Proceedings of the

20th European Conference on e-Learning

ECEL 2021

a Virtual Conference

Supported by

University of Applied Sciences HTW Berlin

Germany

28-30 October 2021

Review Process

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E-Book ISBN: 978-1-914587-19-1
E-Book ISSN: 2048-8645
Book version ISBN: 978-1-914587-18-4
Book Version ISSN: 2048-8637

Published by Academic Conferences International Limited
Reading, UK
www.academic-conferences.org
info@academic-conferences.org

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ECEL Preface

These proceedings represent the work of contributors to the 20th European Conference on e-Learning (ECEL 2021), hosted by ACI and the University of Applied Sciences HTW Berlin (Hochschule für Technik und Wirtschaft) Berlin, Germany on 28-29 October 2021. We, Prof. Dr.-Ing. Carsten Busch and Prof. Dr. Tilo Wendler, have the honour to act as the Conference Chairs. Prof Dr. Regina Frieß and Martin Steinicke are the Programme Chairs.

ECEL is now a well-established event on the academic research calendar and now in its 20th year the key aim remains the opportunity for participants to share ideas and meet the people who hold them. We would have loved to welcome you, but due to the global Covid-19 pandemic the conference was moved online to be held as a virtual event. All four of us have a long-standing interest in e-learning and the digitisation of learning scenarios with a focus on game- and "Mixed Reality"-based learning. The pandemic has shown us how much Germany can learn from other countries in implementing innovative ways and formats of learning on- and offline. But on the bright side, this sometimes distressing view of the German educational system in times of stress also set things in motion that will bring new opportunities but also challenges. All of these need to be faced on solid scientific ground thus making the sharing of ideas and results all the more important. The subjects covered and the scope of papers in this year's ECEL illustrate the wide range of topics that fall into this important and ever-growing area of research and will ensure an interesting two days – to which we look forward.

The opening keynote presentation is given by Dr Dan Remenyi, Extraordinary Professor at the University of the Western Cape, South Africa, on the topic of *University of the Future.* The second day of the conference will include an address by Prof Shawren Singh, University of South Africa, Pretoria, South Africa, entitled *Reflecting on Higher Education Examinations.*

With an initial submission of 141 abstracts, after the double blind, peer review process there are 68 Academic research papers, 8 PhD research papers, 2 Masters Research papers and 3 work-in-progress papers published in these Conference Proceedings. These papers represent research from Australia, Austria, Belgium, Canada, Chile, China, Cyprus, Czech Republic, Czech Republic, Denmark, Estonia, France, Germany, Greece, Hong Kong, India, Ireland, Italy, Japan, Kazakhstan, Malaysia, Nigeria, Norway, Oman, Poland, Portugal, Romania, Russia, Saudi Arabia, Singapore, Slovak Republic, South Africa, Spain, Sweden, Turkey, UK and USA.

We hope you enjoy the conference.

Prof. Dr.-Ing. Carsten Busch, Prof. Dr. Regina Frieß, Martin Steinicke and Prof. Dr. Tilo Wendler

University of Applied Sciences HTW Berlin (Hochschule für Technik und Wirtschaft Berlin), Germany

October 2021

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Biographies

Conference Chairs

Prof. Dr.-Ing. Carsten Busch studied computer science at TU Berlin. In his doctorate he investigated metaphors in computer science. In 1995 he took up a position as a research assistant and university planner at the Universität der Künste Berlin. Carsten Busch has lectured at many universities, including as a visiting professor in Poznan and Moscow. From 2002 to 2019 he was also a Managing Partner of the Institut für Marken und Medien (Institute of Brands and Media). In 2006 Carsten Busch was appointed as a professor for the International Media and Computing study programme at HTW Berlin, where he also took over as the Director of the Creative Media research group. He has been the President of HTW Berlin since April 2019. https://www.htw-berlin.de/hochschule/personen/person/?eid=3030

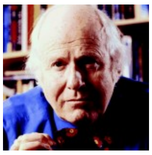
Prof. Dr. Tilo Wendler studied mathematics and physics as well as computer science and did his doctorate in the field of applied statistics. From 1997 to 2012 he worked in the banking and information technology sector. In 2013 Tilo Wendler was appointed as a professor for quantitative methods at HTW Berlin. From 2015 to 2019 he held the position of Vice-Dean and Dean of the HTW Berlin Business School. Since April 2019, Tilo Wendler has been the Vice-President for Studies, Teaching and International Affairs. https://www.htw-berlin.de/hochschule/personen/person/?eid=8865

Programme Chair

Martin Steinicke is a researcher in professor Carsten Busch´s R&D group Creative Media at the University of Applied Sciences HTW Berlin. He works in the application centre „creative Applied Interactive Technologies“ to support SMEs in tackling the challenges of the digitization as well as the opening up of new markets and technologies. Furthermore, he primarily does research on the application of game concepts (Gamification) and technologies (APITs) as well as their synthesis in digital game-based learning (DGBL). In his courses "Game & Interaction Design" and "Digital Game-based Learning" Martin guides his students on their epic quest to create digital (learning) games and interventions. https://www.htw-berlin.de/hochschule/personen/person/?eid=4407

Regina Friess has been Professor for Media Conception at the Digital Media Department of the University of Furtwangen, Germany, since 2011. Before, she was Lecturer for interactive media at the University of Arts in Berlin. She has worked as graphic designer, 3D-modeler and as concept developer since 1993. Her academic interest focusses on the reflection and design of interactive narration in audiovisual media.

Keynote Speakers



Dan Remenyi has been a Visiting Professor specialising in research methodology at seven universities in four countries over the past 20 years. He continues to write, teach and research in both research methodology and the sociology of research. He conducts seminars on topics related to improving effective academic research and obtaining better research results. One of his areas of specialism is qualitative research and how it may be enhanced using a Grounded Theory approach. He is on the editorial board of a number of academic journals. He is also on the executive committees of several European and International conferences. His research has been published in some 50 peer reviewed papers and he has had some 30 text books published. Some of his books have been translated into Chinese, Japanese and Romanian. He holds a B Soc Sc, MBA and PhD.

Shawren Singh PhD, is an associate professor in the School of Computing at the University of South Africa. He has spent more than 20 years teaching and researching in the Information Systems space. In 2014 he obtained his PhD, based on research into eGovernment in South Africa, from the University of the Witwatersrand. His current research has focused on digital scholarship and e-Government, his research has been published internationally and he has presented papers at several conferences. He is currently supervising several post-graduate candidates and he is the Chair of Information Systems in the School of Computing at the University of South Africa.

Mini Track Chairs

Abbas Fadhil Aljuboori is working currently at the University of Information Technology and Communications, College of Engineering, Baghdad, Iraq as a faculty staff member. He has a Ph.D. in Computer Science from Dongguk University, South Korea. Fulbright Visiting scholar – University of Central Oklahoma, USA. International Advisory Board Member for CT University in India. He worked as a Vice President for administrative affairs and Head of Smart Cities Center at UoITC, Researcher and Manager in the Advanced Institute of Convergence Information Technology (AICIT), South Korea, Head of Computer Science Department, University of Kerbala. Vice President of Iraqi Universities Accreditation and Quality Assurance Council for Computer Science and IT. His field of Interest are in Data Mining, Web Applications, Big Data, Data Security, Information Systems and Smart Applications. He is a member of several academic and professional societies. He is an Editor, Committee Member and Reviewer of many eminent International Journals and Conferences worldwide.

Ayanda Pamella Deliwe holds a Ph.D. from the University of KwaZulu Natal. Her Ph.D. was on Measuring e-learning systems at higher education institutions. She is an academic at Nelson Mandela University. She has 10 years' experience working in the public sector, 2 years of tutoring experience and 3 years of lecturing experience. She is the coordinator of undergraduate modules and a supervisor to postgraduate students. She is involved in the internal and external examination of MBAs. Dr. Deliwe has published several papers on e-learning in academic journals and conference proceedings. She serves in the school research committee and faculty teaching and learning committee of her university. Her main research interests are e-learning and blended learning and new pedagogies.

Asmaâ Retbi is an Associate Professor at the Department of Computer Science, Mohammadia School of Engineers (EMI), Mohammed V University in Rabat, Morocco. She is also a member of the RIME "Networking, Modeling and e-Learning" research Team since 2010. She received her Ph.D. in Computer Science from EMI, Mohammed V University, and Computer science engineering degree from Institut National des Postes et Télécommunications, Rabat, Morocco. Her main research areas are related to technology-enhanced learning like social learning, game-based learning, recommender systems in eLearning, mECEL 2020 First CFPobile serious game modeling.

Eleni Rossiou is Principal in Experimental School of the Aristotle University, Greece and teaches Computer Science. She is certified teachers' trainer, reviewer in international journals and conferences Proceedings and member of scientific Associations. She has authored and co-authored various papers in International and European conferences and journals; Her research focuses in blended learning, game-based learning in all levels of Education and educational leadership.

Sheryl Williams is a renewable energy specialist, Senior Fellow of the Higher Education Academy and an award-winning Distance Learning Manager. Her Doctorate in Electronic & Electrical Engineering focussed on the performance of photovoltaic devices and she has participated in the EU funded IP PERFORMANCE PV and PVCAtapult WP9: PV performance prediction. Sheryl leads flexible and distance learning programme in Wolfson School. She won the 2015 e-Learning Excellence Award at the 14th European Conference on e-Learning for the Photovoltaic Remote Laboratory. She pioneered innovative use of ICTs in MSc in Renewable Energy System Technology via distance Learning; and mentored and trained staff.

Workshop Facilitators

Stefano Perna has a PhD in Information and Communication Design, conducted research at intersections of design, new media and humanities at University of Salerno, taught New Technologies for Art at the Academy of Fine Arts of Naples. He is a faculty member of the Apple Developer Academy at University of Naples Federico II.

Moritz Philip Recke studied Media Technology and Next Media at Hamburg University of Applied Sciences, conducted entrepreneurship policy research at UNSW Business School in Sydney and focused on entrepreneurial ecosystems, public policy discourse and sociotechnical imaginaries for his PhD. He is a faculty member of the Apple Developer Academy at University of Naples Federico II.

Biographies of Contributing Authors

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Sara Bandar Alharbi is a PhD student in the Department of Informatics at the University of Sussex. She has a BSc in Computer Science from Umm Al-Qura University and a MSc in Advanced Computer Science from Essex University. Her research in the area of mobile learning development integrating Universal Design for Learning principles and digital storytelling.

Paulo Alves – has received his Ph.D. in Technology and Information Systems from University of Minho, Portugal, and Master in Multimedia Technology from the University of Porto. He is integrated member of the Research Centre in Digitalization and Intelligent Robotics (CeDRI). His research interests include intelligent systems, big data analytics, e-learning, web development and multimedia.

René Holm Andersen: René is an assoacited professor at Unioversity College of Northen Denmark. His research is based on the use of podcasts as a learning medium for adult learners at higher education institutions.

Eskil Olav Andersen is a PhD researcher at Aalborg University Business School. His research is focused on emerging ecosystems of educational technology in higher learning institutions. His main research approach is quantitative, utilizing progamming languages (Python), Natural Language Processing (NLP), and Machine Learning/Deep learning.

Maria Lourdes Bacud holds one master's degree in Public Management from Philippines and another in eGovernance Technologies and Services from Tallinn University of Technology, Estonia. Her primary research and project implementation focus areas are public sector capacity building, cybersecurity awareness, game-based learning, human development, eGovernance, and users' experience.

Wendy Barber is an Associate Professor in the Faculty of Education at Ontario Tech University in Oshawa, Canada. She is the recipient of Teaching Awards of Excellence in Health and Physical Education, Teacher Development, Resilience, and Online Pedagogy. Her research is centred in the PHEWISE Digital Research Lab at https://www.phewise.ca/

Yongmei Bentley is Principal Lecturer in Logistics and Portfolio Lead of international partnership programmes at University of Bedfordshire, UK. She has worked on several projects funded by European Union and British Council with colleagues and partners from Europe and China. She has published academic journal papers related to her teaching and research.

Lisa Binkowski studied business mathematics and numerics. She works in the field of basic mathematical education at HTW Berlin.

Mie Buhl is Professor in Visual Culture, IT and Learning design. Head of research Center Visual Studies and Learning Design, (ViLD) Department of Communication and Psychology, Aalborg University Copenhagen. Research Interests: Visual Culture, Media and ICT with an emphasis on University Education, Teacher Training, Primary School and with the focus on visual learning. She has several publications in this field.

Tim Cappelli has worked with educational technology for over 20 years, from setting up work-based learning centres to introducing blended learning initiatives to HE. He was responsible for the first large-scale deployment of iPads in HE, the development of a new learning platform in WordPress and the creation of a Curriculum Mapping Tool.

Felix Chao is Senior Lecturer at the Independent Learning Centre of the Chinese University of Hong Kong, the institution from which he received a PhD in Chinese language and literature. His academic and research interests include classical Chinese literature, Chinese grammar, Chinese communication skills, Chinese language education and independent learning.

Paula Charbonneau-Gowdy: Graduate (McGill University). Associate professor of education (Universidad Andres Bello, Santiago, Chile. Formerly Senior Advisor in Learning and Technology for the Government of Canada, she also has work experience in Europe and Chile. Main area of interest is the socio-cultural implications of emerging technologies on teaching, learning and learners at all levels of the educational system.

Lee Yen Chaw is an assistant professor at UCSI Graduate Business School, UCSI University, Malaysia. Her research interests include blended learning practices for university students, mobile applications, and tourism management.

Sakshi Chhabra is currently serving as an Adjunct Professor at CMS Business School, Jain University. She has recently submitted her Ph.D thesis on "Promoting Women entrepreneurship in Indian MSME's" at BITS Pilani, Pilani Campus. She holds a publication in *Emerald & Springer* for her research work. Her main research areas are women, sustainable and innovation entrepreneurship.

Adam Christopher is a Senior Lecturer of English. He received his PhD in computer sciences from Kagoshima University in 2009. His main research areas are Applied Linguistics, Computational Linguistics, CALL, Curriculum Development, EAP, Foreign Language Acquisition, Intercultural Communication, Comparative Culture

Ben Clark is a University Teacher in Digital Electronics at Loughborough University within the Wolfson School of Mechanical, Electrical and Manufacturing Engineering. He currently teaches on engineering project modules and has interests in embedded electronics as well as software solutions for data acquisition and signal processing.

Susanne Dau: Susanne Associate Professor and Research Manager My Research interest: Professsional Development & Judgement, Educational Research, Blended Learning and ICT for Learning & Inclusion.

Ayanda Pamella Deliwe is a Lecturer at Nelson Mandela University. She received her PhD in Leadership researching e-learning at the University of Kwa-Zulu Natal. She has been invited to be a guest speaker at some conferences on e-learning. Her main research areas are, blended learning, online learning and flipped classroom.

Xiangping Du is a principal lecturer at Hertfordshire Business School, University of Hertfordshire, UK. She received her PhD in sociolinguistics and education in 2005. Her main research focuses on learning, teaching and student experience in higher education, e.g. flipped learning, blended learning, diversity in classroom, identity and cross-cultural communications.

Lucia Szabová – a student of the Ph.D. level at the Department of Ecology and Environmental Sciences UKF in Nitra. She is focused on Environmental education and modern pedagogic approaches.

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Mariella Farella, is a research fellow at Institute of Educational Technology of the National Research Council of Italy and she is attending a PhD course in Mathematics and Computational Science at the University of Palermo in Italy. Her main research activity focused on the development of Augmented and Virtual Reality systems in educational contexts.

Regina Frieß works at the University of Applied Science Berlin. She teaches concept development and media sciences. She is leading the research group *creative media*, whose activities are centred on game based learning and mixed reality environments. Her research focusses on emotional and cognitive aspects of media usage in interactive environments

Sonja Gabriel works as a professor for media literacy at University Teacher College Vienna/Krems (Austria). Her primary focus of research is on doing research of the consequences of Covid-19 measures at university on teaching and learning. She also researches using digital media for learning and teaching, with a special focus on digital game-based learning.

Caroline Galdames, a Preschool Educator. In 2011, she received a Master's degree in Innovation in Early Childhood Education (2011, Universidad Central Chile). Since 2014, she has worked in Online Education as Academic Vice-Rector at a technical higher education institute in Chile. Currently a PhD student in the Education and Society doctoral program (Universidad Andres Bello, Chile).

Carolin Gellner is a research associate at Beuth University of Applied Sciences Berlin, Germany. She received her M.Sc. in computer science and digital media from Beuth University of Applied Sciences Berlin in 2019. Her main research areas are instructional design, gamification, and pedagogical agents in e-learning.

Thomas Goetz is a professor of English and Director of the Cross-Departmental Language Program. He has been a leader in Moodle at Hokusei University, promoting blended learning at all levels. His research is in the application of computers for language learning. He has presented widely in Asia, the North America, and Europe.

Rolando Gonzalez is an assistant professor at Kristiania University College. He leads a research group within pedagogy and subject didactics which are his main fields of research. In addition, he is responsible for a study specialisation in frontend and mobile development and teaches web development and programming courses.

Vici Daphne Händel is a PhD student in playful learning studies connected to IT, Learning and Design lab at Aalborg University (AAU) and Digitalisation in School at University College Copenhagen (KP). Research interest: Playful activities with digital technologies integrated with physical activities in higher education as an alternative way to learn the curriculum.

Leo Hatvani is lecturer and researcher at the school of Innovation, Design and Engineering at Mälardalen University with the background of embedded systems, formal verification, and machine learning. He is currently working on the topics of data visualization, human-computer interaction, software testing, and e-learning.

Heidi Hautopp, PhD student in graphic facilitation at Research Center for Video and Research Lab: ICT and Design for Learning at the Department of Culture and Learning, Aalborg University Copenhagen. Research interests revolves around the use of analogue and digital audio-visual methods as idea generating and communication tools across different academic disciplines.

Michael A. Herzog is a full professor for Information Systems Engineering at Magdeburg-Stendal UAS and the head of the SPiRIT research group. His research focuses on Educational Technologies, Human Computer Interaction, Self-adaptive Information Systems, and IT-supported Sustainability. Michael received a PhD in information systems and a MSc in computer science from Technical University Berlin.

Niklas Humble is a PhD Student in Computer and System Science at the Mid Sweden University. He has a background as a K-12 teacher and IT-coordinator and is now teaching on programming courses. Research interests include Programming education, Game-based learning, System development, Artificial intelligence, Learning analytics.

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Hans Hüttel is an associate professor in the Department of Computer Science at Aalborg University and the Department of Computer Science at the University of Copenhagen. His research interests are programming language theory *and* problem-based learning.

Tomas Javorcik works at the Department of Information and Communication Technologies at the Faculty of Education of the University of Ostrava. He teaches courses that focus on the use of ICT in the educational process. His research focuses on the use of Personal Learning Environment at various levels of education and the use of microlearning at universities.

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Konstantinos Kotsidis has been teaching in Primary Education since 2003. He is a Ph.D. holder from the University of Crete, Department of Education. His Dissertation is titled "The Significance of "Social Media Networks" and their role in the Process of Teacher Training". He participates in training sessions on the use of ICT in the Educational Act and implements training programs in collaboration with the eLearning Lab of the University of Crete

Iain D. Lambie is an Associate Lecturer with the Open University and is a Senior lecturer at Glasgow Caledonian University. He has worked for both organisation for 25 years and his current research is focused on delivering online support to distance learning students on a range of computing and technology programmes.

Bobby Law has held an Associate Lecturer position with the OU since 2005 and currently Tutors on TU100 My Digital Life and is also a Lecturer at Glasgow Caledonian University working there since 2001. Prior to this he worked as a Software Developer for J&B Scotland and the Clydesdale Bank.

Madlene Leißau studies management (M.Sc.) at the University of Applied Sciences Zwickau, Germany. She currently works as a research assistant in the Team Industry Analytics in the EU-project iDEV40. Her research interests focus on material flow simulation and virtual reality.

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Birgy Lorenz is a scientist Tallinn University of Technology and an experienced trainer in cybersecurity-related awareness (commoners cyber hygiene/security behavior, children/teachers/parents skills on digital safety). She has developed CyberSecurity materials for secondary school and exercise portal for beginner cybersecurity young talents as well as curriculum for cybersecurity in basic and high school level in Estonia.

Kagiso Mabe is a lecturer in the Department of Information and Knowledge Management at The University of Johannesburg, South Africa. He is currently working on his PhD, focusing on the 4IR. His main research areas are Information and Knowledge Management topics, digitisation and the 4IR.

Katharina Maitz is a postdoctoral researcher at the Research Center for Inclusive Education (University of Graz, Austria). In 2020, she received her PhD in Inclusive Education from the University of Graz. Her main research areas are inclusive education and digitalisation, technology supported differentiated and adaptive instruction, and technology enhanced learning.

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Josef Malach has long been involved in the use of digital technologies in vocational and teacher education. He is the author of more than 200 professional studies. It guarantees doctoral studies in pedagogy at Faculty of Education of University of Ostrava (FE UO). josef.malach@osu.cz

Fareeza Marican is a Senior Instructional Designer at International Medical University, Malaysia. She is an experienced Learning & Instructional Designer in a wide variety of training and elearning in corporate and educational environment with 15 years across various subject domains. Fareeza is a highly creative person and possess in depth knowledge of Instructional design and e-learning.

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A Competency-Based Approach to Support e-Learning During the Covid-19 Situation

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Abstract: The Faculty of Education and Lifelong Learning of the University of Strasbourg implemented a competency-based approach during the academic year of 2020-2021. This study presents empirical research on students' perspectives of their self-regulation and self-direction in learning as one of the first feedbacks on this project. This research was conducted in an online course organised during the Covid-19 pandemic. It was hypothesised that the competency-based approach positively impacted students' self-direction within the course and their self-regulation in an online learning context. Anonymous pre- and post-surveys were conducted. The results confirmed the research hypothesis. The design of the course presented could serve as a valuable input to define appropriate learning scenario to increase students' self-regulation and self-direction in e-learning.

Keywords: competency-based approach, e-learning, self-regulation, self-direction, instructional design

1. Introduction

Mallillin et al. (2021) stated that the competency-based approach was one of the most appropriate teaching approaches to adopt during the covid-19 pandemic due to its evident learning stages, expected competencies, and targeted knowledge. The approach also ensures the completion of educational goals through the flexibility and accessibility provided by the online learning environment. Moreover, through the adoption of this approach, lecturers are encouraged to establish strategies focusing on students' learning processes that fit into the new modality of online classes. This means that students receive guidance in their online learning while having control over their activities. A competency-based approach confronts students with real-life professional situations. Students are trained to perform professional tasks and to initiate or complete a project (Fall, 2018) which help to enhance their self-direction in learning (Tsai, 2020). It also provides reflective time for students to be aware of the development of their competencies (Kirk and Courtner, 2020). Reflective work also helps students prove mastery of targeted competencies and develop their self-regulation in learning (Poumay et al., 2020).

During France's second national lockdown due to the covid-19 situation, the Faculty of Education and Lifelong Learning of the University of Strasbourg implemented a competency-based approach to promote students' professionalisation, also known as the Accompli project. This study presents empirical research on undergraduate students' perspectives on their self-regulation in online learning and their self-direction in response to the implementation of the Accompli project within the Instructional Design in the Digital Age course (*Ingénierie de l'éducation à l'ère du numérique*).

The studied group never experienced a competency-based approach during their study in the institution but had had their first online learning experience during the first lockdown. Due to their lack of preparation for online learning, this question remains: Can the competency-based approach help students to enhance their self-direction in the course and the aptitude to self-regulate their e-learning activities? The purpose of this study was to investigate students' self-direction and self-regulation in an online learning context in which a competency-based learning approach was adopted. To ensure these aspects, the competency-based approach adopted put emphasis on active learning activities that targeted students' sense of initiative and critical thinking. Both are competencies required to develop self-regulation and self-direction in learning. Consequently, we hypothesised that the competency-based approach could positively impact students' self-direction in the course and their aptitude to self-regulate their learning despite their lack of preparation for online learning. Anonymous pre- and post-survey were conducted to get insight into students' perception of their self-regulation strategies in e-learning and their self-direction within the course. The results confirmed the research hypothesis and highlighted students' ability to seek peer support and aptitude to control the learning environment as the indicators of significantly increasing self-regulation in e-learning. As for students' self-direction in the course, the results also highlighted its development.

2. Literature review

2.1 Competency-based approach and e-learning

As defined by Fall (2018) the competency-based approach was built not only on the competencies inherent to the exercise of a profession but also on the competencies expected by society. According to Bouzeriba and Kouadria (2018), the competency-based approach implied giving meaning to the practices and knowledge taught. Based on these definitions, the aim of the competency-based approach is for students to be able to apply what they have learned, manipulate a certain number of acquired competencies under specific conditions, design a plan of actions, and implements resources in a practical and technical context, first in a learning situation, then later in a socio-professional environment. Fall (2018) pointed out five stages of competence acquisition according to a learning logic:

- 1. Discovery, motivation, and commitment. In this stage students learn about a targeted profession by exploring the required competencies to complete the tasks in this phase.
- 2. Essential learning. During this stage, fundamental concepts related to the duties and tasks to be performed are studied.
- 3. Integration and exercise of real tasks. Students are confronted with real-life situations in which they perform professional tasks in this stage.
- 4. Transfer. In this phase, the tests and tasks become the subjects of evaluation to measure the achievement of the targeted competencies of the aimed profession. Students can self-assess their mastery of targeted competencies and the development of their personal objectives in relations to the course objectives.
- 5. Enrichment.

By its very nature, the competency-based approach provides experiences that transform students' learning situations. Mallillin et al. (2021), and Lancaster and Lundberg (2019) pointed out that competency-based approach enhances students' engagement. Indeed, the fact that the students have control over time, place, and strategy to learn promotes students' learning ownership. The competency-based approach may also be one of the best modalities of teaching approaches to adopt during the new normal situation since it allows clear demonstrations of the competencies and knowledge developed by learners through the stages (Mallillin et al., 2021). During the Covid-19 or the new normal learning context, almost all teaching and learning are online. Hence, lecturers need to develop teaching and learning scenarios that support student-centred learning so that students get student-focused learning experiences and are able to perform deep learning. Mallillin et al. (2021) highlighted that adopting a competency-based approach in online learning ensure the completion of educational goals and achievement through interaction, flexibility, and accessibility. According to Mallillin et al. (2020) lecturers, through competency-based approach, could establish strategies focusing on the learning process while providing instructions fit with the new modality of online classes. This means students are well guided in their e-learning, and at the same time, having control of their activities. In this regard, Tsai (2020) and Kirk and Courtner (2020) highlighted that adopting an online competency-based approach enhanced students' self-direction in learning. In the stage of "Transfer", students can do a self-assessment or reflective work. This may help students to prove mastery of the targeted competencies. On this subject, Poumay et al. (2020) confirmed that along with students' interaction and discussion with peers and lecturers, the reflexive phase can also be beneficial for developing self-regulation in learning.

2.2 Targeting students' self-direction and self-regulation

Rimini and Spiezia (2016) reported for the OECD that the fundamental skills for coping with the current dynamic and digital world, as well as the labour market, included self-direction. Self-directed learning is a concept related to one's cognition, metacognition, self-direction, and self-directedness. According to Kirk and Courtner (2020), self-directed learning generally involved adult learning in various forms and included learning activities that one performed at will, such as participating in a project and voluntarily returning to school. Additionally, Knowles (1975, p. 18) defined self-direction as "a process in which individuals take the initiative, without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and integrating appropriate learning strategies, and evaluating learning outcomes". Subsequently, self-directed learning involves one's control of their learning, as Merriam and Brockett (2007) highlighted. Students' self-direction in learning is not innate. The triadic reciprocity developed by Albert Bandura highlights essential determinants that influence one's behaviour: the individual (highlighting how one thinks, feels, and regards their previous experience), and the environment. For Bandura, cited in Carré (2003), each determinant has a reciprocal relationship as one's reaction to their environment leads to a particular behaviour that is also influenced by their personal traits, prerequisites, and experiences. Consequently, if lecturers would like their students to develop a particular behaviour as self-direction, it is essential to create a self-directed learning scenario that would be the most fitted design to support their objectives.

According to Guglielmino (1997), cited in Kirk and Courtner (2020), a person who has a high level of self-direction shows initiative and commitment to learning, understands the importance of learning or the task he wishes to complete, is able to be in control of their own learning, is autonomous and accepts responsibility for his actions during learning or task completion, perceives problems as challenges, has self-confidence, is able to identify his skills and uses it, is able to organize his time and sets a learning pace according to his needs, is goal-oriented, and enjoys learning. Indeed, self-direction can be regarded as a psychological state or a personal characteristic as well as one's behaviour in learning (Adinda, 2020). As a research-based concept in adult education field introduced in France in the late 1980s (Carré et al., 2011), self-direction shares common characteristics with self-regulation. Hadji (2012) defined self-regulation as the ability of an individual to conduct the regulation of his or her activity. From an action perspective, self-regulation can be seen as an individual's ability to observe and evaluate himself or herself (Zimmerman, 2002) in achieving his or her personal goals (Zimmermann, 2005). Similar to self-direction, self-regulation involves metacognition and generally indicates one's active participation in learning (Saks and Leijen, 2014) by producing favourable behaviours, such as performance control, and critical thinking mobilization which lead to the achievement of his/her goals (Poumay et al., 2020). However, self-direction requires individuals to take initiatives in their own learning (Hadji, 2012) in a more extensive way. This involves, among other things, their ability to identify their goals and needs, the formulation of their learning goals and regulation of learning strategies, as well as the ability to identify resources to attain their goals (Carré, 2010).

To sum up, among the similarities identified between self-direction and self-regulation, the most shared element is the self-orienting actions in task completion, such as defining the meaning of the task, identifying an appropriate strategy, and monitoring plan to achieve the targeted goals (Saks and Leijen, 2014). While emphasizing the role of "self" in self-directed learning to ensure the development of self-direction, Brookfield (1985) and Long (1989), cited in Kirk and Courtner (2020), stated that self-direction took place in a social context and could not be completed in solitude. It is also the case for self-regulation. Various studies highlighted that lecturers' interventions in a learning situation (instructions, adaptation of the time allocated to the task, etc.), and their direct interactions with the students can influence students' self-regulation of learning (Poumay et al., 2020). In an e-learning context, Cosnefroy, Fenouillet and Heutte (2019) included peer support and procrastination brought by the challenges of online learning as important elements to measure individuals' self-regulation.

Therefore, it was hypothesised that adopting the competency-based learning scenario could positively impact students' self-direction and self-regulation in an online learning context. However, the only experience that observed students had in online learning was during the first national lockdown. Since the Accompli project is an innovative pedagogical project that has been newly accepted, it can be assumed that students have never experienced a competency-based approach beforehand. With the students' specific profile and within the uncommon setting of online learning due to the pandemic, there was a need to investigate whether the competency-based approach could help students enhance their self-direction in the course and their aptitude to self-regulate their e-learning activities. The elements presented in this section construct the instructional design of the teaching and learning scenarios involving the competency-based approach of the present study, and in the following sections, the methodology that has been set up, as well as the findings, will be detailed.

3. Materials and methods

3.1 The instructional design of the course

This study was conducted in a course called Instructional Design in the Digital Age (*Ingénierie de l'éducation à l'ère du numérique*). To adopt a competency-based approach, the initial competencies targeted by the Faculty of Education and Lifelong Learning for this course have been revisited. Some wordings have been made to adjust with the essential competencies of an instructional designer as defined by the French National Directory of Professional Certifications (*Répertoire national des certifications professionnelles*) (See Figure 1).

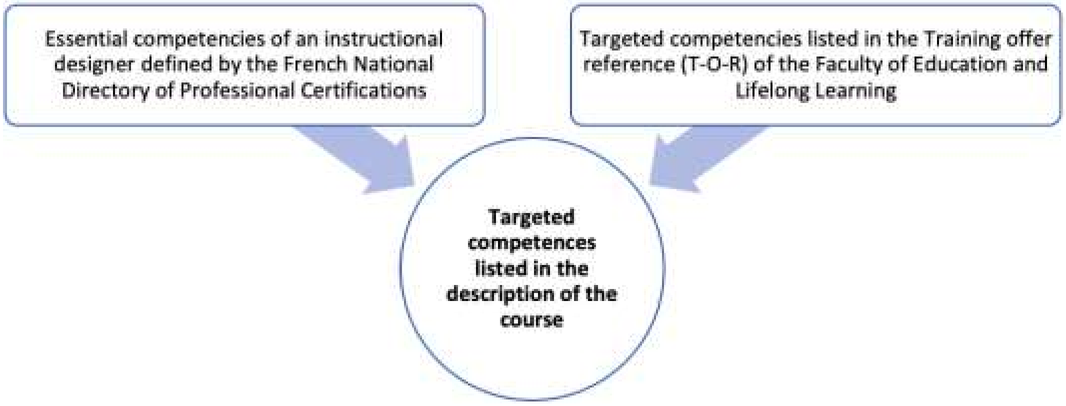

Figure 1: Defining the targeted competencies of the course

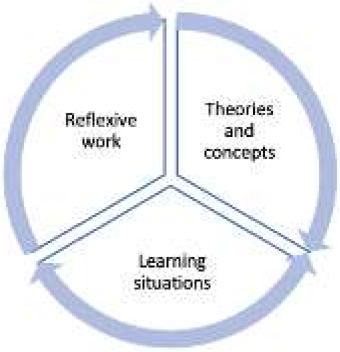

Figure 2: Three action phases of the course

This course was initially an offline course. However, the current context of the pandemic required the digitization of the course content and activities. An online forum was provided to support students' communication among themselves and with the lecturers after class time. Some online collaborative tools such as online mind/concept map tools, online graphic design platform such as Canva, online collaboration tools provided by Google®, collaborative online board such as padlet.com, scrmblr.ca, etc., were provided to support students' online learning and the completion of their projects. Students were also free to use other collaboration and communication tools such as Messenger®, Facebook® chat, Whatsapp® group, etc., to support their learning. The University of Strasbourg uses Moodle® as their learning management system (LMS), and to support the online learning sessions, the BigBlueButton®, an open-source web conferencing system for online learning, is integrated within Moodle. Figure 2 above shows the three phases of actions adopted in the course, and Table 1 below presents the conduct of the course sessions. To support students' active participation within the course, they were invited to work in groups of three to four to design a pedagogical project and conduct it. Table 1 shows that the first three online meetings were organised to deliver the course content and strengthen students' knowledge on the theory, concepts and notions presented. During the regular lectures, some non-graded online quizzes were provided. The objective was to ensure students' comprehension of the course materials. As for online tutorial sessions, the focus was on the completion of group projects. To ensure the progress of the course and the completion of students' pedagogical projects, starting from the third online meeting, the regular lectures were paired with the tutorials within the same week.

Table 1: Conduct of the online courses' sessions

Regular lectures	Tutorials
Regular lecture 1 Introduction Defining instructional design	
Regular lecture 2 Semantic network of the concept of instructional design	
Regular lecture 3 Dynamics of instructional design: Knowledge references Task: Analyse a training need and the profile of the learners	**Tutorial 1** Dynamics of instructional design: Knowledge references Task: Design a teaching and learning situation using digital technology (1/4)

Regular lectures	Tutorials
Regular lecture 4 Dynamics of instructional design: Design process Task: Make a list of tips to plan a training	**Tutorial 2** Instructional design and digital technology: Pedagogical functions of the digital technology Task: Design a teaching and learning situation using digital technology (2/4)
Regular lecture 5 Discovering the types of teaching and learning plan: Planning a training outline Preparation for Written test 1	**Tutorial 3** Using a concept map to support the reflection and the structure of training Witten test 1
Regular lecture 6 Developing teaching resources Task: Make a list of tips for developing training material/designing resources for training	**Tutorial 4** Task: Design a teaching and learning situation using digital technology (3/4)
Regular lecture 7 Task: Design a teaching and learning situation using digital technology (4/4) Conduct a sequence of the project (25 min/team)	**Tutorial 5** Conduct a sequence of the project (25 min/team)
	Tutorial 6 Reflective work on skills developed during the course Written test 2

For the completion of the pedagogical projects, students were invited to define the public (the targeted recipients of their projects) and the objective of their projects by assessing their public's needs. As for the instructional design of the projects, students were prepared to be able to 1) characterize the knowledge and identify the elements to be taught in their pedagogical project by considering the results of their public's needs analysis, 2) integrate digital technology to support their project, 3) prepare a specific sequence of their pedagogical project to be conducted online at the end of the semester, and 4) carry out the projects while generating constructive feedback from teachers and peers who attended the project presentation and experienced the learning sequence organised. In fact, in this course, students were encouraged to showcase their initiatives and critical thinking skills to develop their project management skills and sharpen essentials soft skills to complete their projects. Since students had to define the objectives and the essential steps of their projects themselves, this teaching scenario would be beneficial for the development of students' self-direction within the course.

3.2 Population observed

The study was on undergraduate students majoring in Advising and Training for Skill Development and Social Integration (*Conseiller et former pour les compétences et l'insertion*) enrolled in the Faculty of Education and Lifelong Learning of the University of Strasbourg. This study was administered during the spring semester of 2020-2021 academic year. All 28 participants were informed about the main objective of implementing the competency-based approach and the experiment without disclosing the hypothesis to maintain students' objectivity while filling out the questionnaires. Students' participation was voluntary and for the research publication's purposes their participation was kept confidential and anonymous.

This study was conducted in the Instructional Design course, an obligatory course for all enrolled students. Twenty-seven students have participated in the post-test. However, only 15 students completed both the pre- and post-tests. This showed 54% of participation rate, which was satisfactory for an online questionnaire. The number of students participated in the post-test compared to the pre-test served as evidence of the increase of students' involvement towards the end of the course.

Table 2: Study sample

Academic year	Number of enrolments	Participants of the pre-test	Participants of the post-test	Participants of the pre and post-test	Participation rate to the pre and post-test (in %)
2020-2021	28	15	27	15	54%

3.3 Data collection and analysis procedures

The main hypothesis of this research was that the competency-based approach positively impacted students' self-direction within the course and their self-regulation in e-learning despite their lack of preparation for online learning. To study this hypothesis, questionnaires measuring students' readiness to perform self-directed learning in the course and their aptitude to self-regulate their learning strategies in an online learning environment were deployed. The first instrument was specifically created for the course. It was a fifteen-item questionnaire with a seven-point Likert scale representing participants' attitudes ranging from "not at all" to "completely". These items were divided into three indicators: self-determination, self-regulation, and self-efficacy. The Cronbach's alpha for this scale was 0.999. The correlation of the indicators of the scale was also very satisfactory (See Table 3), meaning that this scale was reliable, and the results generated could represent the objective of its conception.

Table 3: Pearson's correlations

Variable		Total of the scale	Self-determination	Self-regulation
Self-determination	**Pearson's r**	0.878	—	—
	p-value	< .001	—	—
Self-regulation	**Pearson's r**	0.974	0.838	—
	p-value	< .001	< .001	—
Self-efficacy	**Pearson's r**	0.912	0.630	0.855
	p-value	< .001	0.012	< .001

The second scale was designed by Cosnefroy, Fenouillet and Heutte (2019). The scale consisted of 24 items distributed into four indicators or sub-scales namely procrastination, control of the context, learning strategy, and peer support. Participants were asked to self-position themselves using a seven-point Likert scale, representing participants' attitudes ranging from "not at all" to "completely". The Cronbach's alpha for this scale was 0.996, which was very satisfactory. All scales were administered through the Limesurvey® of the University of Strasbourg, and the access was provided through the course's learning management system, Moodle®. The pre-test was organized at the beginning of the semester, and the post-test was administered at the last course of the semester, during the Tutorial 6. For data analysis, the paired samples t-test was applied to all students who have participated in the pre-and the post-test to determine any significant development of students' self-direction and self-regulation within the course. The overall methodology is summarized in Table 4.

Table 4: Research methods and analysis framework

Objectives	Instruments	Analysis framework
Evaluate students' self-direction in learning before and after the course module	Scale created for the study	Paired samples t-test
Evaluate students' self-regulation in online learning before and after the course module	Self-regulation scale for online learning (Cosnefroy, Fenouillet and Heutte, 2019)	

4. Results

This study targeted the impacts of competency-based approach implemented on e-learning on students' self-direction within the course and their self-regulation in an online learning environment. To highlight this aspect, two scales were dispensed. The studied variables were students' level of self-direction and self-regulation in e-learning before and at the end of the course period. With 54% participation rate, a student t-test was conducted to identify any development or regression of studied elements.

4.1 Measuring students' self-direction

The results showed that 67% of students have progressed, and a Gain score of 16% was identified. These results were supported by the paired samples t-test results which showed that students' self-direction within the course has significantly progressed over a semester, and it was at a significant level from 70.1 to 75.6 ($t=-2.471$; $p <.05$; $df=14$). Figures 3 below represents the dynamics of students' self-direction levels at the pre- and post-tests. These histograms show that fewer students obtained scores less than 60 in the post-test.

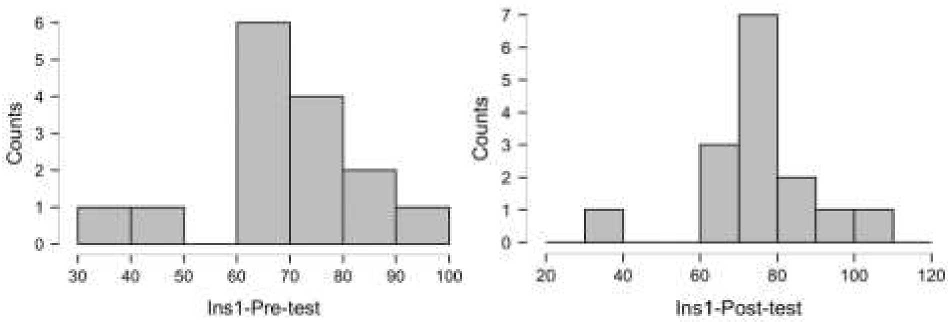

Figure 3: Students' scores for pre- and post-tests of instrument 1

Score progressions were identified within the three indicators of this scale (see Table 5). However, self-determination and self-efficacy became the only variables that significantly progressed from 20.1 to 22.7 and from 24.5 to 26.5, respectively. As for students' self-regulation within the course, the progression of this variable from 25.5 to 26.4 was identified but was not of a significant level (t=-0.994; p=0.169; df=14).

Table 5: Pre and post-test results per indicator of instrument 1

Indicator	Pre-test Mean score	Post-test Mean score	t	df	p-value
Self-determination	20.1	22.7	-2.120	14	0.026
Self-efficacy	24.5	26.5	-2.981	14	0.005
Self-regulation	25.5	26.4	-0.994	14	0.169

4.2 Measuring students' self-regulation

The results were interesting because according to the Pearson's correlation performed on students' self-regulation within the course and their readiness to self-regulate their learning in an online environment (the second instrument of the study), these two elements were correlated (Pearson's r: 0.567, p-value: <.05). Moreover, the second scale used to measure students' self-regulation in an online environment identified significant progress of this variable (Figure 4). The paired-samples t-test administered shows that students' scores progressed from 94.9 to 102, and the p-value of these results indicated that this progression was statistically significant (see Table 6). The Figure 4 below also shows that no students obtained score less than 80 in the Post-test.

Table 6: Paired samples T-test results of instrument 2 (Cosnefroy, Fenouillet and Heutte, 2019)

	t	df	p-value
Pre-test – Post-test	-2.419	14	0.015

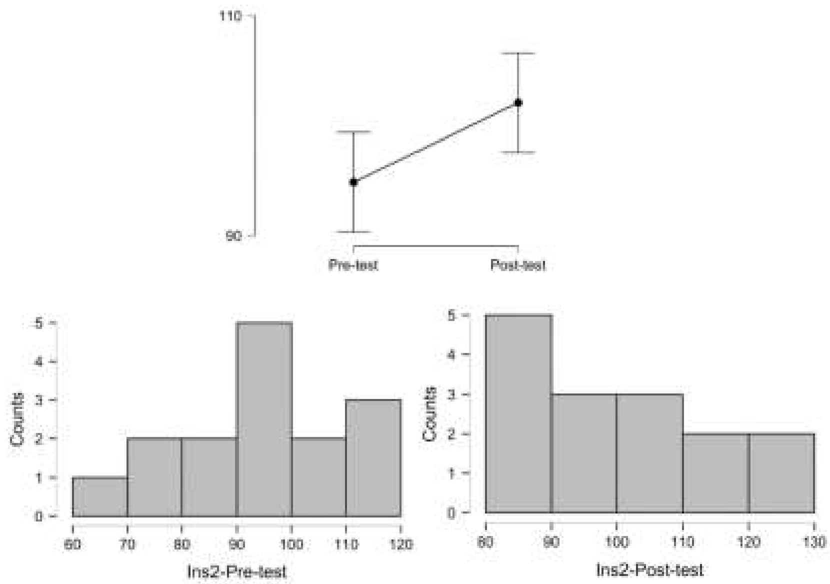

Figure 4: Students' scores for pre- and post-test of instrument 2 (Cosnefroy, Fenouillet and Heutte, 2019)

It was good to see that students' procrastination did not progress significantly, and students' control of the learning context as well as their aptitude to benefiting from the presence of their peers, seeking help, and offering help in an online environment, which was covered by the indicator of peer support, developed significantly (See Figure 5 and Table 7). The indicator of students' procrastination highlighted the challenges students might experience during online learning. The challenges which lead to procrastination included difficulties in planning the work, lack of motivation, concentration problems, and feelings of boredom. Consequently, the positive result highlighted in this study indicated that the learning scenario and environment provided can successfully help students overcome the e-learning challenges. However, the results indicated that students needed support to develop their learning strategy.

Table 7: Pre- and post-test results per indicator of instrument 2 (Cosnefroy, Fenouillet, and Heutte, 2019)

Indicator	Pre-test Mean score	Post-test Mean score	t	df	p-value
Procrastination	19.7	20.8	-0.604	14	0.278
Control of the context	28.5	31.6	-1.904	14	0.039
Learning strategy	24.3	25.2	-0.698	14	0.248
Peer support	22.3	24.5	-1.693	14	0.062

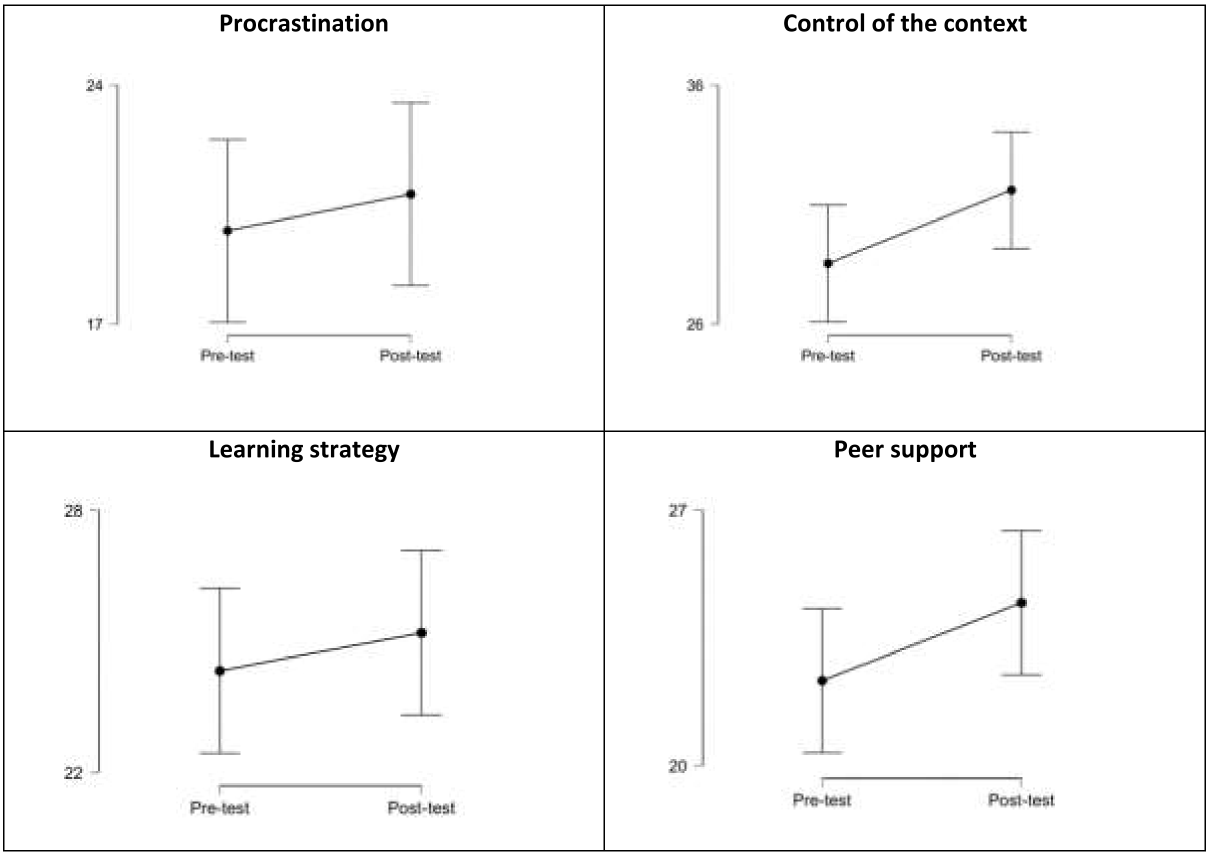

Figure 5: Indicators of Instrument 2 (Cosnefroy, Fenouillet and Heutte, 2019)

5. Conclusion and future work

The results showed that the competency-based approach supported the development of students' self-direction and self-regulation within the general online learning context. These findings have confirmed the research hypothesis of this study and demonstrated encouraging results regarding students' readiness for future online learning despite their lack of experience prior to participating in the studied module. It was also good to see that the learning scenario supported by this learning approach did not significantly contribute to students' procrastination during online learning. However, the need for help in refining students' online learning strategies was identified in the research findings. The Pearson's correlation performed on students' self-regulation within the course and their readiness to self-regulate their learning in an online environment showed that these two elements were correlated. However, based on the results of the paired t-test administered on each indicator in both scales, student self-regulation in the course became the only indicator for which student scores did not experience a significant increase. Since the two scales used were developed in different research work, it could be assumed that this difference might have been the result of the different indicators provided. Further studies related to this outcome are necessary to understand better the relationships between students' self-regulation in general and specific learning contexts. Ponton and Carr (2016) stated that the higher one's degree is, the higher his self-directed learning readiness will be. In confirmation to this statement, Kirk and Courtner (2020) stated that generally one's self-direction in learning increases when he is about to pursue his education above the bachelor level. It is interesting to explore participants' self-direction in a general learning context as well as to observe participants in their future master's studies. Finally, it is intriguing to investigate the development of students' self-direction over several years starting from their very first year of undergraduate study.

References

Adinda, D 2020, 'Stratégies d'accompagnement des étudiants en formations hybrides : Effets sur l'autodirection dans l'apprentissage, Doctoral thesis, Université de Strasbourg, Strasbourg, France.

Bouzreiba, R., Kouadria, A 2018, 'L'enseignement supérieur dans une approche par compétence (APC) : Conception d'un référentiel de compétences', in R Bouzreiba, H Cellier, A Kouadria (eds.), *L'approche Par Compétences Dans l'enseignement Supérieur*. L'Harmattan, Paris, pp. 91–106.

Brookfield, S. 1985, 'Self-Directed learning: From theory to practice', in G.G Dankerwald, A.B Knox (eds.), *New Directions for Continuing Education*. Jossey-Bass, pp. 11–16.

Carré, P 2003, 'La double dimension de l'apprentissage autodirigé Contribution à une théorie du sujet social apprenant', *Canadian Journal for the Study of Adult Education*, vol. 17, pp. 66–91.

Carré, P 2010, 'L'autodirection des apprentissages', in P Carré, A Moisan, D Poisson (eds.), *L'autoformation, Perspectives de Recherche.* Presse Universitaire de France, Paris, France, pp. 117–169.

Carré, P., Jézégou, A., Kaplan, J., Cyrot, P., Denoyel, N 2011, 'L'Autoformation : The State Of Research On Self-(Directed) Learning In France', *International Journal of Self-Directed Learning®,* vol. 8, no. 1, pp. 7–17.

Cosnefroy, L., Fenouillet, F., Heutte, J 2020, 'Construction et validation de l'Échelle d'autorégulation des apprentissages en ligne (EAREL)', *Canadian Journal of Behavioural Science / Revue canadienne des sciences du comportement,* vol. 53, no. 3, pp. 255–260. https://doi.org/10.1037/cbs0000147

Fall, M.M 2018, 'L'approche par compétences, articulation des formations supérieurs universitaires aux compétences exigées par le marché du travail', in R Bouzreiba, H Cellier, A Kouadria (eds.), *L'approche par compétences dans l'enseignement supérieu*r. L'Harmattan, Paris, pp. 67–78.

Hadji, C. 2012, *Comment impliquer l'élève dans ses apprentissages : L'autorégulation, une voie pour la réussite scolaire*, ESF éditeur, Issy-les-Moulineaux.

Kirk, J., Courtner, A 2020, 'Self-Direction in Learning of EdD Candidates at a Small, Private Institution', *International Journal of Doctoral Studies,* vol. 15, pp. 353–371. https://doi.org/10.28945/4378

Knowles, M 1975, *Self-directed learning*, Association Press, New York.

Lancaster, J., Lundberg, C 2019, 'The influence of classroom engagement on community college student learning: A quantitative analysis of effective faculty practices', *Community College Review*, vol. 47, no.2, pp. 136–158. https://doi-org.scd-rproxy.u-strasbg.fr/10.1177/0091552119835922

Mallillin, L.L.D., Laurel, R., Mallillin, J., Carag, E., Guingab-Carag, C 2021, 'Competency Based-Learning and Quality Education in the New Normal Modality of Teaching', *East African Scholars Journal of Education, Humanities and Literature*, vol. 4, no. 4, pp. 156-166.

Mallillin, L.L.D., Mallillin, J.B., Carag, E.A., Collado, J.B., D. Largo, M.G 2020, 'A framework in online learning process: A guide to educational teaching during Covid 19 pandemic', *European Journal of Open Education and E-learning Studies*, vol. 5, no.2, pp. 1-15. https://doi.org/10.46827/ejoe.v5i2.3274

Merriam, S.B., Brockett, R.G 2007, *The profession and practice of adult education*, Jossey-Bass, San Francisco, CA.

Ponton, M.K., Carr, P.B '2016, 'The Possible Role of Higher Education in Developing Learner Autonomy: A Quantitative Exploration', *International Journal of Self-Directed Learning*, vol. 13, no. 1, pp. 12–25.

Poumay, M., Jamin, V., Jacquet, M., Georges, F 2020, 'Interagir avec un pair pour autoréguler son développement de compétences', in S.C Cartier, J.-L Berger (eds.), *Prendre en charge son apprentissage: L'apprentissage autorégulé à la lumière des contextes*, L'Harmattan, pp. 117–195.

Rimini, M., Spiezia, V., 2016. *Skills for a digital world, 2016 Ministerial meeting on the digital economy*, OECD Digital Economy papers, OECD.

Saks, K., Leijen, Ä 2014, 'Distinguishing Self-directed and Self-regulated Learning and Measuring them in the E-learning Context', *Procedia - Social and Behavioral Sciences*, vol. 112, pp. 190–198. https://doi.org/10.1016/j.sbspro.2014.01.1155

Tsai, C.-W 2020, 'Applying online competency-based learning and design-based learning to enhance the development of students' skills in using PowerPoint and Word, self-directed learning readiness, and experience of online learning', *Universal Access in the Information Society,* vol. 19, no. 2, pp 283–294. https://doi.org/10.1007/s10209-018-0640-6

Zimmerman, B.J. 2002, 'Becoming a Self-Regulated Learner: An Overview', *Theory Into Practice*, vol. 41, pp. 64–70. https://doi.org/10.1207/s15430421tip4102_2

Zimmerman, B.J 2005, 'Attaining Self-Regulation: a Social Cognitive Perspective', in M Boekaerts, P.R Pintrich, M Zeidner (eds.), *Handbook of Self-Regulation*, Academic Press, California, pp. 13–35.

Dilemmas in Designing e-Learning Experiences for Professionals

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Abstract: The aims of this research are to enhance industry-university collaboration and to design learning experiences connecting the research front to practitioners. We present an empirical study with a qualitative approach involving teachers who gathered data from newly developed advanced level courses in artificial intelligence, energy, environmental, and systems engineering. The study is part of FutureE, an academic development project over 3 years involving 12 courses. The project, as well as this study, is part of a cross-disciplinary collaboration effort. Empirical data comes from course evaluations, course analysis, teacher workshops, and semi-structured interviews with selected students, who are also professionals. This paper will discuss course design and course implementation by presenting dilemmas and paradoxes. Flexibility is key for the completion of studies while working. Academia needs to develop new ways to offer flexible education for students from a professional context, but still fulfil high quality standards and regulations as an academic institution. We suggest a student-first approach to solve these and other dilemmas, which involves changes in teacher roles, culture, and processes. The findings will be relevant for teachers designing and running courses aiming to attract professionals. They will also be relevant for university management, building a strategy for lifelong e-learning based on co-creation with industry.

Keywords: lifelong learning, higher education, e-learning, online learning, industrial co-production

1. Introduction

Higher education institutions need to adjust to a fast-changing environment and act as a partner for companies in need to upskill and reskill. These companies act in a highly competitive complex and global economy and need to be adaptive and on constant alert for changes in the environment.

The European Skills Agenda is a five-year plan to help individuals and businesses develop more and better skills (European Commission, 2020). The Skills Agenda points out several aspects relevant for a sustainable future: "The rapid shift towards a climate neutral Europe and digital transformation is changing the way we work, learn, take part in society and lead our everyday lives." In practice this involves needs to both change direction and upskill to remain relevant in current positions. The European Skills Agenda has a set of objectives. For example, an objective for 2025 is to have 50% of adults aged 25-64 participating in learning during the last 12 months (European Commission, 2020).

Academia has a vital role to play, both by conducting research and by sharing research results with relevant actors in industry and, of course, all of society. This involves challenges for universities and the need to adjust offered education. Some examples of challenges that institutions in higher education need to address are: 1. competition and market share, 2. mindset changes towards entrepreneurship, and 3. involvement of stakeholders in co-creation of learning experiences (Pucciarelli & Kaplan, 2016). Political trends include a focus on lifelong and adult learning and the need for industry to transform to stay competitive. The European Commission outlined these challenges as a significant part of the 2030 Agenda for Sustainable Development (Goals 4 and 9) (UN General Assembly, 2015). Other challenges include cooperation between universities and business, and development of skills and learning mobility (European Commission, Directorate-General for Education, Youth, Sport and Culture, 2018).

The call for renewal also affects how higher education organizes ways to involve new groups of students. Commissioned education is an established way of collaborating with companies and public organizations. However, it is a company decision to initiate a course and it is not open for anyone. On an individual level, Massive Open Online Courses (MOOCs) provide ways for both upskill and reskill. MOOCs offer great flexibility for the individual student; any course content is available at any time. A MOOC is normally self-paced and may have a lower amount of interaction with teachers and other students. MOOCs are an attractive option for those in working life since regular courses interfere with their professional duties and schedules. In this article we present another way of meeting these challenges and we share experiences from designing, running, and evaluating learning modules on advanced level aiming for the full-time professional student in need of upskill or reskill. These courses are distance courses and do not require pre-scheduled interactions but will provide teacher-student interaction for an improved learning experience. Compared to commissioned education, these courses are open for individuals to apply for. This enables individual responsibilities for addressing needs of upskill and reskill and enhances mobility in the labour market. The courses provide flexibility for the individual learner, but both the flexibility and the large diversity of the group challenge current pedagogical practices required for educational experience.

1.1 Project background

The research study on the 'dilemmas in designing e-learning experiences for professionals' is conducted through a project called FutureE[1] Co-funded by KKS[2] (The Knowledge Foundation). The aim of this project is to develop and implement a lifelong learning approach through online courses at the advanced level at Mälardalen University (MDH), Sweden. The purpose of the FutureE project is to give national as well as international students and professional practitioners an opportunity to benefit from the skills in MDH's strongest research profiles, by means of flexible web-based distance courses. Here, the profile areas are: Embedded System (ES) and Future Energy (FE). ES focuses on embedded software, and FE on process optimization, targeting the process industry and the energy sector. Here, the project also focuses on the improvement of the university's competitiveness in an international perspective by supporting online courses and creating a unique platform for online advanced level education. The project covers a total of three years and within the framework of the project period we have developed and successfully run 12 online courses of 2.5 ECTS credits each. The newly developed advanced level courses are in the area of artificial intelligence (Deep Learning for Industrial Imaging, and Predictive Data Analytics), energy (Implementation of Industrial process control, and Measurement Techniques in Fluid Flow and Heat Transfer), environmental (Ambient Air Quality Management, Applied Spectral Imaging in Environmental Engineering, and Circular Economy in Context of Environmental Engineering), systems engineering (Systems-of-Systems Engineering, and Introduction to IoT Infrastructures) and others (Statistical Analysis in Industrial Systems, Automated Test Generation and Applied Statistics in Engineering). The people responsible for the course are all active researchers with responsibility for their own research projects. They all have a solid interest in developing undergraduate education, as well as linking research and education closer together. In addition to the course development, FutureE also includes tasks to develop support functions that are extra relevant for online courses. It is partly about assisting researchers with support in the development of courses, but also to build competence and administrative support around admission, validation, ICT support, internationalization and marketing.

2. Methodology

This study was made with a qualitative approach based on empirical data. The aim was to identify tension, dilemmas, and areas for improvement in higher education when addressing students combining advanced studies with work life. Also, teachers' perspectives were studied to add depth to the different aspects of managing courses for this group of students.

We present an empirical study with a qualitative approach involving teachers who gathered data from newly developed advanced level. Empirical data comes from course evaluations, course analyses, teacher workshops, and semi-structured interviews with selected students, who are also professionals.

Data from course evaluations was partly generated through the regular quality systems of the university, with a standard survey covering course quality, content, teacher performance etc. Besides that, the teachers

[1] More information about FutureE project and the courses: https://www.mdh.se/en/malardalen-university/collaboration/education-in-collaboration/continuing-professional-development-with-futuree

[2] More information about The Knowledge Foundation: https://www.kks.se/om-oss/in-english/

experimented with additional evaluations, performed either during the course or right after the course ended. To mention a few; three question survey after each finished learning module, open but anonymous postings on the app Padlet and Community of Inquiry.

To further understand the needs and context of this group of students, we performed a series of semi-structured interviews. In total 22 interviews were made with representatives from five out of 12 courses. For student interviews, an open invitation was presented in course settings to students who are also professionals. These interviews were made by independent researchers, not involved in teaching these courses. Due to the pandemic, all interviews were made via Zoom and recorded. All participants were informed about how the data was being used, terms of confidentiality, and also that they could terminate their participation at any time. Informed consent was recorded as well.

The interview guide consisted of overall themes rather than specific questions. Examples of such themes were motivation and reflections on learning, conditions for studying, interactions during the course and relevance for professional life. Also course content and structure was discussed.

Analysis was made through thematic coding and common themes were identified and discussed as emergent dilemmas. Dilemmas were validated with data from a previous project and from participants' reflections based on experiences working with distance education for professionals. The dilemmas presented under results were identified both from teacher perspective and from student perspective.

To understand teacher perspective, the data has been generated during a process of three years with regular seminars, workshops, and reflective discussions. Data was generated on different topics identified as relevant for the teachers. Live field notes were taken during these sessions and the documentation has been transparent for the entire project team as well as the teachers. The teachers also once responded to a teacher survey as part of the concept of Community of inquiry.

3. Results

In Table 1, an overview of the results is presented as dilemmas. Dilemmas ask for creative solutions where students' needs contradict each other. The table contains the overall themes, a brief description of the identified dilemmas and some quotes to exemplify students' voices.

Teachers' perspectives are presented in the following sections where teachers have reflected on their own project experiences through the lens of student dilemmas.

Table 1: Dilemma overview from student's perspective

Overall theme	Bite-sized learning vs. vast knowledge	Interaction vs. valuable time	Feedback hunger vs. hesitation to share work	Flexibility vs. deadlines	Simple and clean structure vs. large variation	Clear instructions vs. freedom of expression
Description of dilemmas	Students want small modules that looks manageable, but they also want the feeling of an extensive course with solid content, so it feels like a real accomplishment.	Students want to interact with other students specially to get their professional perspective on the course content, but they don't want to waste valuable time on awkward social situations. They express interest in others but also avoid interaction.	Students really appreciate good, fast and continuous feedback but are reluctant to share unfinished work or engage in problems of others.	Students want great flexibility so that they can take the course without interfering with work or everyday life and want strict deadlines to motivate them to finish work.	Students want a clean, predictable and easy to understand structure and also a great variation in the study material; Videos, charts, PowerPoints, pre-recorded lectures etc.	Students want there to be clear instructions, so they don't do it the wrong way and want to be able to relate the assignments to own work and address questions relevant to professional field.
Students' voices	"Short courses good for working life" "I thought it was for industry, but it feels more like it's for a doctoral student. The scope was large relative to points, and it was theoretically heavy." "Pointless to give out 2 credit courses." there must be some scope to it all." "Would have liked to have seen, for example, a 6hp course divided into 3x2 hp instead with a longer time, so maybe 2hp / semester for people like me." "It is not the number of credits that matters" "Very much knowledge, but easily communicated"	"Many of us do not have the opportunity for group work" "I don't want to be the one asking stupid questions on the forum." "There were possibilities for collaboration, but I didn't use it." "There were an enormous number of knowledgeable students with different experiences that I would have liked to have had more exchange with."	"The feedback from the teacher was really good" "Extra fun with peer feedback because we were so few students" "Low activity - there were few other posts, the others did not seem active on forums etc." "I have not shared with anyone yet. Want to share later."	"Had to work evenings and weekends, and rather long evenings" "I did apply late because there was an opportunity." "I did not have time to complete the course but want to do it later."	"Tricky to find the study material on Canvas" "Navigation from the MDH student page and canvas could have been easier but is still better than other universities." "Would be nice with video sessions" "Several tasks keep you focused" "I have learned a lot outside the scope of the course. It is appreciated"	"Difficult to know which level to go to" "I want the teacher to tell me that for these 3 modules, I want you to especially include this..." "Good to be able to exemplify what we have gone through. Preferably more examples of how the answers, math, etc. should be expressed." "I want an equivalence to "last year's exam."" " I work with this in my ordinary work so how deep should I go in the examples? I can go really deep"

4. Conflict between traditional structures and new ways of teaching

The development of attractive and effective e-learning courses for professional learners requires a good understanding of the broad environment in which the teaching will take place. The main actors in this are the learners who are also professionals, universities and the overall higher education regulation, teachers, and the learners' employers. In addition, there are competitors, such as commercial course providers and free MOOCs. In this section, we will discuss the different perspectives of these stakeholders, and how their interests and established procedures may be in conflict.

4.1 Professionals as learners

The group in focus of this project has been professionals in various engineering disciplines. This group is characterized by a large diversity, from newly graduated to near retirees, with a vast range of prior experiences. The younger students are up-to-date on online technology, and have recent studying experience, whereas others have not been enrolled in formal education for decades. On the other hand, the latter have a vast work experience to which they can relate the teaching which improves reflection.

Professional learners' main occupation is their work, and studying is often seen as a marginal activity. Sometimes, their employers allocate work time for studying, but more often at least parts of the studying have to take place on evenings and weekends. Professionals often have a more complex life situation, with family and children, to which they also need to adapt during off-work hours.

The motivation for the professionals to study is also different from traditional students at universities. The latter are mostly there to take a degree, which makes it important to get credits. It is also an important part of a younger individual's personal development and hence they value interactions with other students. Professionals, on the other hand, are more focused on learning a specific subject. They already have a degree, and consider formal credits secondary, which means that they are sometimes satisfied with just taking parts of a course without completing all exams. Also, they are usually already deeply embedded in a social context, and sometimes even saturated in their social network capacity.

4.2 University regulation

The Swedish higher education, which is the context MDH and FutureE operate in, is based on traditions, structures and regulations that are well suited for mass education of younger students that come directly from high school. The admission mainly takes place twice a year, and there is a fixed number of seats in each program or course. The funding for universities is provided by the government and is to a large extent based on how many credits are produced. However, there is also an upper limit on this, so that universities that produce more credits than budgeted are not given additional funding. The ordinary students are mostly full-time at the university, for several years, and courses are generally broader and larger than the courses directed at professional learners. Finally, the quality requirements on university teaching is based on traditional academic values, which may not always be the same qualities that professionals appreciate.

These structures are in many ways making it difficult to support e-learning for professionals. These students are often reluctant to wait four to six months for a course to start after the lengthy admission process. If they see a need, then they want to start studying much sooner and universities thus need to have a continuous enrolment process. Furthermore, the diversity in non-formal knowledge gathered from work experience makes it difficult to match the exact admission prerequisites.

The economic incentives for universities are counteracting professional education. As mentioned above, professional learners may be inclined to attend the course even if they did not get any credits in the end, but this also means that the university loses funding. There is also a large fluctuation in demand which makes it difficult to plan, and the university may need to turn down many applicants one year since the budget cap has been reached, and another year have many seats left. Given their work-life situation, shorter and more specific courses are preferred, but the administration required for admission and conducting the course is the same, and thus the overhead for the university is larger per credit for smaller courses.

4.3 Teachers

Working with professionals is in many ways stimulating for teachers, who can get many valuable insights from industry on the application of their subject. However, the diversity of the learners population is a challenge for teachers, since they need to adapt to the prior knowledge of learners, and in an online situation, it is particularly difficult to get to understand their needs. This also accounts for getting feedback on the course. Since professionals tend to study at odd hours, interaction with the teachers is often asynchronous (e.g., by e-mail) rather than face-to-face, which makes it harder to understand where the learners are in their development of an understanding. The same applies for getting feedback and suggestions to improve the course.

The fluctuation in demand for a course is not only a challenge for universities with respect to funding, as mentioned previously, but also for teachers. Many of the teachers are also researchers, and have other tasks, so adapting to an unusually high demand that requires more hours for teaching can be difficult.

Finally, without additional support, marketing towards professionals can easily become a burden for teachers, who may be asked to use their own personal networks and contacts to reach professionals. Although such marketing has been successful in our experience, it must be correctly accounted for.

4.4 Employers

In many cases, the professional learners enrol to increase their knowledge based on needs at their company, and the employer thus has a strong interest in the training being successful. Many companies regularly pay substantial fees to send their employees to commercial courses and training, and it is likely that they would also be willing to pay for specific further education at universities. However, this requires formal involvement and agreement between the company and the university. Such involvement and course fees would probably increase the company's attention to their students and would provide important funding for universities. The fact that higher education in Sweden is free if the students enrol themselves may also make it harder to convince companies to pay, and probably some adapted offers and mechanisms are needed. It should also be mentioned that not all professional students wish to involve their companies, since they sometimes study in preparation for applying for a position at another company.

5. Flexible teaching environments

We will now turn our focus on the needs of flexibility for professional students, and how to create a teaching environment where those needs can be catered for. By teaching environment, we mean how the course is organized on an operational level, with lectures, exercises, etc. Many of the courses in this study have used pre-recorded video lectures that the students can follow at their own pace. Automatically corrected exercises for the students to practice and repeat topics of the lecture has also been a common instrument. However, this has not been taken to the same level as is typically done in a MOOC. Instead, examinations have been mostly manually corrected, and involved, e.g., essays, programming exercises, oral presentations, etc. Altogether, these mechanisms have allowed students a lot of flexibility in terms of where and when to study.

Flexibility is however a double-edged sword. In one instance of the course Implementation of Industrial Process Control (Aslanidou, et al., 2020), two tracks were created to give students the possibility to choose the preferred study pace, 25% (i.e. 6 weeks) or 50% (i.e. 3 weeks). It was initially believed that a faster pace may suit full-time learners better, since they may be in a hurry to get accreditation, while professionals benefit from the extra flexibility given by a slower pace. However, after 3 weeks all the learners that had previously selected a faster pace requested to change to a slower one. This seems to highlight that a more flexible environment is preferred by a wider variety of learners. Furthermore, the students that did not complete the course after 6 weeks because of a lack of time, declared that an even slower pace would not have changed things much. Another indication that although some level of flexibility adds benefits, a fixed study timeline can be helpful to keep the motivation. The same approach was followed in the course on Measurement Techniques, with the majority of students opting for a slower pace. The pace was fixed in the next instance of the course, and in that case the throughput was in fact higher. Overall, the students that asked for (and were offered) more flexibility did not always complete the course.

In the Systems-of-Systems Engineering course (Axelsson, 2020), an experiment was conducted by increasing the flexibility of deadline within the course. The hypothesis was that the throughput rate of the course would increase. In the course evaluations, students were generally very positive to having this flexibility, and claimed that it was decisive for them to complete the course. However, the throughput did not change at all compared to previous instances of the same course with fixed deadlines. A possible explanation is that some students really need the pressure of the deadline to be able to focus on their studies, and that freedom leads to procrastination.

In most of our courses, we have allowed admission of students for a much longer time than the standard university admission period, and in many cases right up to the start of the course. In the same course, we also experimented with even more flexible admission coupled with a flexible pace. The Systems-of-Systems Engineering course nominally runs at 25% pace, but it was modified to run over a whole semester and students were admitted during the first half. In that way, students could choose any pace from 10% and up, as long as they completed the work during the semester. This needed to be combined with flexible examination, and the students were asked to set their own deadline for the three essay assignments that made up the examination.

As a teacher, this flexibility meant some additional work, in that assessment no longer could be carried out in large batches, but instead were continuous activity. This could be helped with some additional automation. Having a longer course period, with a lower intensity, can also be problematic since the students might need to go back and repeat things if their study periods are long in-between, and a more concentrated and intense course is more efficient if it is feasible for the individual. This, together with the need to be flexible with respect to the number of students taking the course, makes planning for the teacher more difficult. Another drawback of this flexible setting was that all students were at different parts of the course at a given time, which made student-to-student interaction even more difficult.

6. Software support in online teaching environments

In online teaching, software and hardware support is of paramount importance. It differs significantly from a traditional physical teaching environment where a physical lab is included with the required software, hardware, tools, frameworks, etc. Here, the students are mostly professionals working in industry and use computers provided by their employers. These computers differ in hardware, operating systems and often are locked for installation of 3rd party software. So, it is a challenge to provide a general solution that can work for all. For example, in the Deep Learning for Industrial Imaging course, teachers recommended computers and hardware, as presented in Figure 1. Similar computer requirements were also provided in all other courses that required specific hardware.

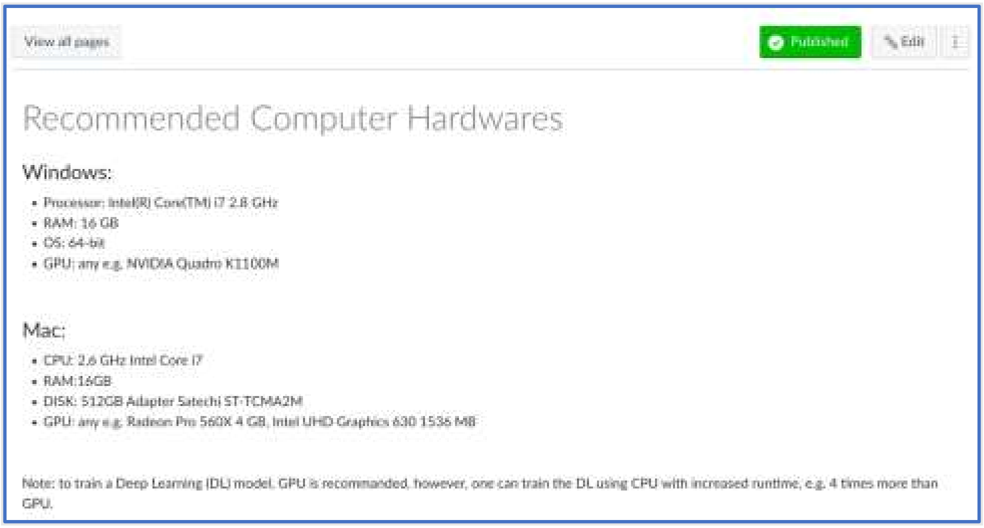

Figure 1: An example of recommended computer hardware

Students experienced problems with different software versions, operating system versions, and issues with hardware. The setup needs additional time without any benefit to the course and its learning outcome and creates frustration in learners that increases drop-out. In traditional physical teaching environments, a lab room is normally created with all of the necessary hardware, software, tools, frameworks, etc., so students only focus on their assignments, labs, and projects.

In the second year, when courses were offered, a dedicated group for IT support for distance learning was formed and supported teachers of the courses to create a virtual lab with 27 computers considering recommended hardware and software configuration. All active students were given access to this virtual lab, where a learner can connect to a remote lab application from almost any computer.

This solution seems to be accepted by the students and saves lots of time for both teachers and students. The main downside of this solution is that the University needs to keep the computers dedicated for the specific courses and increased maintenance efforts from the IT department.

7. Interactions in virtual environments

A great challenge in online learning is to include social interactions and collaboration activities. The benefits of such activities are evident: not only students can learn from each other and formulate more complex solutions than if they work alone, but it is also demonstrated by years of research that social presence and “a sense of belonging” facilitate the learning experience (Garrison, et al., 1999). As such, if learners are not afraid to make mistakes or of others’ judgement, they often feel more comfortable to explore more ideas, share, and debate. However, the asynchronous nature of online learning renders these interactions difficult. Learners are fully aware of the benefits, and they expressed so in several pre-course surveys. But work and life constrain the time that can be dedicated to study and participating in learning activities. Among the benefits expressed in the pre-surveys, students identified the opportunity to share different perspectives and professional experience, as well as more space for creativity and innovation when collaborating with others.

The simplest way to encourage learners’ interactions was believed to be an asynchronous discussion forum. Numerous forums were implemented in the courses Circular Economy, Measurement Techniques for Fluid Mechanics and Implementation of Industrial Process Control. In these forums, the students were asked to answer one or more questions, share their reflections, and comment on other posts. Even though this solution offers more flexibility because the students can decide when to do it, it also presents several drawbacks. The interaction is very limited; if students are not obliged to comment other entries, they very rarely find the time or motivation to do so. When cross commenting was made compulsory, the feedback from students was somewhat negative. Some did not appreciate the burden of replying to other people posts, while others did not find other posts or reflections relevant enough, or lamented insufficient feedback to their own posts. When participation to a discussion forum was not compulsory, only a couple of students engaged a discussion. This can be somewhat discouraging for “active” participants, whereas following a discussion can be considered as “legitimate peripheral participation” and contribute to the learning of the “passive "participants (Lave & Wenger, 1991) justifying the implementation of such communication platforms.

The type of platform used for these forums may have a great effect on the participation. Since all the courses were designed in Canvas LMS[3], the provided forum functionality was used. Negative aspects included lack of notifications for new posts and/or new comments to existing posts and a design that lacks in usability on a smartphone screen. In a society that is used to fast interactions, notifications, and the most user-friendly interfaces possible, this is an even greater limiting factor.

On the other hand, the use of interactive documents as part of the lecture material promoted discussions and interactions and was rated very positively by the students. Also, this forum enabled the possibility for both student-student, student-teacher, student-course material and teacher-course material interactions, which are central in online learning (Anderson & Garrison, 1998).

When webinars were introduced in the courses, the participation increased up to 90%, even in those cases when the webinar was recorded. The possibility for real-time discussion and asking questions to the teacher is very appealing to the learners; however, webinars present two main challenges. The first one regards the limited flexibility, since professional may not have time during the day to participate to a synchronous activity, but also because the course participants may be from different parts of the world and hence in different time zones. The second challenge is the time that the teacher needs to allocate. Very often, teachers are offered less time to run an online course versus a traditional campus course, which limits the synchronous interactions that they can plan. However, even as few as 2-3 synchronous activities of one hour each can make a very big difference in an online course, especially if the activities are recorded and a possibility to participate asynchronously after the activity is provided.

Another dilemma is around student-teacher interactions. Students generally appreciate continuous feedback as a way of learning. In all course evaluation surveys, there were positive comments related to the teachers’ availability to answer questions and provide feedback quickly; on the contrary, when this did not happen,

[3] More information about Canvas LMS: https://www.instructure.com/canvas

negative comments from the students were made explicit in the final evaluation. The paradox presents itself when students don't feel a psychological safety, and they are afraid to ask questions or share something that could make them look "stupid". In this case, they don't seek feedback until they are satisfied with their work, or until they feel desperate. Creating psychological safety is essential to avoid this issue. However, social interactions are needed to build it. And students may not feel so attracted to interact with others in an online environment.

Finally, some students commented as part of the course evaluation that social interaction was not a priority for them in an online course, which can be considered a dilemma since the interplay between cognitive, teaching and social presence are required for an educational experience (Garrison, et al., 1999).

A course should offer a suitable learning environment for a wide range of students, including those who want more interactions and those who do not. This is perhaps one reason why compulsory cross-commenting was received negatively by the students. Furthermore, the teacher has to spend time monitoring the discussion even in an asynchronous forum. It seems that this time would be best spent on a webinar that offers the possibility of multiple interactions, both among students as well as with the teacher. Recording the webinar allows the students to join if they can and want or get the information later on. Making it optional gives them the power of choice without making it a burden.

8. Conclusions

In this work, we have presented the dilemmas, paradoxes, and insights informed by the conduct of 12 courses over three years aimed at learners who are at the same time fully employed. While the courses were not conducted as MOOCs, they shared many similarities. We have identified several adaptations that improve the experience of professional learners, such as increasing the flexibility of the admission process, deadlines, webinar attendance (by recording webinars), and introducing a remotely accessed computer lab environment. However, we have identified a set of further issues connected to each of these adaptations, such as higher workload on teachers, potential reduction of motivation with a flexible deadline, etc. In summary, in this work, we have presented an overview of experiences and discussion points that needs to be considered when adapting the educational program for professional learners.

References

Anderson, T. & Garrison, D. R (1998) Learning in a Networked World: New Roles and Responsibilties. s.l.:Atwood Publishing.

Aslanidou, I., Zaccaria, V., Fentaye, A. & Kyprianidis, K (2020) Development of web-based short courses on control, diagnostics, and instrumentation. Proceedings of the ASME Turbo Expo 2020: Turbomachinery Technical Conference and Exposition, GT2020-14395.

Axelsson, J (2020) Systems-of-Systems Engineering Online Education: An Experience Report. Proc. 15th IEEE International Conference on System of Systems Engineering, pp. 87-92.

European Commission (2020) European Skills Agenda for sustainable competitiveness, social fairness and resilience.[Online] Available at: https://ec.europa.eu/social/main.jsp?catId=1223.

European Commission, Directorate-General for Education, Youth, Sport and Culture, (2018). Education and training monitor 2018, Luxembourg: Publications Office of the European Union.

Garrison, D. R., Anderson, T. & Archer, W (1999 Critical Inquiry in a Text-Based Environment: Computer Conferencing in Higher Education. The Internet and Higher Education, 2(2-3), pp. 87-105.

Lave, J. & Wenger, E (1991) Situated learning: Legitimate peripheral participation. s.l.:Cambridge University Press.

Pucciarelli, F. & Kaplan, A (2016) Competition and strategy in higher education: Managing complexity and uncertainty. Business Horizons, 59(3), pp. 311-320.

UN General Assembly (2015) Transforming our world: the 2030 Agenda for Sustainable Development, Resolution adopted by the General Assembly, s.l.: s.n.

Remote Learning: Students' Satisfaction and Perspectives in Higher Education

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DOI: 10.34190/EEL.21.040

Abstract: The Covid-19 pandemic has brought unexpected difficulties to higher education, which have been overcome by investing in training and reinforcing the use of digital tools. Considering the students' needs and interests in the pandemic context, the main objectives of this work were to: identify the perception of the use of digital tools by higher education students in the context of remote learning; evaluate the degree of satisfaction of higher education students with remote learning; analyze the perspectives of higher education students regarding the use of learning environments and tools in a post-pandemic scenario, and verify if there are significant differences regarding the students' curricular year and the variables associated to the use of digital tools and virtual learning environments. A study of an essentially quantitative nature has been developed using a sample of 677 students from a Portuguese public higher education institution. The results highlight that the digital tools that had greater awareness from the students were Zoom and VLE (virtual learning environment). The VLE tools that were used most frequently were Resources and Activities. Inferential statistics were used to make comparisons between the scores obtained for each variable in the groups related to each curricular year that students attended. In general, students' appreciation for emergency remote learning was considered positive. Regarding the prospects for using digital tools, it appears that they will continue to privilege the tools used during the pandemic, with an emphasis on the institution's VLE.

Keywords: remote learning, virtual learning environments, digital tools, higher education, Covid-19

1. Introduction

The Covid-19 pandemic caused unexpected difficulties for higher education and, consequently, challenges to overcome. It was not easy to move from a well-established teaching methodology based on face-to-face interaction between students and the teacher, and also between students themselves, to a new educational scenario in which the interaction became 100% online. It is in the context of this fully online interaction, that most of the teaching and learning process in Higher Education has been developed, which is generally referred to as emergency remote teaching. The changes mentioned above had several consequences in higher education, which are important to investigate, specifically the use of digital tools and the strategies associated with that use, as well as the students' satisfaction level regarding remote learning. Thus, the main objectives that guided this research were to:

- Identify the perception of higher education students on the use of digital tools in the context of emergency remote learning;
- Verify if there are significant differences between the use frequency of digital tools and the students' curricular year;
- Identify the level of satisfaction of higher education students concerning emergency remote learning;
- Find out if there are significant differences between the students' satisfaction depending on the attendance curricular year;
- Analyze the perspectives of higher education students on the use of digital tools in post-pandemic education.

Considering that the students' attendance in higher education can influence their perceptions about the frequency of use of digital tools and their satisfaction level with the use of those tools, the students in the sample were organized into five independent groups according to the number of years they attended higher education. The relation between the quantitative variables will be evaluated through hypothesis tests, by formulating null hypothesis and respective alternative hypotheses. The results present the descriptive statistics in tables and graphs respectively described. The application of the appropriate statistical tests is also presented.

2. Remote learning in higher education

2.1 Emergency remote learning during the COVID-19 pandemic

Distance learning is a teaching modality that has a complete political and didactic-pedagogical structure, seeking to flexibly encompass a whole range of contents and activities for each subject, according to the objectives and characteristics of general knowledge and specific skills (Sälo, 1993).

More than presenting content and forwarding activities, distance learning must have a well-defined methodology and be compatible with virtual interaction, including the concern of the students' evaluation process (Valentine, 2002).

This is the field of education focused on educating students who are not physically present in the traditional classrooms or students' campus, described as a process where the source of information is parted from the students in space and time and the Internet has become the main communication channel for the development of distance learning (Pandza & Masic, 2010).

The pandemic of COVID-19 has pushed every educational institution towards online learning, although nobody was ready for this transition. Many studies recognized the shift towards online learning as forceful, but an important step to continue the learning process (Bao, 2020; Halim, Hashim & Yunus, 2020; Qazi et al, 2021).

This transition to online learning during the pandemic was named emergency remote teaching, defined as a temporary shift of instructional delivery to an alternate delivery mode due to crisis circumstances. It involves the use of fully remote teaching solutions for instruction or education that would otherwise be delivered face-to-face, or as blended or hybrid courses, and that will return to that format once the crisis or emergency has abated. The primary objective in these circumstances is not to recreate a robust educational ecosystem but rather to provide temporary access to instruction and instructional supports in a manner that is quick to set up and is reliably available during an emergency or crisis (Hodges et al, 2020).

Some studies have highlighted students' negative perception of online learning and their lack of learning motivation and digital competencies (Bozkurt & Sharma, 2020).

However, a study conducted by Lee, Fanguy, Lu. & Bligh (2021) concludes that the students that were previously more satisfied with their university, it seems, continued to feel more satisfied regardless of the instructional medium. They also demonstrated that many teachers have put an incredible amount of work into effectively communicating and supporting their students during the pandemic. Students have recognized and positively responded to such efforts of their teachers.

2.2 Digital tools and virtual learning environments

The current COVID-19 pandemic has made universities, and colleges worldwide, adopt online learning methods, especially Virtual Learning Environments (VLE), entirely and quickly (Almaiah, Al-Khasawneh & Althunibat, 2020).

VLE are platforms that make available a set of tools to support classroom teaching, called mixed methodology, as well as non-classroom teaching. They are based on the web and they should integrate all the tasks involved in the teaching and learning processes.

The concept of VLE could be considered as a dynamic concept due to the constant evolution of digital technologies, their features, and potentialities, and the importance that such environments have within the learning processes (Alves, Miranda & Morais, 2017).

Numerous studies have demonstrated that learning in VLE enhances students' engagement, motivation, learning outcomes, as well as twenty-first-century skills including creativity, problem-solving, communication, and collaboration skills (Khlaisang & Songkram, 2019).

Communication-related tools have increased their use in the context of a pandemic, especially those that allow real-time communication. The interaction between students and teachers is in either asynchronous or synchronous activities. In synchronous activities students and instructors are engaging in learning at the same time, usually using audio and/or video conferencing, virtual classrooms, and instant messaging. Asynchronous learning does not happen in real-time, and the instructor applies to email and online discussion boards to conduct interaction (Ruiz, Mintzer & Leipzig, 2006).

Synchronous classes based on videoconference were adopted during the pandemic to minimize the distance effect and promote the teacher-students communication during the learning process. The use of video conferencing at a higher education level in synchronous instruction impacts the learners' feeling of association with their instructor (Han, 2013).

For synchronous instruction, despite competing with other software, such as Skype, Google Meet, Webex, MS Teams, and even WhatsApp, Zoom was the most used technology-mediated learning platform to teach online classes during the COVID-19 pandemic (Wiederhold, 2020).

Professors can use the different features of Zoom to create interactive learning environments, which include a virtual whiteboard with annotation capacity to explain concepts, breakout rooms to create small collaborative group work, polls for students' feedback, and chat to facilitate class discussions (Serhan, 2020).

During the pandemic, the teacher felt they need to adapt their materials to promote students' autonomy. Self-studies and online classes needed stronger support. So, the possibility to create lessons (create and organize texts, resources, quizzes, tests, assignments, links, video, podcasts, WebQuests, and other media material) allowed to join several formats of information in one learning object that were used by the student as a guide for studying.

3. Methodology

This research is of quantitative nature; however, it may, in some situations, assume characteristics of qualitative research. It can also be considered an empirical research, given Hill and Hill (2002) for focusing on observations that allow a better understanding of the phenomenon under study, such as the use of digital tools and the students' perceptions of the level of satisfaction with their use. The quantitative nature is evidenced in the use of variables that assume numerical values. The relationships between them can be tested using statistical procedures and the researchers have a distant and neutral scientific attitude (Coutinho, 2013; Creswell, 2014).

The data applied in this research was obtained through a questionnaire, constructed and validated by the authors of the study, from a sample of 677 higher education students. The questionnaire was administered online in the academic year of 2019/2020, and the invitation was made by email to all registered students. The sample can be considered adequate to the study nature, considering that all students had the same possibility and identical conditions to answer the questionnaire.

The ages of the subjects in the sample ranged from 18 to 62 years, with the average age being 23.5 years, the mode 20, the median 22, and the standard deviation 6.1.

Considering the curricular year in which students are enrolled, the 677 students in the sample were organized into five independent groups: G1, G2, G3, G4, and G5. Groups G1, G2, and G3 were created based on undergraduate students who are enrolled, respectively on the 1st, 2nd, and 3rd years; the G4 group was made up of students attending the 1st year of a master's degree; the G5 group was made up of students attending the 2nd year of a master's degree. The G1, G2, G3, G4 and G5 groups have, respectively, 196 (29.0%), 179 (26.4%), 194 (28.7%), 72 (10.6%), 36 (5.35%) students.

Given how the five groups were defined and the convention of transforming the data from an ordinal scale into a ratio scale, each group provides quantitative data, in which the responses of each subject admit the values 0, 1, 2, 3, 4, and 5, depending on whether there is no answer, or the answer is presented, respectively, in the options of “Never”, “Few times”, “Sometimes”, “Many times”, “Always”.

Therefore, five independent groups were formed for each variable under study, based on five ordinal independent samples of numerical data. Following the statement of Laureano (2011), the appropriate test for this situation is the one-way ANOVA parametric test, applied when a quantitative variable (dependent) is compared to its mean in two or more defined independent population groups by a qualitative variable (independent), in this situation, the students’ curricular year.

The application of parametric tests assumes that the dependent variable has a normal distribution and the population variances are homogeneous, so that normality can be tested with the Kolmogoronov-Smirnov test and the homogeneity of variances with the Levene test (Maroco, 2010).

The presentation, analysis, and discussion of the results are presented in the following sections.

4. Results

The results are presented following the objectives of this research, based on the same sequence, organized into two main topics: Perception of higher education students on the use of digital tools in the context of emergency remote learning and degree of satisfaction with the online learning during the pandemic.

Regarding the total sample, there are differences between the variables analyzed. In this sense, it is questioned whether these differences result in the same way regarding aspects associated with the sample as a whole, or on the contrary if they are due to aspects of particular academic years. Thus, the analysis of the data that follows is performed according to the five groups into which the sample was divided, as referred to in the methodology of this study.

4.1 Perception of higher education students on the use of digital tools in the context of emergency remote learning

In the analysis of the students' perception regarding the use of digital tools in the context of emergency remote learning, particular emphasis was given to the evaluation of the frequency of use of digital tools VLE, Zoom, Educast, YouTube, social networks and email. It was also evaluated the frequency of use of tools from the institution's virtual learning environment (VLE).

4.1.1 Evaluation of the frequency of use of digital tools VLE, Zoom, Educast, YouTube, social networks, and email

The evaluation of the frequency of use of digital tools: VLE (virtual learning environment of the institution to which the students belong), Zoom (videoconferencing system), Educast (educational video platform), YouTube, Social Networks and email, having also analyzed, in a particular way, the main tools that constitute the institution's VLE. Considering that the data came from a Likert-type questionnaire with five options, the data is of the ordinal type. Adopting the convention defined in the methodology, it was calculated the averages of the scores in each of the variables, based on the ratio scale, hence that it is possible to carry out arithmetic operations.

Figure 1 shows the average of the scores related to the perception of the frequency of use of the VLE, Zoom, Educast, YouTube, social networks, and email.

By observing Figure 1, the students’ perception of the frequency of digital tools use, is quite high in all groups, as on a scale of 0 to 5 the results are higher or equal to 2.5, except for the Educast tool. It is also observed that the referred average varies from group to group. A question that arises is whether “the frequency of digital tools use is significantly different depending on the students’ curricular year”. To answer this question, the following hypotheses were formulated:

> *H0: The frequency of the use of digital tools by students at the institution does not depend on the curricular year they attend.*
>
> *H1: There is at least one curricular year in which the frequency of the use of digital tools by students at the institution is significantly different from another curricular year(s).*

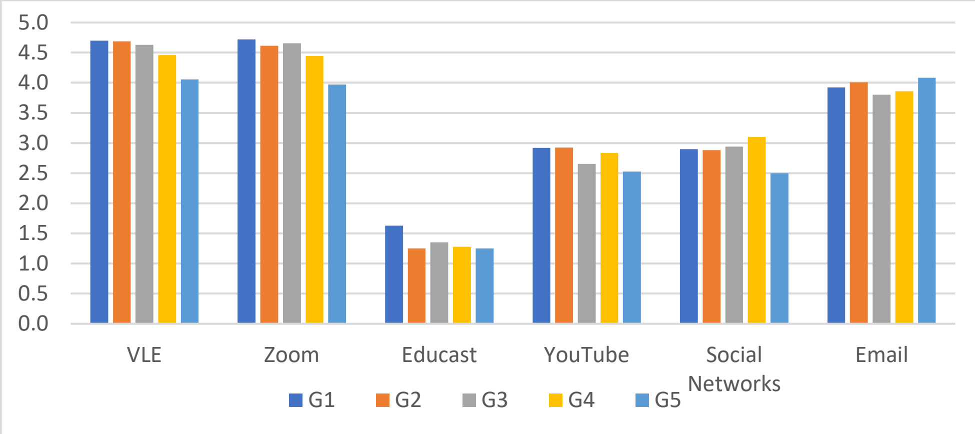

Figure 1: Average of the scores attributed by each group to the use of digital tools

Considering that we intend to compare five independent data samples, according to Maroco (2010), when we intend to test two or more independent samples, we can use a methodology called analysis of variance (ANOVA), if the variables under study have a normal distribution and if the population variances are homogeneous.

It was used the SPSS statistical program to test the normality of the data, for each of the variables: Zoom, Educast, YouTube, Social Networks and Email. The null hypothesis (normal distributions) must be rejected, since it can be admitted that each data set under analysis does not have a normal distribution.

Maroco (2010) suggests that the parametric methods are robust to the contravention of the assumption of normality as long as the distributions are not extremely skewed or flat and that the sample dimensions are not extremely small. Having in mind that for the distribution to be considered normal, the skew and kurtosis coefficients must be close to zero, translating this proximity to be in the range of] -0.5; +0.5 [. It also adds that whenever the absolute values of these coefficients are greater than 1, it can be assumed that the data distribution is not of the normal type. Once the skew and kurtosis coefficients were determined for each data sample, it was found that most of these coefficients assume values that are in the range] -0.5; +0.5 [.

From the above, it is assumed that the data distributions do not satisfy the conditions of applicability of the parametric statistical tests. Thus, to analyze the statistical hypotheses, the Kruskal-Wallis non-parametric test was used, which according to Laureano (2011) is applied to compare three or more distributions of independent populations. The same author states that it is used to compare two or more independent groups, defined by a nominal qualitative variable or treated as such, for which it is intended to test the equality of means, when the test variable is quantitative, based on the application of one-way ANOVA assumptions.

The application of the Kruskal-Wallis test resulted that it is not possible to reject the null hypothesis, at the significance level of 0.05, when assessing the tools YouTube, Social Networks and Email, that is, for each of these tools it is not possible to reject the hypothesis that "The frequency of use of digital tools by students at the institution does not depend on the curricular year they attend". It is possible to reject the null hypothesis, at the significance level of 0.05, regarding the variables VLE, Zoom, and Educast, that is, it is possible to admit “There is at least one curricular year in which the frequency of use of digital tools by students of the institution is significantly different from another curricular year(s)”.

To identify between which groups there are significant differences in the referred variables, multiple comparison tests (post-hoc tests) were performed to find pairs of groups with significant average frequency. According to Laureano (2011) the Scheffé test is a robust test regarding the assumptions of normality in the different independent groups and the homogeneity of the variances of the variables under test.

By applying the Scheffé test, it is concluded that there are significant differences in the frequency of use of digital tools, at a significance level of 0.05: between group 1 and group 5, group 2 and group 5, and group 3 and group 5 in the VLE variable and in the Zoom variable; between group 1 and group 2 in the Educast variable. Thus, it stands out that there is a significant difference in the use of the institution's VLE and in the use of Zoom between each of the first three years of the degree and the group of master's students. And there are significant differences in the frequency of use of the Educast tool between 1st and 2nd-year students.

4.1.2 Evaluation of the frequency of tools use within the institution's VLE

After analyzing the perceptions on the use of digital tools, which are VLE, Zoom, Educast, YouTube, Social Networks, and email in the context of emergency remote learning, the perceptions on the frequency of the use of tools that integrate the VLE were carried out. The main tools used on the institution's VLE are Messages, Chat, Forums, Resources, Activities, and Tests. Each of these tools were used regularly and are essential for professors and students of the institution. Thus, according to the adopted conventions, regarding the treatment of data, on a scale of 0 to 5, the averages of the frequencies of use are shown in Figure 2.

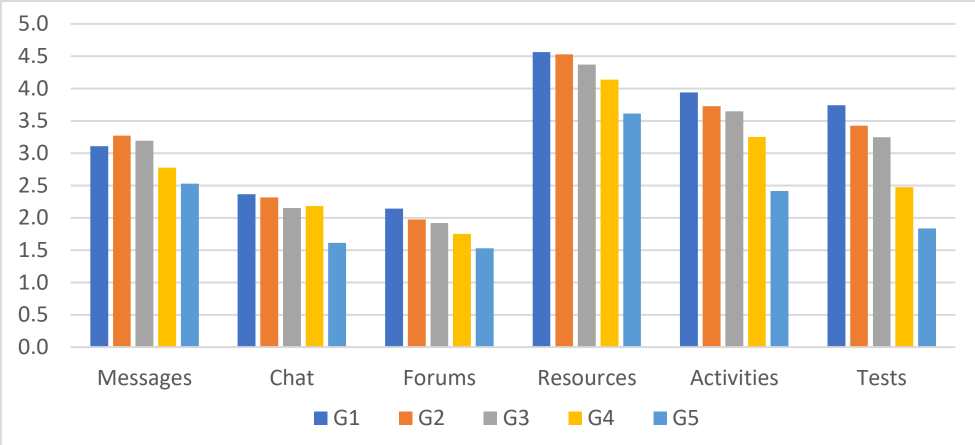

Figure 2: Average scores given by each group to the Institution's VLE tools

By observing Figure 2, it is possible to observe that the tools with less use by all groups are Chat and Forums, with an average of less than 2.5, on a scale of 0 to 5. The tools with the most frequent use are Resources and Activities, stating that groups G1 and G2, respectively, students attending the 1st year or the 2nd year, show frequency of use above 4.5. It also appears that perceptions about the use of VLE tools vary from group to group. In this sense, one question arises: There are significant differences regarding the perception of the institution's VLE tools usage according to the students' curricular year?

To answer the question, the following statistical hypotheses were defined:

H0: The frequency of use of the institution's VLE tools does not depend on the students' curricular year.

H1: There is at least one curricular year in which the frequency of use of the institution's VLE tools is significantly different from other curricular year(s).

After procedures similar to those performed in the analysis of the VLE, Zoom, Educast, YouTube, Social Networks, and email tools were performed and for the same reasons, the Kruskal-Wallis non-parametric test was applied.

From the application of the Kruskal-Wallis test, we concluded that there are significant differences between groups in all variables, that is, it is possible to reject the null hypothesis and admit the alternative hypotheses: "there is at least one curricular year in which the frequency of the use of each of the institution's VLE tools is significantly different from another curricular year(s)". Table 1 shows the pairs of groups in which there are significant differences, at the level of significance of 0.05, in the frequency of VLE tools use.

Table 1: Pairs of groups with significant differences

Variables	Groups where there are significant differences (Sig $\leq 0,05$)
Chat	G1-G5; G2-G5
Resources	G1-G4; G1-G5; G2-G4; G2-G5; G3-G5
Works	G1-G4; G1-G5; G2-G5; G3-G5; G4-G5
Tests	G1-G3; G1-G4; G1-G5; G2-G4; G2-G5; G3-G4; G3-G5

From the comparisons made, it was found that there are 19 pairs of groups where significant differences were identified, at a significance level of 0.05, as shown in Table 1.

4.2 Level of satisfaction of higher education students regarding emergency remote learning

Having in mind the changes that the teaching and learning process has experienced in the context of the pandemic, although they are the result of an emergency, we sought to know the students' appreciation regarding emergency remote learning. In this sense, using a five-point Likert scale, students were asked about pedagogical methodologies, digital tools, teachers' commitment, evaluation process, study time, and global appreciation of remote learning developed during the pandemic. The graphical representation of the students' responses, after the convention of changing the data to numeric, is shown in Figure 3.

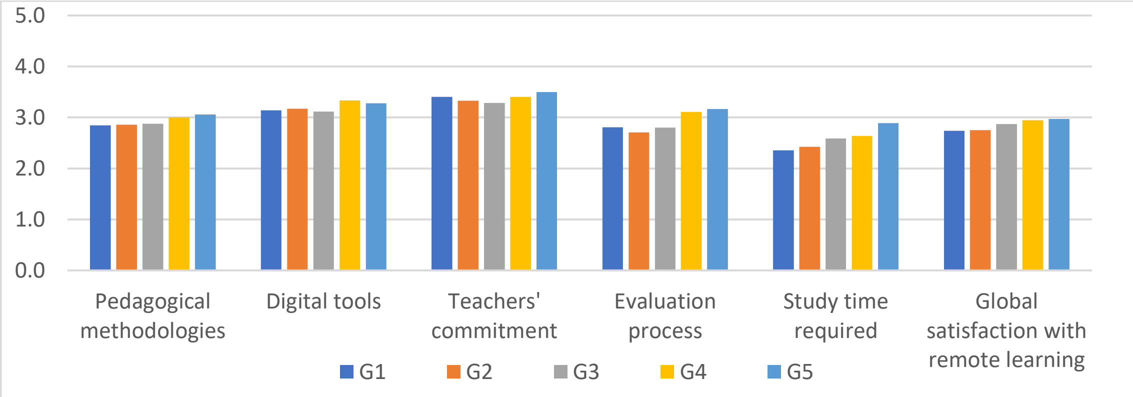

Figure 3: Average of the scores attributed by each of the groups to translate the degree of satisfaction with remote learning.

By observing Figure 3, it stands out that the degree of satisfaction in all groups varies between 2.5 and 3.5, which cannot be considered high, however, it is highlighted that in all groups the most valued aspect is the commitment of teachers.

While there are differences between the groups in each of the variables, it is necessary to verify if these differences are significant, that is, to test the hypotheses:

H0: The degree of student satisfaction is identical in all academic years.

H1: There is at least one academic year in which the degree of student satisfaction is significantly different from another academic year(s).

Admitting the aforementioned assumptions, the Kruskal-Wallis test was applied, with which it appears that the null hypothesis cannot be rejected in each of the variables, that is, the null hypothesis must be admitted. The degree of satisfaction of students in each of the variables analyzed is identical in all curricular years.

4.3 The prospects for the use of digital tools in learning

We also sought to appreciate the prospects for using digital tools in the post-pandemic scenario.

The graphical representation of the students' answers, after the convention of changing the data to numerical ones, the average of the scores obtained by each group under study is presented in Figure 4.

By observing Figure 4, it appears that students have very high prospects for using the institution's VLE and email, with very low prospects for using Educast.

After the appropriate tests were applied, no significant differences were identified between the groups in each of the variables.

The prospects for using VLE's tools after the pandemic was analyzed. The graphical representation of the students' answers, after the convention of changing the data to numeric ones, is shown in Figure 5, with the average of the scores obtained by each group under study.

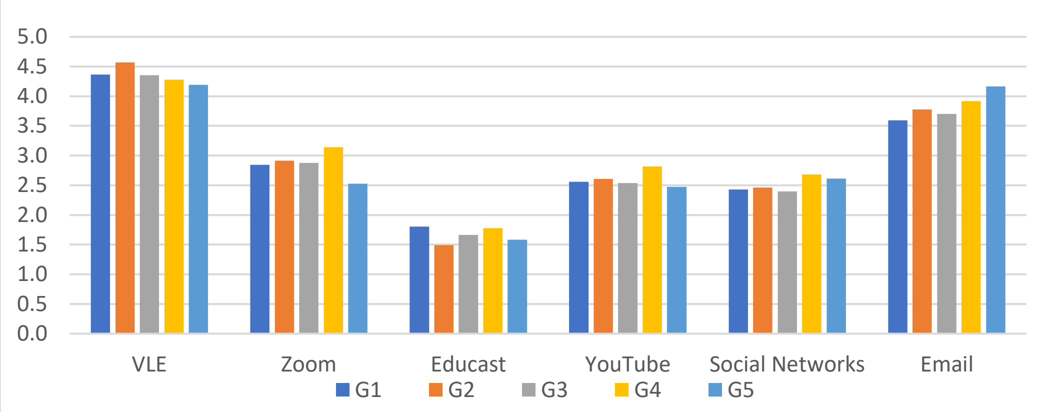

Figure 4: Averages of the scores attributed by each group to translate the prospects of use of digital tools in the post-pandemic scenario

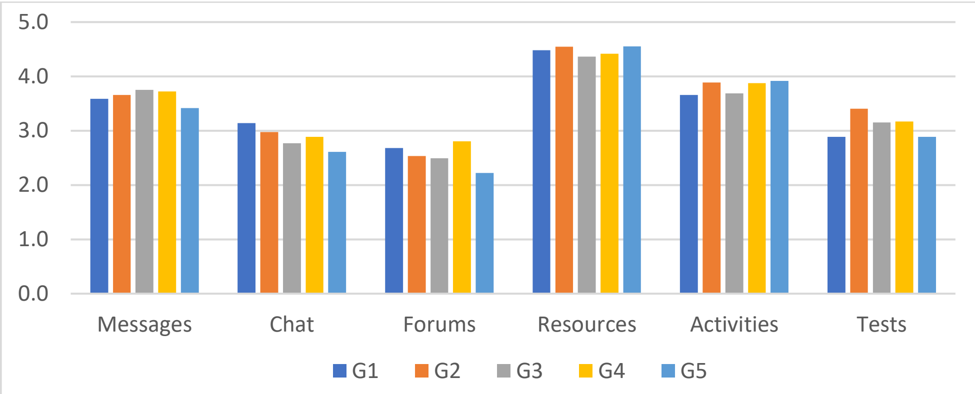

Figure 5: Average of the scores attributed by each group to the level of use of VLE's tools in a post-pandemic scenario

By looking at Figure 5, it appears that the higher usage perspectives are associated with the use of the resources, activities, and message tools.

After the statistical analysis of the data and the appropriate hypothesis tests were applied, it was found that there are significant differences between the G1 and G2 groups, in the Tests tool. Thus, 1st year and 2nd-year students have different perspectives on the use of the Tests tool.

5. Conclusions

The conclusions of this study are focused on digital tools appreciation, at the general level and at the level of the institution where the study was carried out, the students' satisfaction with emergency remote learning, and their prospects for using the referred digital tools. 677 higher education students from the same institution participated in the study and were organized into five groups according to their attending curricular year. For data treatment, descriptive and inferential statistics were applied. In inferential statistics, the conditions of applicability of parametric tests, normality, and homogeneity were first investigated, which were not verified, having resorted to non-parametric tests.

The main conclusions of the study are:

- The students' perception is that the use of digital tools is quite high in all groups, with VLE and Zoom standing out with the highest frequencies;
- The Resources and Activities are the most frequently used VLE tools;
- There are significant differences between groups in all variables; therefore, it is possible to reject the null hypothesis and admit alternative hypotheses: "there is at least one curricular year in which the frequency of use of the institution's VLE tools is significantly different from another curricular year(s)";

- The satisfaction level regarding remote education is positive, with the commitment of teachers being the most valued aspect in all groups. The students' satisfaction in each of the variables analyzed is identical in all curricular years;
- Students have very high prospects for using the institution's VLE and email, with very low prospects for using Educast.
- Higher usage prospects are associated with the use of the Resources, Activities, and Message tools.

This study enables the identification of indicators that allow to better understand the perception of the students on the frequency of use of institution's digital tools during the Covid-19 pandemic, the satisfaction level concerning remote learning and perspectives on the use of digital tools in a post-pandemic scenario.

Acknowledgements

The authors are grateful to the Foundation for Science and Technology (FCT, Portugal) for financial support by national funds FCT/MCTES to CeDRI (UIDB/05757/2020) and CIMO (UIDB/00690/2020).

References

Almaiah, M.A., Al-Khasawneh, A., Althunibat, A. (2020). Exploring the critical challenges and factors influencing the E-learning system usage during COVID-19 pandemic. Educ. Inf. Technol.

Alves, P., Miranda, L., Morais, C. (2017). The influence of virtual learning environments in students' performance. Universal Journal of Educational Research. ISSN 2332-3205. 5.3, p. 517-527

Bao, W. (2020). COVID-19 and online teaching in higher education: A case study of Peking University. Human Behavior and Emerging Technologies, 2(2), 113-115. Available at: https://doi.org/10.1002/hbe2.191.

Bozkurt, A., Sharma, R. C. (2020). Emergency remote teaching in a time of global crisis due to Coronavirus pandemic. Asian Journal of Distance Education, 15(1), i–vi. https://www.asianjde.org/ojs/index.php/AsianJDE/article/view/447

Coutinho, C. (2013). Metodologia de investigação em ciências sociais e humanas: Teoria e prática. Coimbra: Almedina.

Creswell, J. (2014). Research design: Qualitative, quantitative, and mixed methods approaches (4th ed.). London: SAGE Publication Ltd.

Han, H. (2013). Do nonverbal emotional cues matter? Effects of video casting in synchronous virtual classrooms. American Journal of Distance Education, 27(4), 253–264.

Hill, M., Hill, A. (2002). Investigação por questionário. Lisboa: Edições Sílabo, Lda.

Hodges, C., Moore, S., Lockee, B., Trust, T., Bond, A. (2020). The Difference Between Emergency Remote Teaching and Online Learning. Educause Review. https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning

Khlaisang, J., Songkram, N. (2019). Designing a Virtual Learning Environment System for Teaching Twenty-First Century Skills to Higher Education Students in ASEAN. Tech Know Learn 24, 41–63

Lee, K., Fanguy, M., Lu, X., Bligh, B. (2021). Student learning during COVID-19: It was not as bad as we feared., Distance Education, 42:1, 164-172

Laureano, R. (2011). Testes de hipóteses com o SPSS: O meu manual de consulta rápida. Lisboa: Edições Sílabo.

Maroco, J. (2010). Análise Estatística: Com utilização do SPSS (3.ª ed.)

Pandza, H., Masic, I. (2010). Distance learning perspectives. Acta Informatica Medica, 18(4), 229.

Qazi, A., et al. (2021). Adaption of distance learning to continue the academic year amid COVID-19 lockdown. Children and Youth Services Review, 126.

Ruiz, J. G., Mintzer, M. J., Leipzig, R. M. (2006). The impact of e-learning in medical education. Academic Medicine, 81(3), 207–212.

Sälo, R. (1993). Learning discourse: Qualitative research in education. International Journal of Educational Research, 19 (3), 199-325.

Serhan, D. (2020). Transitioning from Face-to-Face to Remote Learning: Students' Attitudes and Perceptions of using Zoom during COVID-19 Pandemic. Int. J. Technol. Educ. Sci., 4, 335–342.

Valentine, D. (2002). Distance learning: Promises, problems, and possibilities. Online journal of distance learning administration, 5(3).

Wiederhold, B.K. (2020). Connecting Through Technology During the Coronavirus Disease 2019 Pandemic: Avoiding "Zoom Fatigue". Cyberpsychol. Behav. Soc. Netw. 2020, 23, 437–438.

Remote Teacher Training During COVID Lockdown by e-Learning Lab (University of Crete)

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DOI: 10.34190/EEL.21.118

Abstract: The need to limit the spread of Covid-19 led to measures that had a significant impact on education. The closing of schools at the beginning of spring 2020, highlighted the need for School Distance Education (SDE) to make up for lost teaching time and to maintain pupils' contact with the educational process and other members of the school community. Nevertheless, teachers did not have previous experience in SDE and as a result, they were in need of support in this urgent situation. The Laboratory for Advanced Teaching Technologies for Lifelong Learning and Distance Education (E-Learning Lab) of the University of Crete, attempted to contribute with its own means to the support of teachers who struggled to respond to the challenges of distance teaching resulting from the suspension of schools. Within the above framework, fast track distance seminars were designed and implemented, aiming at the support of teachers on pedagogical issues of Distance Education. During the period from 19 March to 29 April 2020, 20 distance training seminars were conducted, in which more than 40.000 teachers of primary and secondary education from around Greece participated. The overall presentation and assessment of the training actions showed not only the enormous interest of the teaching community but also the need for such training actions with particular emphasis on the principles and the methodology of SDE, on synchronous and asynchronous learning environment as well as the designing or planning of teaching scenarios based on the pedagogical approaches compatible with Distance Learning.

Keywords: teacher training, school distance education, COVID-19

1. Introduction

Supporting the teachers with key issues regarding Distance Education became a major priority during the first lockdown, as till then teachers had no previous experience on School Distance Education.

The Department of Primary Education of the University of Crete and most specifically the Laboratory for Advanced Teaching Technologies for Lifelong Learning and Distance Education (E-Learning Lab), responding to the need for teacher support, designed and implemented fast-paced, free distance learning programs for primary and secondary education teachers.

The purpose of this paper is on the one hand to summarize the training activities that took place in the first period of the ban / Lockdown in the direction of introductory training of teachers on issues related to School Distance Education and on the other hand to investigate teachers' attitudes regarding participation in training.

The structure of the paper is as follows: In the first section, a first approach is attempted regarding the issues of the implementation of the School Distance Education in an emergency situation, such as Covid-19. The second section summarizes the contribution of the University of Crete and the e-Learning Lab (E-Learning Lab), in the support / training of teachers in introductory issues related to School Distance Education focusing on the pedagogical dimension of the whole project. In the third section, a first attempt is made to make a comprehensive assessment of the training activities during the first period of the ban / Lockdown (March-April 2020). The paper is completed with the conclusions section.

2. School Distance Education in periods of emergency (Pandemic, Covid-19)

The term "School Distance Education" refers to the provision of education for primary and secondary education, which is provided remotely, is addressed to school-age individuals and is distinguished into autonomous and complementary (Vergou, Koutsoumpa & Mouzakis, 2016).

During the first period of the Covid-19 pandemic, 80% of the global student population was affected by restrictive measures in 138 countries (Chang & Yano, 2020), the impact of which has not yet been studied (Flores & Gago, 2020). The need to address the negative impact of the suspension of the educational process pushed the shift to distance learning not as an option but as a coercive de facto enforcement (Toquero, 2020).

Therefore, emphasis in this first period of the pandemic was placed on (Anastasiades, 2020):

- ensuring access to Panhellenic School Network services, technological tools and infrastructure
- reconnection of students in an emergency with classmates and teachers in an educational environment of technological mediation.

The response of the teaching community exceeded all expectations as it managed to significantly restore a first contact with the students, despite the technological problems and mainly the fact that teachers lacked the training. Obviously, the indiscriminate transfer of the philosophy of Face-To-Face Teaching methods and techniques into purely technological / technocentric terms in Distance Education Environments created risks of considering distance education as a problematic choice.

The absence of the minimum pedagogical conditions for the basic implementation of the School Distance Education was more than obvious. It was therefore necessary to try to support teachers on the basis of pedagogical approaches based on the fundamental principles of distance education, such as the interaction between learners, learners with teachers and learners with educational materials (Moore, 1989), practice communities and the three dimensions of the Exploration community model (Social, Teaching and Cognitive Presence) (Garrison, Anderson & Archer, 2001), for the design and implementation of distance learning school activities with an emphasis on social interaction (Anastasiades, 2018).

3. Case study description

The e-Learning Lab of the Department of Primary Education of the University of Crete, responding to the need to support Primary and Secondary Education teachers in their efforts to implement introductory activities of distance education with their students, in the period of March - April 2020, designed and implemented fast-paced seminars with the method of distance education.

3.1 Objective

The objective of the training actions is divided into 3 Thematic Units:

- 1. Fundamental principles of Distance Education: Basic Theories, differences between Distance Education and in person teaching, the importance of educational material, Social dimension, etc.
- 2. The Pedagogical utilization of ICT in a School distance education environment (synchronous, asynchronous environments and blended Learning environments).
- 3. Design of Educational material: introductory activities for the critical utilization of the existing material with the methodology of Distance Education / Development of scenarios of teaching intervention based on the methodology of Distance Education.

3.2 Target group

The target group of the program was composed of Primary and secondary school teachers.

3.3 Implementation methodology

Each training seminar lasted 9 hours and was structured on two levels:

A. Syncronous School Distance Education (3 hours): Each training seminar provides one (1) training meeting, in which interested parties could participate:

- 1. via video conference for a limited number of participants (150)
- 2. via real time streaming (Live Streaming) for an unlimited number of participants.

For the most effective coverage of the needs of practice and the thorough support of the trainees, the solution of the two tutors was chosen. The first tutor focused on the synchronous e-learning environment (teleconferencing), presented the activities and interacted with the participants in the teleconference, while the second one focused on social networks and interacted with the users who watched the live broadcast of the seminar. He received their questions and transferred them to the video conference room, giving answers via chat while helping as well to coordinate the training activity.

B. Synchronous Distance Education (3 hours): In each training seminar

The seminars were complemented with interactive educational material, specially designed with the method of distance education, which the trainees had the opportunity to study asynchronously in space and time of their choice, aiming at their own support. Finally, in the context of the training, the trainees were asked to do an optional task related to the creation of a teaching scenario using the methodology of distance education, so as to establish a direct connection between theory and practice in the context of sharing good practices.

3.4 Implementation of training seminars

In the context of the above actions in the period of March - April 2020 were carried out a total of:

- 20 Teleconferences with the participation of 1.560 trainees,
- 6 Live Streaming Sessions with 15.000 participants in the "main hall" and another 25,000 from notifications from a total of 175.000 unique viewers.

Finally, the website with the educational material (www.edivea.org) was visited by over 60.000 unique visitors.

4. Research methodology

4.1 Purpose

The purpose of this research is to explore the views of trainee-teachers regarding their impressions of their participation in this training program.

4.2 Research questions

- 1. How satisfied are the participants with their participation in the Training Seminar in terms of trainers?
- 2. How satisfied are the participants with the training material?

4.3 Methodological framework

The survey was conducted in March and April 2020. It is an action survey that was synchronous, field-based and quantitative. A questionnaire was used as a means of data collection, which included closed-ended questions.

4.4 Sample

The sample of the research is the 4.239 teachers of different specialties.

Table 1: Participants via teleconferencing/ livestreaming

	Participants via Live Streaming		Participants via Teleconferencing		Total	
	N	percentage %	n	percentage %	n	percentage %
Male	609	21,6	242	17	851	20,1
Female	2.209	78,4	1.179	83	3.388	79,9
Total	2.818	100	1.421	100	4.239	100

Regarding the academic profile, the sample of the research consists of 2.111 (49,8%) primary school teachers, 708 (16,7%) preschool teachers, 122 (22,9%) teachers of Informatics, 4 (0,1%) Special Support Staff, 12 (0,3%) Special Education Kindergarten Teachers, 218 (5,1%) Teachers of Various Specialties (Music, Physical Education, Arts, Theatre), 55 (1,3) Special Education Primary School Teachers, 345 (8,1%) Teachers of Foreign Languages 648 (15,3%) Teachers of Other Specialties (Physicists, Mathematicians, Chemists, Philologists) 6 (0,1%) Special Education Staff, 6 (0,1%) students and 3 (0,1%) teachers of the Republic of Cyprus.

Table 2: Academic profile of the participants

Academic Profile	N	%	N	%	N	%
	Participants via Live Streaming		Participants via Teleconference		Total	
Specialty						
Primary School Teachers	530	37,3	1.581	56,1	2.111	49,8
Preschool teachers	123	8,7	585	20,8	708	16,7
Teachers of Informatics	41	2,9	81	2,9	122	22,9
Special Support Staff	1	0,1	3	0,1	4	0,1
Special Education kindergarten teachers	1	0,1	11	0,4	12	0,3
Teachers of Various Specialties (Music, Physical Education, Arts, Theatre)	45	3,2	173	6,1	218	5,1
Special Education Primary School Teachers	-	-	55	2,0	55	1,3
Teachers of foreign languages	149	10,5	196	7,0	345	8,1
Teachers of Other Specialties (Physicists, Mathematicians, Chemists, Philologists)	522	36,7	126	4,5	648	15,3
Special Education Staff	-	-	6	0,2	6	0,1
Students	5	0,4	-	-	5	0,1
Teachers of the Republic of Cyprus	2	0,1	1	0,0	3	0,1
Not stated	2	0,1	0	0	2	0,0
Total	**1.421**	**100**	**2.818**	**100**	**4.239**	**100**

5. Presentation of results

Table 3: Degree of satisfaction from the training program of participants via teleconferencing

How satisfied are you with your participation in the Training Seminar regarding	Participants via Teleconferencing												
	Low level of ICT literacy			Medium Level of ICT literacy			High Level of ICT literacy			Total			
	n	M.O	S.D.	N	M.O	S.D.	N	M.O	S.D.	N	M.O	S.D.	sig
a. the trainers	90	4,4	0,761	808	4,33	0,781	513	4,26	0,85	1.412	4,31	0,805	0,151
b. the training material	90	3,81	0,959	803	3,82	1,012	512	3,83	1,066	1.406	3,82	1,028	0,987

According to the results of the research, the participants in the Training Seminar via Teleconferencing stated that they were quite satisfied (4,31) with the trainers. Also, the participants were moderate to quite satisfied (3,82) with the training material.

Table 4: Degree of satisfaction from the training program of participants via livestreaming

How satisfied are you with your participation in the Training Seminar regarding	Participants via Livestreaming												
	Low level of ICT literacy			Medium Level of ICT literacy			High Level of ICT literacy			Total			
	n	M.O	S.D.	N	M.O	S.D.	N	M.O	S.D.	N	M.O	S.D.	sig
a. the trainers	133	4,18	0,869	1.556	4,34	0,763	1.128	4,46	0,720	2.817	4,38	0,755	0,000
b. the training material	133	3,78	1,054	1.556	4,06	0,945	1.128	4,19	0,922	2.817	4,10	0,946	0,000

According to the results of the research, the participants in the Training Seminar stated that they were quite satisfied (4,38) with the trainers. In particular, there was a slight variation in the already large satisfaction depending on the level of ICT literacy: participants with very low ICT literacy, appeared quite satisfied (4,18), participants with a moderate level of ICT literacy, felt quite satisfied (4,34) and participants with a high level of ICT literacy, felt quite satisfied (4,46). The difference of the GPA is considered statistically significant (p=0,000). Also, the participants were quite satisfied (4,10) with the training material. In particular, there was a slight variation in the already large satisfaction (3,78), participants with a moderate level of ICT literacy, felt quite satisfied (4,06) and participants with a high level of ICT literacy, felt quite satisfied (4,19). The difference of the GPA is considered statistically significant (p=0,000).

Table 5: Degree of satisfaction from the training program of participants via livestreaming depending on specialty

How satisfied are you with your participation in the Training Seminar regarding	N	M.O.	S.D.	N	M.O.	S.D.	N	M.O.	S.D.	N	M.O.	S.D.	N	M.O.	S.D.	N	M.O.	S.D.
	Participants via Livestreaming																	
	Primary School Teachers			Preschool teachers			Teachers of Informatics			Special Support Staff			Special Education Kindergarten Teachers			Teachers of Other Specialties (Physicists, Mathematicians, Chemists, Philologists)		
a. the trainers	1.581	4,39	,763	585	4,41	,733	81	4,30	,766	3	4,00	1,000	11	4,64	,505	126	4,47	,745
b. the training material	1.581	4,10	,934	585	4,14	,937	81	4,15	,910	3	4,00	1,732	11	4,45	,820	126	4,06	,924

N	M.O.	S.D.	N	M.O.	S.D.	N	M.O.	S.D.	N	M.O.	S.D.	N	M.O.	S.D.	N	M.O.	S.D.	Sig
									Participants via Livestreaming									
Teacher of the Republic of Cyprus			Teachers of Various Specialties (Music, Physical Education, Arts, Theatre)			Special Education Primary School Teachers			Teachers of Foreign Languages			Special Education Staff			Total			
1	5,00	-	173	4,36	,747	55	4,16	,811	195	4,33	,756	6	4,00	,632	2.817	4,38	,755	,189
1	4,00	-	173	4,18	,989	55	3,84	1,214	195	3,99	,961	6	3,50	,837	2.817	4,10	,946	,199

According to the results of the research, Primary School teachers, Preschool teachers, teachers of Informatics, Special Support Staff, teachers of Other Specialties (Physicists, Mathematicians, Chemists, Philologists), teachers of Various Specialties (Music, Physical Education, Arts, Theatre), Special Education Primary School teachers, teachers of Foreign Languages, as well as the Special Education Staff stated that they were quite satisfied with the trainers (4,39, 4,41, 4,30, 4,00, 4,47, 4,36, 4,16, 4,33 and 4,00 respectively). The teacher of the Republic of Cyprus stated that he/she was very satisfied (5,00). Overall, they stated that they were quite satisfied (4,38).

Regarding the training material, the Special Education Staff stated that they were moderate satisfied (3,50). Special Education Primary school teachers, as well as the teachers of Foreign Languages stated that they were moderate to quite satisfied (3,84, 3,99 respectively). Primary School teachers, Preschool teachers, teachers of Informatics, Special Support Staff, Special Education Kindergarten teachers, the teacher of the Republic of Cyprus, teachers of Other Specialties (Physicists, Mathematicians, Chemists, Philologists), as well as teachers of Various Specialties (Music, Physical Education, Arts, Theatre) stated that they were quite satisfied (4,10, 4,14, 4,15, 4,00, 4,45, 4,00, 4,06 and 4,18 respectively). Overall, they stated that they were quite satisfied (4,10).

Table 6: Degree of satisfaction from the training program of participants via teleconferencing depending on specialty

How satisfied are you with your participation in the Training Seminar regarding	N	M.O.	S.D.	N	M.O.	S.D.	N	M.O.	S.D.	N	M.O.	S.D.	N	M.O.	S.D.	N	M.O.	S.D.
	Participants via Teleconferencing																	
	Primary School Teachers			Preschool teachers			Teachers of Informatics			Special Support Staff			Special Education Kindergarten Teacher			Teachers of the Republic of Cyprus		
a. the trainers	528	4,30	,816	122	4,37	,707	41	4,24	,943	1	4,00	-	1	5,00	-	2	4,00	1,414
b. the training material	525	3,82	1,034	122	3,88	,950	41	3,78	1,061	1	3,00	-	1	5,00	-	2	4,00	1,414

How satisfied are you with your participation in the Training Seminar regarding	N	M.O.	S.D.	N	M.O.	S.D.	N	M.O.	S.D.	N	M.O.	S.D.	Sig
							Participants via Teleconferencing						
	Teachers of Other Specialties (Physicists, Mathematicians, Chemists, Philologists)			Teachers of Various Specialties (Music, Physical Education, Arts, Theatre)			Teachers of Foreign Languages			Total			
a. the trainers	518	4,28	,821	44	4,39	,722	148	4,34	,787	1.412	4,31	,805	,909
b. the training material	516	3,80	1,046	44	3,77	1,159	147	3,88	,979	1.406	3,82	1,028	,955

According to the results of the research, Primary School teachers, Preschool teachers, teachers of Informatics, Special Support Staff, teachers of the Republic of Cyprus, teachers of Other Specialties (Physicists, Mathematicians, Chemists, Philologists), teachers of Various Specialties (Music, Physical Education, Arts, Theatre), as well as the teachers of Foreign Languages stated that they were quite satisfied with the trainers (4,30, 4,37, 4,24, 4,00, 4,00, 4,28, 4,39 and 4,34 respectively). Students stated that they were quite satisfied (4,60). The Special Education Kindergarten teacher stated that he/she was very satisfied (5,00). Overall, they stated that they were quite satisfied (4,31).

Regarding the training material, the Special Support Staff stated that he/she was moderate satisfied (3,00). Primary School teachers, Preschool teachers, teachers of Informatics, teachers of Other Specialties (Physicists, Mathematicians, Chemists, Philologists), teachers of Various Specialties (Music, Physical Education, Arts, Theatre) as well as teachers of Foreign Languages stated that they were moderate to quite satisfied (3,82, 3,88, 3,78, 3,80, 3,77, 3,80 and 3,88 respectively). The teachers of the Republic of Cyprus stated that they were quite satisfied (4,00). Overall, they stated that they were moderate to quite satisfied (3,82).

6. Conclusions

The results of the concluding evaluation, based on the answers of the 4.239 participants are the following:

- 1. The participants in the Training Seminar stated they were very satisfied with the trainers. In particular, there was a slight variation in the already large satisfaction depending on the level of ICT literacy: participants with very low ICT literacy, appeared quite satisfied (4,19), participants with a moderate level of ICT literacy, felt quite satisfied (4,34) and participants with a high level of ICT literacy, felt quite satisfied (4,46). The difference of the GPA is considered statistically significant (p=0,000). Overall, they felt very satisfied (4,38).
- 2. All participants felt moderate to very satisfied with the training material (3,84). In particular, for the participants via Live Streaming on Facebook, a slight variation was observed depending on the level of ICT knowledge, where moderate to very satisfied (3,78) appeared the trainees with a low level of ICT knowledge, while the trainees with a medium level of ICT knowledge, as well as trainees with a high level of knowledge of ICT use were very satisfied (4,06 and 4,19 respectively). The difference of the GPA is considered statistically significant (p=0,000). Overall, the trainees felt very satisfied (4,10). There was also a slight variation for participants via Live Streaming on Facebook, depending on their specialty. More specifically, those who belonged to the Special Education Staff felt moderately satisfied (3,33), as well as the Special Education Primary School Teachers (3,47). The Primary School Teachers (3,84), the Preschool Teachers (3,85), the Teachers of Informatics (3,74), the Teachers of Various Specialties (Music, Physical Education, Arts, Theatre) (3,84) and the Foreign Language Teachers (3,71) appeared moderate to very satisfied. Those who belonged to the Special Support Staff, the Special Education Kindergarten Teachers PE 61, the Teacher PE of the Republic of Cyprus and the Teachers of Other Specialties (Physicists PE 04.01, Mathematicians PE 03, Chemists PE 04.02, Philologists were very satisfied 02) (4.00, 4.00, 4.00 and 4.21 respectively). The difference of the means is considered statistically significant (p = 0.001). Overall, they felt moderate to very satisfied (3,84). Those who belonged to the Special Auxiliary Staff, the Special Education Preschool Teachers, the Primary School Teacher of the Republic of Cyprus and the Teachers of Other Specialties (Physicists, Mathematicians, Chemists, Philologists) were very satisfied (4,00, 4,00, 4,00 and 4,21 respectively). The difference of the GPA is considered statistically significant (p=0,001). Overall, they felt moderate to very satisfied (3,84).

The hasty introduction of Distance Education in emergency conditions, has highlighted readiness problems not only in central planning but also in the school units. According to recent research, the training of prospective teachers often lags behind the preparation for distance learning (Debruler et al., 2020).

E-Learning Lab designed and implemented 20 fast-paced seminars from March 19 to April 29, 2020, through the teleconferencing platform of Webex Meetings, while they were also broadcast live (live streaming) on the page of the University of Crete | e-Learning Lab and in social networking media (Facebook). Emphasis was placed on the principles and methodology of Distance Education, the environments of synchronous and asynchronous DE, as well as the design or formulation of teaching scenarios based on pedagogical approaches compatible with DE in order to support teachers.

The satisfaction of 40.000 teachers of all levels for the whole training process highlighted the importance of the pedagogical approach in the design and implementation of the seminars which was based on the practical training of the trainees in both synchronous and asynchronous distance learning environments.

A key role in the design and implementation of these seminars was played by the experience accumulated by:

- the distance training of teachers within the Major Training Program of the Pedagogical Institute (Anastasiades, 2012) and the training of expatriate teachers within the Expatriate Education Program of the University of Crete (Anastasiades, 2007; 2012; Damanakis & Anastasiades, 2005)
- conducting distance learning programs for teachers
- distance education through the ODYSSEUS program, which is the first systematic effort to design and implement an integrated complementary school environment with the use of ICT in Greece through the pedagogical utilization of Interactive Teleconferencing in Primary schools of Cyprus during the period 2000-2003 (Anastasiades, 2003) and Greece during the period 2004-2020 (Anastasiades, 2003; 2009; 2017).

References

Anastasiades, P. (2003) Distance Learning in Elementary Schools in Cyprus: The evaluation Methodology and Results. *Computers & Education,* 40(1), pp. 17-40.

Anastasiades, P. (2007) Blending Interactive Videoconferencing and Asynchronous Learning in Adult Education: Towards a Constructivism Pedagogical Approach. A Case Study at the University of Crete (EDIAMME). In: S. Negash, M. Whitman, A. Woszczynski, K. Hoganson and H. Mattord, eds., *Handbook of Distance Learning for Real-Time and Asynchronous Information Technology Education*. Hershey, PA: Idea Group Inc., pp. 24-64.

Anastasiades, P. (2009) *Interactive Videoconferencing and Collaborative Distance Learning for K-12 Students and Teachers: Theory and Practice*. New York: Nova Science Publishers Inc.

Anastasiades P. (2012) Design of a Blended Learning Environment for the Training of Greek Teachers: Results of the Survey on Educational Needs. In: P. Anastasiades, ed., *Blended Learning Environments for Adults: Evaluations*. Hershey, PA: Idea Group Inc., pp.230-256.

Anastasiades, P. (2017) "ODYSEYS 2000-2015": Complementary school distance education using ICT: evaluation of the research contribution. *Open Education - The Journal for Open and Distance Education and Educational Technology,* 13(1), pp. 88-128.

Anastasiades, P. (2018) Learning & Social Network at the University of Crete [eLearning Lab]. In: A. Volungeviciene and A. Szűcs, eds., *Exploring the Micro, Meso and Macro Navigating between dimensions in the digital learning landscape: European Distance and E-Learning Network (EDEN) Conference Proceedings, 17-20 June 2018, Genoa.* Budapest, EDEN. pp. 598-605.

Anastasiades, P. (2020) Distance learning in the era of COVID-19, focusing on the Greek Educational System. *Open Education - The Journal for Open and Distance Education and Educational Technology,* 16(2), pp. 20-48.

Anastasiades, P., Kaga, E., Loukeris, D., Mantas, P. and Trantas, P. (2011). Major Teacher Training Program: A study to investigate the training needs of teachers. *Comparative and International Educational Review,* 16-17, pp. 126-154.

Chang, G. C. and Yano, S. (2020) *How are countries addressing the Covid-19 challenges in education? A snapshot of policy measures.* Available from https://www.gecv.ac.in/uploads/ssip/UNESCO%20snap %20shot%20for%20maintaining%20education.pdf [Accessed 1st February 2021]

Damanakis, M. and Anastasiades, P. (2005) Life Long & Distance Learning and the Diaspora: Implementing a Virtual Learning Environment at the University of Crete. *Themes in Education,* 6(1), pp. 83-96.

Debruler, K., Denton, C., McKay, A. and Sicilia, E. (2020) Supporting Michigan Educators Through the Transition to Online Learning. In: R. Ferdig, E. Baumgartner, R. Hartshorne, R. Kaplan-Rakowski and C. Mouza, eds., *Teaching, Technology, and Teacher Education During the COVID-19 Pandemic: Stories from the Field*. AACE-Association for the Advancement of Computing in Education, pp. 191-196.

Flores, M. and Gago, M. (2020) Teacher education in times of COVID-19 pandemic in Portugal: national, institutional and pedagogical responses. *Journal of Education for Teaching,* 46(4), pp. 507-516.

Garrison, D.R., Anderson, T. and Archer, W. (2001) Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education,* 15(1), pp. 7-23.

Moore, M.G. (1989) Three Types of Interaction. *American Journal of Distance Education,* 3(2), pp. 1-7.

Toquero, C. M. (2020) Emergency remote education experiment amid COVID-19 pandemic. *IJERI: International Journal of Educational Research and Innovation,* 15, pp. 162-176.

Vergou, M., Koutsoumba, M. and Mouzakis, H. (2016) Supplementary Distance Learning for Infants: an Action Research based on Museum Education. *Open Education - The Journal for Open and Distance Education and Educational Technology,* 12(2), pp. 24-39.

A Review of Podcasts as a Learning Medium in Higher Education

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DOI: 10.34190/EEL.21.021

Abstract: Podcasts and podcasting have emerged as widespread methods for providing learning at different levels in higher education. The podcast has become a learning media that provides students with more flexibility and opportunities to learn and reflect on course content. Given that podcasts as a learning medium are relatively new, few studies have investigated their use and effectiveness on learning. Previous studies, mainly case studies, have provided insights into a specific field of practice. This study combines the best available evidence to provide an overview of the state of the art of the current research regarding the benefits, challenges and current design tenets to use podcasts and podcasting as a learning medium in higher education. Following the preferred reporting items for systematic reviews, we included 15 studies from 2016 to 2021. These studies were analysed to respond to our research objectives. One of the key findings was that existing research indicates optimism towards podcasting as a learning medium in higher education, supporting more flexible, reflective and engaging learning environments. However, there are still several practical and pedagogical challenges in the use of podcasting in higher education. One of the difficulties of using the podcast as a learning medium is the lack of interactions. Learning via the interaction between students themselves, the course content, peers and course educators is essential for transferring podcast content. To overcome these challenges, different didactical and pedagogical designs have been used to harvest the benefits that podcasts can provide. It is concluded that most of the existing literature examines case studies, both quantitative and qualitative. These studies have focused mainly on descriptions of students' experiences. Furthermore, podcasts and podcasting have only been used as a supplement within certain learning activities. Empirical studies are still in their infancy, and more research is needed into different pedagogical and didactical scenarios. Additionally, more longitudinal studies with a focus on podcasts' impact on students' learning outcomes are needed.

Keywords: podcast, review, higher education, learning, learning media

1. Introduction

There has been an escalation in the use of podcasting in Denmark over the last five years. Statistics from podcaststats.dk reveal that in 2015 9 % and 2019 24% of the population listened to podcasts weekly (Ziengs, 2021). Of the 24% of people (in 2019) that listened to podcasts, 58% of them listened to podcasts in their home, and the rest listened on the go, for instance on their way to work (McGarr, 2009). Statistics reveal that 40% of the Danish population in 2020 had listed to a podcast during the last three months (Tassy, 2020) These statistics support that content-relevant podcasts are supporting flexibility motivation and engagement cognition and learning in higher education (McNamara and Drew, 2019). Podcasts are produced digital episodes of video or audio content that are available on the Internet and can be downloaded or streamed on demand directly on the consumers' media device (Drew, 2017). A podcast is available online and can be based on a single idea that is exposed/discussed, or it could be part of a series where the single podcasts refer to each other. A podcast is stored on a website or another internet location, like a learning management system (Palenque, 2016).

In this study, the classification of podcast and podcasting refers to an MP3 file that is distributed to listeners.

1.1 Rationale

Although an extensive body of research has been dedicated to the investigation of how podcasts can be used in higher education, there is no specific state-of-the-art review of the findings of scholarly activity in the specific field of podcasts as a learning medium in higher education. As the research literature grows, it is difficult for researchers and practitioners to outline an accurate picture of the issues and trends across the complete field. This paper is timely as it informs about scholarly activity on the state-of-the-art use of podcasts as a learning medium and provides directions for future research. This review can be of value to various stakeholders, including educators, students and researchers by providing insights into different approaches adopted in the use of podcasts.

2. Research object

This study aims to define the state of the art in the use of podcasts and podcasting in the last 6 years. The scope of this review is guided by the following research questions:

- What are the main benefits of podcasting in higher education?
- What are the main challenges of using podcasts in higher education?
- How are podcasts and podcasting used as didactic and pedagogical tools in higher education?

The composition of this paper includes the methodology used in this review, the results and a discussion aiming to illustrate the use, benefits and challenges of using podcasts as a learning medium in higher education.

3. Methodology

3.1 Inclusion and exclusion criteria

As the intention of this review was to find structures, benefits and challenges in research, the review considered studies that explored any aspect of the use of podcasts and podcasting in higher education from 2015 to February 2021. There was no restriction regarding the population and the topic of interest. Neither were criteria related to the method of the study applied because we were especially interested in the different kinds of studies that already have been performed. Therefore, a range of quantitative and qualitative study designs was considered for inclusion. Also, this review included studies that explored learners' outcomes (i.e. cognitive and affective outcomes) as long as they were within the context of using podcasts as a learning medium. However, this review excluded literature focusing on video podcasts, voiceover PowerPoints and any form of visual learning tools as only podcasts to take on the go affords real flexibility. Another explanation for the exclusion of video is that is questioned and in some cases even renamed vodcasts (e.g., Jarvis & Dickie, 2010) Also, language education was excluded due to the majority of research and its specificity.

3.2 Search strategy

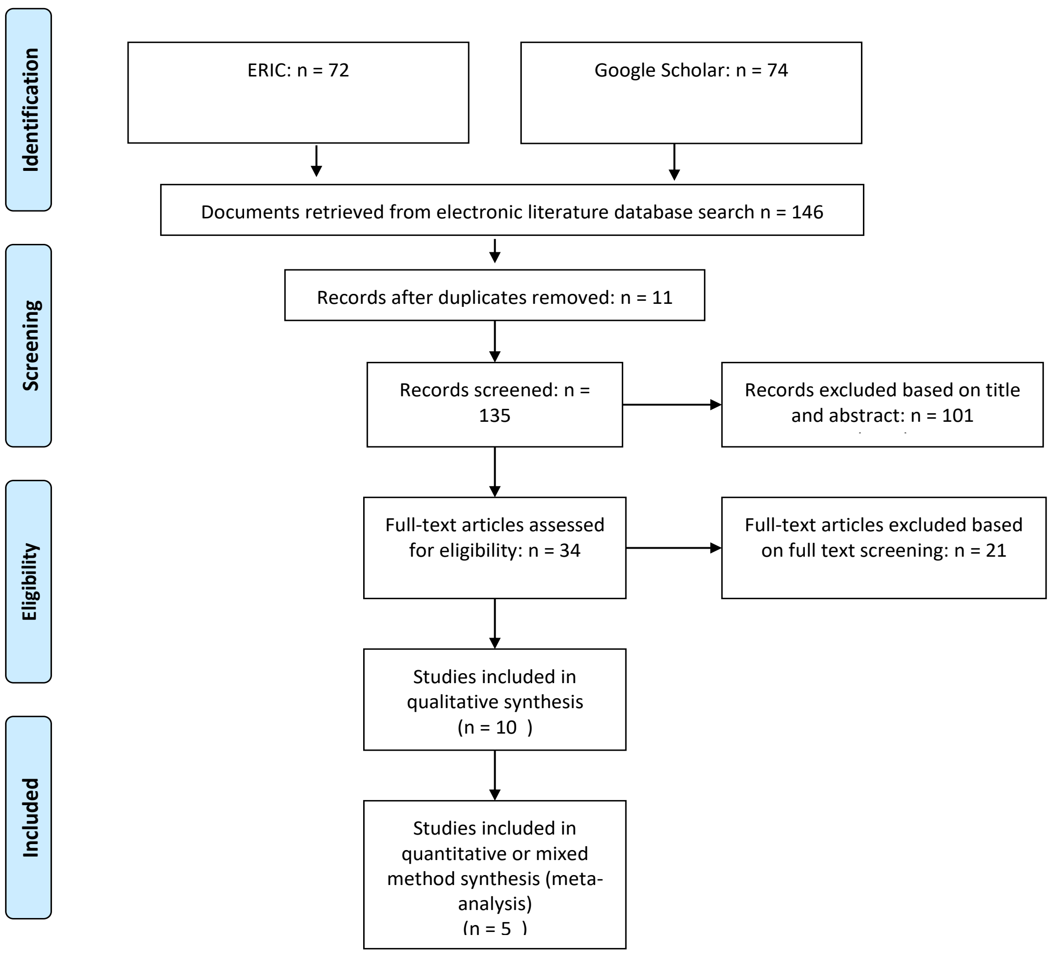

Figure 1: Overview of the search conducted based on PRISMA statement (Stewart, L. A. and Group, 2009)

A search strategy was followed to find literature published in peer-reviewed journals and conference proceedings. The systematic search was based on the databases ERIC and Google Scholar. ERIC was chosen because it is a database that includes several scholarly publications from a wide range of academic publishers within the field of educational research. Google Scholar was used to supplement the research not available in ERIC.

Keyword descriptors for publications on podcasts and podcasting in higher education included the following groups of search terms and truncations: (a) Podcasting; (b) Podcast* AND Teaching Method; (c) Educational Technology AND Podcasting; (d) podcast in education literature review (Google Scholar); (e) Podcast* and Reflection* and Higher education*; (f) Podcast* and literature review* and Higher education*. Search terms within each group were combined by means of a Boolean AND, depending on the options of the two databases used in this study. Articles considered relevant were retrieved for full-text review and were reviewed for inclusion using the pre-established selection criteria. Studies were restricted to the English language. The search ranged from 2015 to 2021.

4. Results

No.	Study	Learning setting, context & participants	Study design & methods	Study purpose
1	(Martins et al, 2020)	Podcast aggregator, Financial statements. N = 26; Financial statement structure. N = 45	Qualitative single case study	Behavioural factors enabling students' acceptance and use of podcast aggregator
2	(Teckchandani and Obstfeld, 2016)	Pedagogical merits of one podcast. N = not specified	Qualitative case study over two year	The potential of using a specific podcast in the classroom
3	(Hassell et al, 2018)	Electronic lectures vs traditional lectures. N = 164	Quantitative study	Comparing the use of podcasts against traditional lectures
4	(Middleton, 2016)	Using podcast as a learning tool. N = 13	Qualitative module – a case study	Using a podcast as a learning space
5	(Gachago et al, 2016)	Use of podcast as a didactic tool. N = 696, n = 434	Quantitative study	Can podcast be a socially inclusive technology?
6	(Norsworthy and Herndon, 2020)	Podcast as a pedagogical experience. N = not specified	Case study	Student-produced podcast as an educational tool
7	(Gonulal, 2020)	Using podcast as a learning tool. N = 49	Action research design	To increase students' listening skills
8	(Almeida-Aguiar and Carvalho, 2016)	Using podcast as information. N = 30	Quantitative study	Podcast as a pedagogical
9	(Kõnig, 2020)	Use of podcast as a didactic tool. N=163	Quantitative study	Teacher's enthusiasm is linked to positive outcomes
10	(Andersen et al, 2018)	Podcast as a learning tool. N = 53	Mixed method	How students integrate teacher-generated podcast content in the lecture
11	(Ferrer et al, 2019)	Student-led podcasting. N = 19	Qualitative – a case study	Podcast creation generating student reflection
12	(Ballinas-Gonzalez et al, 2020)	Using podcast as a pedagogical tool. N = not specified	Case study	Development of soft skills in engineering students
13	(Riddell et al, 2020)	Podcast for education. N = 16	Qualitative – a case study	How students integrate podcast into their learning experiences

No.	Study	Learning setting, context & participants	Study design & methods	Study purpose
14	(Andersen and Dau, 2020)	Podcast as a reflection tool. N = 38	Mixed method	How students can reflect based on a podcast
15	(Hatfield, 2017)	Using podcasts to stimulate narrative learning. N = not specified	Observation	How podcasts can be a tool for narrative learning

4.1 What are the main benefits of podcasts in higher education?

Below we summarise the main benefits of using podcasting in higher education. Founded on a textual data analysis, the research papers were studied to determine types of persistent benefits. An inductive process of identifying analytical types as they emerged was inspired by elements in grounded theory (Glaser and Strauss, 2017) because we wanted an open analysis based on the available research. Benefits were found through identifying and indexing.

During this process, benefits could be categorised into two categories, namely (1) learning benefits related to educational content, knowledge and skills and (2) reflective benefits related to the students' ability to reflect based on a podcast.

4.2 Learning benefits

A key element when using podcasts as a learning medium is to gain learning benefits. Can podcasting and the use of podcasts increase the student's ability to access the course content? According to students, podcasts with summaries are the most useful (Almeida-Aguiar and Carvalho, 2016). According to Almeida-Aguiar and Carvalho (2016), 90 % of students find that the integration of podcasts gives them a learning advantage. Also, by listening to podcasts, students can make significant progress in their overall listening skills (Gonulal, 2020). In addition, studies have also suggested that students improve their knowledge of words and phrases by using podcasts (Gonulal, 2020). Another learning benefit is that the students can use podcasts for revision of the content during the semester (Gachago et al, 2016). For instance, this study found that podcasts could lead to deeper learning because the students involve themselves in the learning process while listening to podcasts, by taking notes, for example (Gachago et al, 2016). Moreover, it was revealed that it supported students' engagement and cognitive strategies, which stimulated students' self-regulation skills during their studies (Gachago et al, 2016). Another study stressed that podcasts in higher education have the potential to provide language and context to the students and give the students a vocabulary they can use during classes (Riddell et al, 2020). This was supported by Martins et al (2020), who found that podcasts contribute to expanding students' vocabulary. Hatfield (2017) underlined that students can remember examples from the podcast for much longer than they can remember a simple vocabulary term. Furthermore, a podcast allows the students to listen while doing other activities and thereby draws their attention to their learning because as one study suggests, listening to podcasts requires less mental energy than more traditional learning formats, such as textbooks (Riddell et al, 2020). In accordance, other studies find that listening to podcasts gives the students a feeling of being well prepared and makes the students look forward to learning more about a certain topic (Andersen, 2018). From a study on social work applying a learning perspective, Ferrer et al (2019) found that students generated a deeper understanding of critical social work theory and that podcasting contributes to the existing literature.

4.3 Reflective benefits

Next to learning benefits, reflective skills can emerge and be developed. However, the question is whether podcasts and podcasting give the students the ability to reflect in higher education. Reflective benefits have been addressed in a recent Danish study (Andersen and Dau, 2020). This study suggests that podcasts can help students to overcome their current state of mind and that students gain a language about a certain topic, which is important for their ability to reflect. These results are similar to those reported by Almeida-Aguiar and Carvalho (2016), who argue that podcasts containing extra content provide students with ways to discuss subjects in the class. In addition, the results indicate that podcasting can minimise doubt and help students to reduce mental disturbances (Andersen and Dau, 2020).

Furthermore, Ferrer et al (2019) found that using student-created podcasts can help students relate to their upcoming field of practice and not just be grade-oriented. Students reported how the process of podcasting created a shift in their thinking about their field of practice (Ferrer et al, 2019). Additionally, Middleton (2016) found that podcasts can accumulate new types of learning, develop and relocate existing activities and assist in the review of class activity. Also, Teckchandani and Obstfeld (2016) found that podcasts inspire students to think more deeply about their topic, and thereby they achieve another layer of reflection on a specific topic. These findings are like those reported by Andersen (2018), which revealed that most students could make a direct transfer to their field of practice and that teacher-generated podcasts gave them new insights and thus gave the students the capacity to reflect. Similarly, Norsworthy and Herndon (2020) found that podcasts can be a transformative tool in leadership education. In the same way, Ballinas-Gonzalez et al (2020) concluded that a podcast is a powerful reflective tool for the development of engineering students' communication skills. Hatfield (2017) found that a narrative podcast combined with a traditional classroom lecture supports students and their confidence. Furthermore, narrative podcasts are construed as less omniscient than a traditional fact-based lecture because they involve both fact-based instruction and narrative examples (Hatfield, 2017).

Podcasts, being a flexible learning medium, make it possible to uncover school content in different ways, which allows the students to organise their personal schedules (Martins et al, 2020). In addition, students can engage by listening to a podcast, and the flexibility provides them with the opportunity to interact with the content on demand (Gachago et al, 2016).

4.4 What are the main challenges to using podcasts in higher education?

Apart from the above-mentioned benefits, podcasts as a learning medium also have some challenges. The challenges can be categorised into two groups, namely (1) practical: relating to the practicalities it requires to use podcasts and podcasting, and (2) learning outcomes: related to the lack of learning and student activity.

4.5 Practical challenges

It is stated that the podcast medium can be a time-consuming task when used in higher education (Almeida-Aguiar and Carvalho, 2016). Likewise, teacher-generated podcasts can be a time-consuming task due to manuscripts and technicalities, like recording and production of the podcast (Andersen, 2018). In terms of collecting narrative podcasts, Hatfield (2017) similarly stresses that it can be a time-consuming task for the educator. Furthermore, König (2020) has highlighted the importance of speaking enthusiastically when making teacher-generated podcasts. König (2020) stresses that participants who listened to an enthusiastic version of a podcast enjoyed it and experienced higher motivation to learn more about the topic. Accordingly, creating podcasts with the right enthusiastic approach, which according to König (2020) is important to get a satisfying learning outcome, can be a challenge. Other technical challenges are stated by Teckchandani and Obstfeld (2016), who found that podcasts' lack of a transcript is a challenge for the students when preparing them. Furthermore, sound is a key element in the making of teacher-generated podcasts; lack of sound quality can have a negative effect on student motivation (Andersen, 2018). Also, Teckchandani and Obstfeld (2016) highlighted that students may not see the relevance of podcasts to their learning outcome. In the same vein, Andersen and Dau (2020) found that one third of the participants had not listened to podcasts before and that 50% of the informants did not have any expectations of the podcast. Together, these two studies indicate that students might not value podcasts differently than ordinary literature. Another practical challenge was highlighted by Teckchandani and Obstfeld (2016), who noted that students question the content of the podcast.

4.6 Learning challenges

With the use of podcasts and podcasting, educators aim to gain learning benefits, which are noted above. However, there are learning challenges connected to the use of podcasts in higher education. Studies have revealed that some students merely listened to podcasts as a review for the exam (28%) and that they did not listen to the podcast given to them during the semester (Gachago et al, 2016). The fact that podcasts are a relatively new technology in an educational context can influence the students' learning benefits. Findings report that only half of the students listening to teacher-generated podcasts improved their understanding of a certain topic (Andersen, 2018). It is thus argued that podcasts can result in passive learning and that students do not necessarily benefit from listening to podcasts. For instance, Hassell et al (2018) found that there is no obvious effect on academic performance and that electronic lectures have a negative impact on the students' attendance. Accordingly, Gachago et al (2016) found that 22% of students were listening to recordings without engaging in study-related activities.

4.7 How are podcasts and podcasting used as a pedagogical tool in higher education?

During the process of highlighting benefits and challenges in the use of podcasts and podcasting, two categories have been found, namely (1) designs for learning outcomes and (2) designs for reflective outcomes. In terms of learning and reflection outcomes, the authors stress that some of the reviewed articles focus on learning as knowledge acquisition and creation concerning a certain topic and other articles focus on the students' development of reflection.

4.8 Designs for learning outcomes

Data from several studies suggest that podcasts can create learning outcomes. Gonulal (2020) described how listening skills can be enhanced by extensive listening practice. The use of podcasts showed that the students developed their listening skills outside the classroom and thereby used podcasts to extend their learning (Gonulal, 2020). Other studies aimed to provide tips about the content learned in the classroom through podcasts and then to investigate the impact on the students' knowledge (Martins et al, 2020). These studies are similar to those reported by Andersen (2018), who investigated the impact of teacher-generated podcasts and their effect on the students' ability to obtain communication theory in the classroom. Furthermore, Gachago et al (2016) revealed how podcasts can be used successfully by simply recording lectures or providing summaries of lectures. Additionally, some studies have sought to motivate students to use an educational podcast to get a stronger learning experience (Riddell et al, 2020). There are thus several similarities between Riddell et al's (2020) and Middleton's (2016) studies investigating the use of podcasts for flipped classroom activities and assignments by class recordings posted immediately on the module's blackboard site during class or shortly after. Furthermore, Teckchandani and Obstfeld (2016) used podcasts as homework assignments to illustrate course concepts and facilitate discussions in the classroom for undergraduate entrepreneurship and organisational behaviour classes.

4.9 Designs for reflective outcomes

Concerning designs for reflective outcomes, podcasts can be used in classes where the students write down their reflections on the podcast and discuss these reflections in class, exploring the podcast's content more deeply (Teckchandani and Obstfeld, 2016). There are some similarities between Teckchandani and Obstfeld's (2016), Hatfield's (2017) and Andersen and Dau's (2020) findings on didactical designs and their aims to increase the students' ability to reflect. These three studies used narrative podcasts as homework relevant to a specific topic, and it was found that the content from the podcast can stimulate students' reflective skills. These applications of podcasts are in accordance with those reported by Almeida-Aguiar and Carvalho (2016), who also provided students with an informative podcast before attending class. A teacher-generated podcast was found to have a significant influence on the students' reflective skills, as demonstrated by Andersen et al (2018), who reported that the students used the theory presented in the teacher-generated podcast to reflect on their field of practice and used the content from the podcast to discuss in-class activities.

Another design for reflective outcomes using podcasts as a learning medium is by having the students participate in the creation of the podcasts. For instance, Ballinas-Gonzalez et al (2020) aimed to develop engineering students' communications skills by participating in a podcast. The podcast consisted of talking to engineering students about engineering topics and thereby allowing them to develop their communication skills (Ballinas-Gonzalez et al, 2020). In the same way, Ferrer et al (2019) used a student-led podcast to understand and apply critical reflexivity and new perspectives in their social work. In this case study, the students created a podcast based on interviews with relevant stakeholders and the podcast was officially launched. Throughout this case study, podcasts became the central learning medium for transformative learning (Ferrer et al, 2019). Likewise, student-led podcasting is the at centre of a contemporary study (Norsworthy and Herndon, 2020) in which students host a storytelling podcast, which is distributed to new students. This is an ongoing process that seeks experiential learning for those who produce the podcast and rich leadership content for those who listen to the podcast (Norsworthy and Herndon, 2020).

5. Findings

In this systematic review, we aimed to understand the use of podcasts and podcasting in higher education. The current review generated a total of 14 articles that describe the use of podcasts and podcasting. In the following, we elaborate and discuss our findings related to the three research questions.

The findings revealed that podcasts could produce direct learning benefits for students in higher education. The technology itself is rather simple and therefore easy to use and obtain. This allows educators to record and summarise lectures, thereby giving students review opportunities, which can lead to learning. The flexibility of a podcast means that students can be study-active during non-study activities, which also can lead to learning.

The findings suggest that podcasts and podcasting provide reflective benefits. The fact that students are presented with a language related to a certain topic gives students an extended opportunity to learn the language and interact in class discussions. Additionally, a student-led podcast can give the students a deeper understanding of their field of practice and thereby increase their reflective level.

The most obvious challenge in using podcasts and podcasting in higher education is that it is time-consuming. Findings reveal that lack of time can be a destructive factor both in finding the right podcast and in making one, equally for the students and the educators. Another challenge is the students' views on podcasts. Findings suggest that students do not necessarily value podcasts the same way as ordinary literature. Challenges are also found in terms of learning benefits. Students do not automatically use the podcast provided in the intended way. Thus, in some cases, students only use the podcast as a review of the content. Furthermore, findings showed that the podcast as a learning medium did not address all students' needs.

Findings in the literature review revealed two didactical designs for the use of podcasting in higher education, firstly based on designs for learning outcomes and secondly for reflective outcomes. In deliberating on the different approaches to the use of podcasts and podcasting, there is no significant result showing which approach is the most successful one. Both designs can have the intended impact on the students; however, the right design is needed to get the desired result. Findings illustrate that recordings used to review content can have a positive effect on the students' learning outcomes, but podcasts also have the potential to increase deeper learning and reflection, for instance by having the students create podcasts themselves.

6. Conclusion, limitations, and future work

Given that podcasts as a learning medium are relatively new, this study intended to integrate the best accessible evidence to provide an overview of the current research. This systematic review investigated the benefits, challenges and didactical design regarding the use of podcasts as a learning medium in higher education. It can be concluded that the current research reveals the potential podcast and podcasting. Regardless of the challenges, nearly all studies show positivity regarding the use of podcasts and how podcasts can provide learning outcomes, such as learning more deeply, increasing reflective skills and motivating the students involved. Despite some challenges the review has revealed that podcasts hold potential for the extension of classroom learning as student can bring the podcasts content to their professional placement and r increase in situ reflections on the go. Also, the affordance of repetition seems to increase students reflections and support their in-depth knowledge. Furthermore, the review has revealed that most of the current literature still concerns experimental case studies with a focus primarily on describing students' experiences. In addition, it is reasonable to argue that some case studies can be biased because the researchers mainly focus on the benefits of using podcasts. Limitation of this study are the sample size and the databases used. Though this research aimed to focus on papers published over the last 6 years to provide up-to-date knowledge of existing research and trends developing the topic, nevertheless, a systematic literature review with a broader database search is recommended. Future research should focus on more longitudinal studies in the field of podcasts as a learning medium, as these kinds of studies seem to be absent from the existing research. Also, a broader discussion on the epistemological basis behind podcasts from a learning-theory perspective is needed to get a better understanding of the use of podcasts as a learning medium in higher education.

References

Almeida-Aguiar, C. and Carvalho, A. A. (2016) "Exploring Podcasting in Heredity and Evolution Teaching", Biochemistry and Molecular Biology Education, Vol. 26 No. 3, pp 429–432.

Andersen, R.H. and Dau, S. (2020) "The Potential of Podcasts as a Learning Medium in Higher Education", 19th European Conference on e-Learning ECEL 2020, 28 /10, pp 16–22.
Andersen, R.H., Dau.S., S. Nielsen. (2018) "Podcast as a Learning Media in Higher Education", The 17th European Conference on e-Learning, 1/11, pp 424–430.
Ballinas-Gonzalez, R., Sanchez, B., Rodriguez-Paz, M.X. and Nolazco-Flores, J.A. (2020) "How the Use of an Internet Radio Program and Podcast Helped Civil Engineering Students Engage With Local Communities in Need", ASEE Virtual Annual Conference, 22 6.
Drew, C. (2017) "Edutaining Audio: An Exploration of Education Podcast Design Possibilities", Educational Media International, Vol. 15 April, pp 48–62.
Ferrer, I., Lorenzetti, L. and Shaw, J. (2019) "Podcasting for Social Justice: Exploring the Potential of Experiential and Transformative Teaching and Learning Through Social Work Podcasts", Social Work Education, Vol. 21, No. 10, pp 849–865. DOI: 10.1080/02615479.2019.1680619
Gachago, D., Livingston, C. and Ivala, E. (2016) "Podcasts: A Technology for All?", British Journal of Educational Technology, Vol. 47, No. 5, pp 859–872.
Glaser, B.G. and Strauss, A.L. (2017) Discovery of Grounded Theory: Strategies for Qualitative Research, Routledge, New York.
Gonulal, T. (2020) "Improving Listening Skills With Extensive Listening Using Podcasts and Vodcasts", International Journal of Contemporary Educational Research, Vol. 7, No. 1, pp 311–320.
Hassell, D.G., Hewakandamby, B. and Yueh, L.K. (2018) "Electronic Lecture versus Traditional Lecture: Implications on Students' Learning", International Journal of Computer-Assisted Language Learning and Teaching, Vol. 8, No. 4, Article 5 pp 65–75.
Hatfield, E.F. (2017) "Narrative Learning Using Podcasts in Interpersonal Communication", Communication Teacher, 9 October, pp 236–242.
Jarvis, C., & Dickie, J. (2010). Podcasts in support of experiential field learning. Journal of Geography in Higher Education, 34(2), 173-186.
Kõnig, L. (2020) "Podcasts in Higher Education: Teacher Enthusiasm Increases Students' Excitement, Interest, Enjoyment, and Learning Motivation", Educational Studies. DOI: 10.1080/03055698.2019.1706040.
Martins, A.S.R., Gomes, D.d.G. and Quintana, A.C. (2020) "Factors Enabling the Acceptance and Use of a Podcast Aggreator in Accounting Education", Education and Information Technologies, Vol. 26, No. 5, pp 5427–5449.
McGarr, O. (2009) "A Review of Podcasting in Higher Education: Its Influence on the Traditional Lecture", Australasian Journal of Educational Technology, Vol. 25 March, pp 309–321.
McNamara, S. and Drew, C. (2019) "Concept Analysis of the Theories Used To Develop Educational Podcasts", Educational Media International, Vol. 19, October, pp 300–312.
Middleton, A. (2016) "Reconsidering the Role of Recorded Audio as a Rich, Flexible and Engaging Learning Space", Research in Learning Technology, Vol. 24, No. 5, pp 1–13.
Norsworthy, C. and Herndon, K. (2020) "Leading by Ear: Podcasting as an Educational Leadership Tool", Journal of Leadership Education, Vol. 19, No. 3, p 7.
Palenque, S. M. (2016) "The Power of Podcasting: Perspectives on Pedagogy", Journal of Instructional Research, Vol. 5, pp 4–7.
Riddell, J. et al. (2020) "Independent and Interwoven: A Qualitative Exploration of Residents' Experiences With Educational Podcasts", Academic Medicine, Vol. 95, No.1, pp 89–96.
Stewart, L. A. and Group (2009) "PRISMA", [online] http://www.prisma-statement.org/documents/PRISMA%20IPD%20Flow%20Diagram.pdf [Senest hentet eller vist den 5 4 2021].
Tassy, A.a.N.M.B. (2020) It-anvendelse i befolkningen, København: Danmarks Statistik.
Teckchandani, A. and Obstfeld, D. (2016) "Storytelling at Its Best: Using the StartUp Podcast in the Classroom", Management Teaching Review, Vol. 2, No. 1, pp 26–34.
Ziengs, E. (2021) "Podcaststats.dk", [online] https://www.podcaststats.dk/ [Senest hentet eller vist den 15 4 2021].

Going Online: Student Perspectives in a Problem-Based Learning Environment During the Pandemic

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DOI: 10.34190/EEL.21.031

Abstract: The purpose of this article is to present the key findings from a survey performed across the faculties at Aalborg University (AAU) on students' transition to online education, during the Danish quarantine in spring 2020. We highlight important takeaways that are deemed relevant to the ongoing digital transition process at AAU and the evaluation thereof, discuss students' experiences in the locally anchored settings and compare findings in a broader context. For our analysis, we utilize NLP transformers and topic modelling to present an overview of themes discussed by the students. Further, we perform bibliometric analyses to gain insights on similar studies published during COVID-19. The study highlights central themes, challenges, and opportunities from a student perspective, and evaluates these within the scope of the PBL model. The study highlights the complex structure of student bodies, showing diverse preferences and effects of moving education online. Social aspects of learning suffered for most, posing challenges for both teaching and group work. Students generally reported positively on the use of recorded lectures, providing opportunities for future blended/flipped learning environments. We discuss the implications for creating hybrid/blended approaches that integrate online and physical learning spaces.

Keywords: PBL, social learning, blended/hybrid learning, higher education, topic modelling

1. Introduction

The survey analysis presented here is part of a larger, longitudinal data collection process among the students and faculty at Aalborg University and Aalborg University Business School carried out by the authors. The goal of this project is to harvest student experiences at various stages through the digital transformation to map the process and delimit crucial features that can inform future learning designs. The survey relates to the students' transition from physical onsite teaching, most common prior to the outbreak of Covid-19, to digital teaching enforced during the quarantine. The survey works to illuminate the students' experiences, as well as their considerations if the situation continues. As with most institutions of higher education (and through society in general), the transition to online teaching was abrupt, chaotic, and without much strategic foundation. Our findings should be interpreted in this light.

At AAU, all degree programmes use problem-based learning (PBL), as the foundational pedagogical model. In most cases, this takes the form of project-based PBL carried out by groups of up to 8 students. Each project takes a semester, usually comprising half of the workload of the semester. Consequently, longer-term group dynamics and collaborative are central to learning (Askehave *et al.*, 2015)

1.1 Data

More than 2000 responses were collected across five semesters and five faculties at AAU and AAU Business School. The distinction across the five semesters relate to where the students were engaged in spring 2020, hence, second (30,1%), fourth (24,3%), sixth (20%), and eighth (23,7%) semester are represented, along with a category for people not attending AAU faculties in the spring (1,9%). The faculties represented in this survey round are Engineering & Natural Sciences (29,1%), Social Sciences (25,2%), IT and Design (20,1%), Humanities (18,3), and Health & Medical Sciences (7,2%). Overall, the distribution of students across faculty and semesters are presented as such:

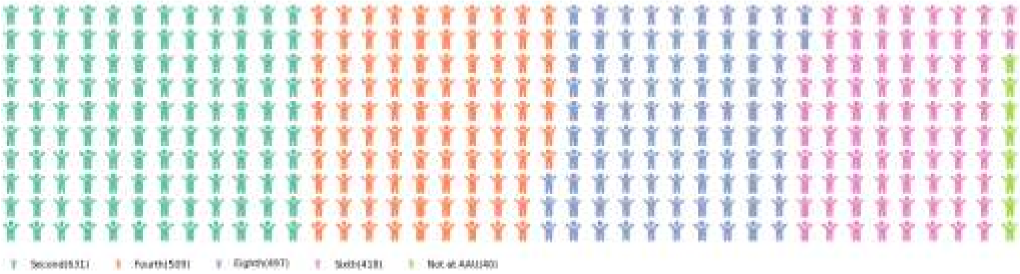

Figure 1: Distribution of respondents across semesters

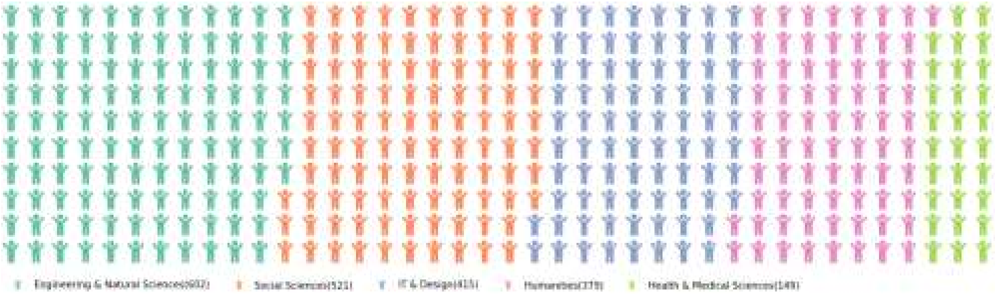

Figure 2: Distribution of respondents across faculties

The survey was developed to encapsulate the students' experiences with moving their education online during the initial lockdown of 2020, and to highlight central aspects of the use of technology in this setting, including the use of PBL methods when moving the education online. The survey had three distinct modes of questioning, Likert-scale, multiple choice, and open-ended questions, where students could elaborate or respond freely. While some aspects of Likert- and MC-responses will be referenced, we focus on the qualitative responses in this article. Because of the considerable number of responses, we have applied Natural Language Processing and Topic Modelling to evaluate the students' comments. Through this, we were able to quantify the contents, and highlight central themes discussed by the students. Furthermore, we used these findings to evaluate thematic responses, providing a thorough analysis of the most central themes.

1.2 Method

The survey sent out to the students included two questions that demanded qualitative response:

> *"*Have you made any considerations as to what you will do, if the situation (Covid-19) continues*", and*
>
> *"*If you have any further considerations about online teaching in the future, you can write them here*".*

These questions were framed quite broadly, and we therefore used further data analyses to identity recurring themes that could give us a first, broad overview of how students perceived the transition to online teaching. Because we were interested in their reflections on the subjects, short responses (e.g. "it was good"/"it was bad"/"I have nothing to add", etc.) were removed. After cleaning and pooling the text data, 2.252 responses were used in our data analysis. We used quantitative topic modelling in order to identify recurring themes in the qualitative responses and to determine how (and how closely) these themes were related. The text analysis determines a metric on words, given a corpus of text and occurrences and co-occurrences of word, which can be used to cluster related topics and to describe the distance between clusters (Grootendorst, 2020). The topic model can be developed to provide a visualization, based on dimensionality reduction, which show emergent themes and their intertopic distance. This generates insights into the relationship between topics, and to differences or similarities in the provided texts. We have used the BERT (BERTopic) analysis proposed by (Grootendorst, 2020). It enables the user to apply pre-trained BERT and transformer embeddings for topic visualization of the responses. Pre-trained models have previously been shown to give superior outcomes in Natural Language Processing. Though it should be noted that transformer models in topic modeling are an emergent niche, the approach yielded the best results among the topic analyses of our data. The transformer model that we used is Facebook AI's RoBERTa (Liu *et al.*, 2019). It is trained on a vastly larger collection of textual data (160gb) than the original BERT (16gb) and has proved to yield optimized results compared to other state-of-the-art transformers, as was also the case through testing in this analysis (ibid.). With this kind of topic modeling, it is important to note that sentences (or responses) are not locked to a specific topic. As such, a response can touch on several topics, or even none, depending on the framing of the model (Grootendorst, 2020).

2. Analysis

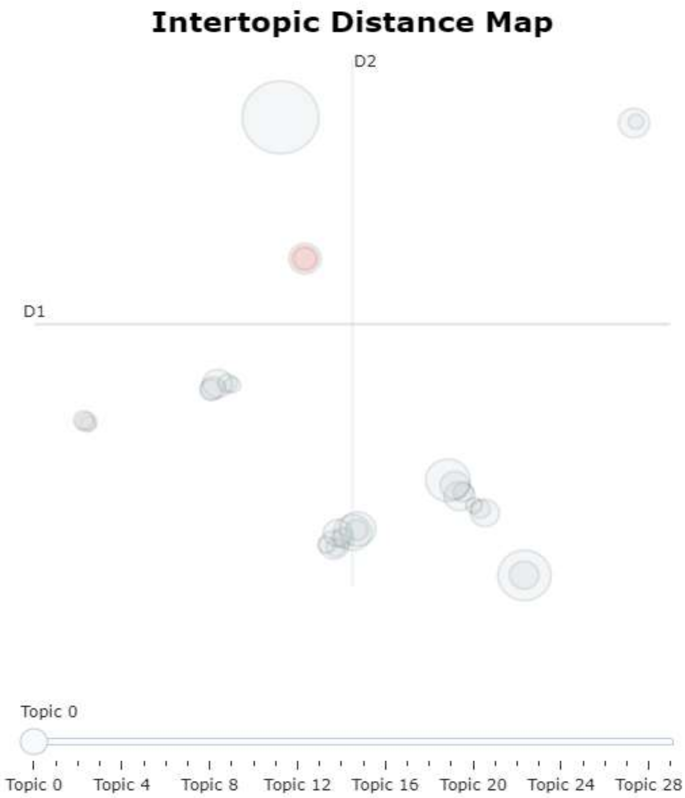

Figure 3: A distance map of the topics identified in our data analysis

The topic model showed several themes emerging from the corpus of text, with subjects spread across 29 topics within eight distinct clusters. Not surprisingly, some of the most central themes relate directly to online teaching, with a clear focus on teacher and student aspects of the transition. Motivation also emerges as a central talking point among the students, supporting findings from the Likert scale questions, where many students reported that they struggled with motivation. The transition period had a noticeable effect on the study environment, but it is not conclusively bad, according to the students. While there are more than a few instances of students reporting degradation of education quality and motivation, the output of the topic model indicates that many respondents thought online education worked well and see considerable potential in it. Further, the students seem concerned with the study environment, where a coalition of topics in the model are centered on workspace vs. home environment. There is also a decent indication that this is often where students face difficulties, as derived by the intertopic distance in the model visualization. Lastly, there is some indication from the topic model that students find that online education can help ease and facilitate group work. The positive attitude concerning group work in online settings seems strongly correlated with pre-recorded lectures, where students can rewind and revisit key information points during online social learning.

2.1 Highlighting central findings

In this section, the central themes presented through the topic model will be scrutinized by examining the qualitative responses for each of these. This will provide deeper insights into how students related to the most central aspects points and show that attitudes are quite polarized.

2.1.1 Social interaction

Plenty of students offer their perspective on how the experience of going online affected student/teacher interaction. Investigating this theme, showed some polarization across respondents. There are students on both ends of the spectrum in terms of enthusiasm for teaching in the online space. Some are positive, and some are much less so. Considering more nuanced perspectives on the subject, there is an emergent consensus on online learning as positive, but with considerable limitations in its current form. A student wrote

> *"In relation to online teaching I think there is a difference in what format the teaching has in relation to how successful I think online teaching is. For lectures (where it is usually primarily one-way communication for us) I think online works fine. For seminar classes etc. some work must be done to find some good solutions in terms of active participation as a student if it is to take place online. "*

Many students, including the one quoted above, express that in lectures and other situations where the communication is mostly one-way, online learning can be perfectly adequate, but highlights the complications when learning becomes active and social. More specifically, the students report exclusively that the social interaction between students has deteriorated during the transition to online learning, in all settings of the education. To most students, the current model of online education has proved valid for parts of the teaching, and many see positive opportunities for learning in an online setting, but it is pivotal that the technology and infrastructure keep being invented and re-imagined while sustaining the fundamental goals of learning.

> *"I hope that the interaction between students and teachers will always be reinvented in a way that remains present and qualitative in the education period."*

As one student states, educational institutions are faced with an ever-present challenge of responding to changing societal demands while fulfilling the need to live up the highest possible standards of teaching. For AAU, and other educational institutions with a strong focus on social learning, this indicates that there are still barriers to overcome, for online learning to become fully functional and optimal.

2.1.2 Study environment

Online education, as studied through this case, must be seen in the light of Covid-19 and the widespread consequences thereof. The transition to full online teaching over the course of a weekend, as was the case for AAU, was not planned, but imposed out of necessity. The Danish society went under a lockdown that forced a large part of its citizens to move their work, study, and other activities into their own homes. The students report a plethora of consequences of having to stay home, with both positive and negative connotations. One of the central themes concerning the study environment is the need to restructure to conform to the new reality, and to stay motivated through the change of environment.

> *"You lose the dialogue with the rest of the students very quickly. It can be difficult to sit as concentrated at home where you are not sitting in a definite study environment."*

In congruence with the deterioration of social interaction in the current online learning model, the lack of mobility due to lockdowns is another mitigating factor in the students struggling. The students, who report negative experiences, often relate it to their lack of social connections and inability to interact, whereas students, who are more positive, often report solutions they have made to overcome the restrictions.

> *"We have generally started to use the online options more! We have kept a few statuses of homework online where we also sometimes meet a few minutes if there is doubt about a task. As well as in the project in connection with interviews etc. it saves all parties a lot of time and most have learned to use those technologies."*

Key to managing these situations, has been for students engaging in creating study environments to suit their style of learning, and/or develop study groups for social learning, be they online or physical. It should be noted that there are distinct variations in how the population of students have responded to the online transition, also in the case of having to stay at home.

> *"I think it's a really nice opportunity for a student like me who needs children, family, and jobs come together. And I save the time on the drive which I can spend on reading the syllabus instead."*

Furthermore, saving transportation time and effort offers the advantage of flexible planning.

> *"(…) It is a good initiative. It seems impeccable and makes everyday life more flexible, as you avoid public transport and save transport time to and from the university. I would like, even when the pandemic has subsided, that online education was incorporated, as it helps students optimize everyday life."*

There are students who have thrived in the landscape of the lockdown, giving them more freedom to structure their own day. This is particularly the case for students who have families, work, or are engaged in other activities not related to their studies. These students perceive the transition as largely positive.

2.1.3 Recorded lectures

One of the consistently positive features of online learning, as perceived by the students, is the use of recorded lectures. Not all teaching is suitable for recorded lectures, but its utility has shown that online learning can be an enhancement of the current structure of teaching.

> *"It [recorded lectures] is a good remedy which has advantages the 'ordinary' physical attendance teaching does not have. For example that there is an opportunity to reflect and work in other ways. Likewise, there are also disadvantages such as not being in social contexts, which is also part of learning. Therefore, I see it as one of many teaching tools that must stand together with others and thus not alone."*

At the core, recorded lectures offer the ability to explore and re-visit academic content at one's own leisure, which to most students is experienced as a major advantage.

> *"What has worked best for me has been recorded lessons. Being able to pause and revisit things significantly increases my understanding of the subject!"*

Transitioning from physical to online education has clearly been a complicate and is still ongoing process for everyone involved. All students have been forced to adapt their learning to the new reality. In this complex situation, where some struggle to keep up the motivation to study, while others thrive in the new setting that has arisen, educational institutions can obtain valuable insights as to how they can evolve when the restrictions of the pandemic will no longer set the agenda. In this study, recorded lectures have emerged as a consistently popular vote among the respondents. While most of the solutions applied to overcome enforced distance in the learning environment have been perceived as similar, or worse, than the teaching practice before the pandemic, recorded lectures emerge as an area where students find that they have benefitted from novel approaches. The utility of recorded lectures is often reported as especially beneficial for group and project work during lockdown, where the availability of recorded lectures enables students to revisit material as fuel for discussions, and to aid in understanding as they develop their projects in collaboration.

> *"I think all lectures should be recorded. There is no reason for the lecturer to say the same thing every year. Then you could see them from home and spend the time at uni to solve tasks physically with your group and get help physically from the teacher."*

On the other hand, the lockdown has had a negative impact on the communication between teachers/supervisors and the students. Physical lectures provided a natural opportunity for interaction, through discussion during lectures, or even by elaborations during breaks, where students can approach the educators less formally. For lectures and projects alike, teacher/student communication is still essential to the students' optimal learning opportunities. Recorded lectures cannot provide this aspect.

> *"A mixture of physical meeting and online teaching in the future could be a good mix. However, I do not think the physical should be removed completely as the social aspect and working in groups / group formation is made a lot more difficult. Teaching as lectures can easily be online."*

Recorded lectures provide flexibility and accessibility of information but is limited in its overall usability for teaching in higher learning institutions. While most students agree that it holds great potential, it can be perceived as a tool that can provide valuable benefits for both students and teachers, within the model of teaching applied.

2.2 Summary findings

Going through the students' responses on studying during Covid-19, and thoughts about the future of online teaching, there are interesting findings that highlight initial experiences with transitioning to learning online. The future is of course always uncertain, but there are many indications that even when the lockdown is over, many institutions of higher education will not fully revert to the model of education pre-Covid-19.

The study has highlighted the complex structure of the student body, and confirmed once again the statement that, *what works for one, may not work for another.* Through the qualitative comments, the students react very differently to the transition to online learning. Some thrive in the setting of distance learning, and the perceived freedom it gives to structuring one's own time. Specifically, the cut in transportation is a factor that benefits many. Those who suffered through the online transition, often cite the diminishing social aspect of learning as a key reason why they disliked online education. Both the communication between students and teachers, and social learning between students regressed, according to the survey responses.

It is the perception of many respondents that during the transition, students were mostly left to themselves concerning the social dimension of the education. Some students also struggled with work/life balance, challenged by isolation. Through the lockdown, faculties and school areas have been shut down, but students have been allowed to meet amongst themselves in smaller groups. The students who actively sought out other students and developed or continued study groups either physically or online, report less detrimental effects of going online, and more often show positivity for the prospects of online education. This points to the need to develop hybrid/blended learning models in the future, who allow individual students to design their own learning pathways in online, digitally supported learning environments. A central finding to the study is the almost exclusively positive feedback on recorded lectures. While it is clear from the student responses that recorded lectures should not replace all kinds of teaching, it is perceived to be one of the most valid additions to the education sphere, brought forward by the online transition. The ability to retrace and revisit key information and the ability to study at leisure is a highly valuable for the students' learning, and is observed to be beneficial to both self-study, group projects, and social learning.

3. Comparing findings

In this section, our findings will be compared to similar studies of student perceptions to online transition. The findings of this survey are local to Aalborg University and the students' perception of the transition to online education in spring 2020. Given the heavy focus on PBL and social learning, it is evident that the model of education took a hit at AAU during the lockdown, with current technological online solutions not fully accommodating the social aspects of learning, so vital to the AAU DNA (Askehave *et al.*, 2015). The digital transformation of higher learning is not unique to the AAU case, and while exacerbated by Covid-19, not a novel theoretical idea either. Similar transitions have taken place across the globe and have let researchers to evaluate and monitor online learning at a much larger scale than previously possible. Most of the key findings presented in this paper are also found in these other, similar studies (Abu Talib, Bettayeb and Omer, 2021).

Online learning has highlighted the psychological, social, and emotional perspectives of learning that have suffered through the transition (Almaiah, Al-Khasawneh and Althunibat, 2020; Baloran, 2020; Kee, 2020). Studies of student perceptions of online transition during COVID-19 draw attention to the need for more attention to mental health, and to the psychological effects of distance learning (ibid.). The sociality of the students, and the social aspects of learning have been challenged by the circumstances surrounding COVID-19, and universities have been forced to mix classical and novel approaches to teaching. Digital competency plays a large part in how universities, faculty, and students have experienced the switch from physical teaching to online, and existing digital infrastructure have been pivotal to the success of universities making the abrupt switch (Haslam, Madsen and Nielsen, 2020). From a university perspective, already having a digital infrastructure in place, helped enforce a sense of continuity, and helped ease the transition process, with students and faculty already being used to the technology utilized. Aalborg University reported a benefit from already having a strategy for digital transition in place before the outbreak of COVID-19, and it appears that universities that have already invested in digital infrastructure have been more successful in the transition to online learning (Favale *et al.*, 2020; Haslam, Madsen and Nielsen, 2020). Comparing studies also highlight the importance of socio-demographics for the ease of transition. Studies reporting issues in transition often expound the vast differences in student bodies, especially concerning digital competencies and technological availability. Students at Aalborg University are generally all digital natives, and have access to technology, software, and other factors enabling online learning. In Denmark, the access to smartphones or computers are almost ubiquitous. This is not the case globally, where the digital divide might be highly exclusive to parts of the student population.

Like the findings of the present study, among the various solutions to lockdown challenges to teaching and learning, utilizing recorded lectures emerged as a positive experience (Bartolo *et al.*, 2020; Pal and Patra, 2020). In some studies, recorded lectures have been used to overcome challenges of technological availability. With some students only having limited access to computers and/or internet, recorded lectures has emerged providing opportunity to implement flexibility to the students' schedules. Centrally, studies indicate that the social learning aspect usually present in physical lectures, cannot be transferred directly to the online format, and thus the models of teaching must adapt to the new circumstances. Pre-recorded lectures grant the opportunity present one-way information in a practical format, freeing up time for lectures to focus on discussion and peer-to-peer learning opportunities. Many studies indicate an invigoration of hybrid or blended learning models, whereby some of the teaching activities are moved to an online format, to not only solve the current challenges of lockdowns, but also to bolster future teaching approaches, to heighten learning opportunities with technology as a tool (Bartolo *et al.*, 2020; Pal and Patra, 2020)

4. Concluding remarks

It is apparent from both the findings of this paper and from kindred studies, that mental health aspect of higher education environments must be considered in the process of digitalization. For some students, motivation and mental wellbeing were heavily impacted by the transition to online learning, and the isolation of being in lockdown. While it is likely that the effects have been exacerbated by university and societal lockdowns, there are clear indications that pure online learning can be detrimental to some students' motivation and engagement. There is no doubt that the mental health and wellbeing of students is of utmost importance to universities, but these findings also underline the need for evaluation of responsibility among university administration and policy makers. Universities rest on a dual foundational rationale, namely education and research. While motivation and mental health are intrinsic to learning, universities alone cannot be held accountable for the psychological factors affecting students' engagement. While considering the benefits associated with online learning, it stands to reason that this must include issues of motivation, social engagement and mental health among students, which may be subject to a wider societal concern.

The digital transformation in education has been a perpetual process of adapting to novel innovations and technologies, following societal and global developments. The experience gained during the pandemic has helped highlight possibilities and pitfalls of the available technological applications, indicating some valuable approaches to online teaching in the wake of Covid-19 that call for a careful evaluation. Asynchronous information sharing or pre-recorded lectures have been well received by the students. Such digitally mediated one-way information was appreciated by students and could potentially free up more time for more focused student/teacher interactions and peer-to-peer learning. We would argue that online learning cannot fully replace traditional learning modalities, at least in its current form. For a university such as AAU, where PBL and social learning is central, a fully online learning environment does not provide the kind of social interactions needed for learning to thrive. Contrarily, the solutions deployed through lockdowns have shown the potential of digital and online applications to support physical learning environments, rather than replace them. Studies of this learning format, also known as blended/hybrid learning, have been around for more than twenty years, but novel research in this area can possibly be invigorated and reinforced by experiences made and solutions developed during Covid-19 lockdowns. Higher education institutions have perpetually adapted to remain valuable spaces for education and research but must also be careful not to adopt poor frameworks or applications that can be detrimental to their purpose. Thus, studies of blended/hybrid learning formats must work towards gaining a better understanding of how various technological or digital applications can be combined with physical learning environments, to develop optimal settings for teachers and students to thrive.

References

Abu Talib, M., Bettayeb, A. M. and Omer, R. I. (2021) 'Analytical study on the impact of technology in higher education during the age of COVID-19: Systematic literature review', *Education and Information Technologies*, (0123456789). doi: 10.1007/s10639-021-10507-1.

Almaiah, M. A., Al-Khasawneh, A. and Althunibat, A. (2020) 'Exploring the critical challenges and factors influencing the E-learning system usage during COVID-19 pandemic', *Education and Information Technologies*, 25(6), pp. 5261–5280. doi: 10.1007/s10639-020-10219-y.

Askehave, I. *et al.* (2015) *Problem-Based Learning*, *Aalborg University*.

Baloran, E. T. (2020) 'Knowledge, Attitudes, Anxiety, and Coping Strategies of Students during COVID-19 Pandemic', *Journal of Loss and Trauma*, 25(8), pp. 635–642. doi: 10.1080/15325024.2020.1769300.

Bartolo, N. S. *et al.* (2020) 'The shift from class-based to online learning during COVID-19: A student and academic perception', *PHARMACY EDUCATION*.

Favale, T. *et al.* (2020) 'Campus traffic and e-Learning during COVID-19 pandemic', *Computer Networks*.

Grootendorst, M. (2020) 'Topic Modeling with BERT', *Towards Data Science*. Available at: https://towardsdatascience.com/topic-modeling-with-bert-779f7db187e6.

Haslam, C. R., Madsen, S. and Nielsen, J. A. (2020) 'Crisis-driven digital transformation: Examining the online university triggered by COVID-19.', *Proceedings of ISPIM Conferences*, (November), pp. 1–12.

Kee, C. E. (2020) 'The impact of COVID-19: graduate students' emotional and psychological experiences', *Journal of Human Behavior in the Social Environment*. doi: 10.1080/10911359.2020.1855285.

Liu, Y. *et al.* (2019) 'RoBERTa: A robustly optimized BERT pretraining approach', *arXiv*, (1).

Pal, D. and Patra, S. (2020) 'University Students' Perception of Video-Based Learning in Times of COVID-19: A TAM/TTF Perspective', *International journal of human-computer interaction*.

Game-Based Learning for Cybersecurity Awareness Training Programmes in the Public Sector

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Abstract: This paper aims to identify an effective and sustainable learning experience by designing a users' experience model on the cybersecurity awareness for public sector using game-based learning. Efforts driven to build cybersecurity awareness to community is as important as strengthening the public sectors' (government) capacity in dealing with cybersecurity threats. Public sectors' capacity to use electronic systems should move in parallel with the awareness and ability to protect these. In most organizations, if not all, the topic of cybersecurity awareness is the initial touch point to educate employees on various fields. Learning from a cybersecurity awareness training can only be effective if done in a safe environment where repetitive failure is seen as input for learning optimization. A simulated environment for practice can facilitate the transfer of learned theories to practice. Reinforcing the learning content with innovative learning experience and digital technologies like (serious) games can make learning more effective and engaging. This study provides a survey of online serious games used in cybersecurity awareness and analysis of the motivational core drives used in the game mapped through the Octalysis framework. While the Octalysis gamification framework is widely used in the design of serious games, it is still rarely implemented to tackle cybersecurity challenges. This paper demonstrates the connection of cybersecurity awareness trainings to motivational factors and the help of a systematic approach, such as Octalysis framework, in comparing the various aspects of different awareness programmes. The paper also presents results from the key informant interviews from experts and implementors of cybersecurity awareness programmes, and serious games on key consideration to integrate the cybersecurity awareness initiatives and game-based learning to improve learning outcomes. The study gathers user journey experience from public sector to sustain their learning experience. Finally, the study presents a users' experience design which can optimize learning and sustain learning experience in cybersecurity awareness with game-based approach.

Keywords: cybersecurity awareness, game-based learning, serious games, Octalysis, simulations for e-learning, public sector capacity building

1. Introduction

The circumstance created by COVID-19 pandemic has heightened the urgency to shift operations and functions typically done on-site to on-line. The increasing dependence on digital systems continually raises the importance of effective cybersecurity training programmes with the special focus on the remotely accessible e-learning courses. In many organizations, cybersecurity awareness is the initial touch point to educate employees on various fields.

As the interactive learning materials tend to better engage the learners, then gamification and game-based learning is often used. However, simply adding a leaderboard to an existing training programme might not have the desired effect. The same could be said for making an online cybersecurity game to increase the cybersecurity awareness of the employees – a poorly implemented game can damage the motivation of learners instead of bolstering it.

Public sector is known for its slow-moving adoption specifically on innovative solutions from private sectors due to bureaucratic and political considerations (Yfantis & Tseles, 2017). Thus, public sector should modify mind-set to "entrepreneur" to improved productivity and quality of services (Kesti, et al., 2017). Professional competence forms part of the bigger and complicated mechanism-intent chain to achieve public value while ensuring end users' benefits, satisfaction, and added value to their needs (Barzelay, 2019). Increasing efficiency at workplace while enhancing human resource motivation is a constant challenge for organizations with expanded scope and reach (Iacono, et al., 2021). Apart from limited and mostly failing innovations in public sector, initiatives are citizen-centric and insignificant number for government to employees (Dawes & Cook, 2007) (Baležentis & Žemaitaitienė, 2013).

This paper aims to answer the following questions:

- How do online games for cybersecurity awareness position their core motivational drivers?

- How can game-based learning be integrated into cybersecurity awareness for the public sector?
- How can game-based learning improve learning and learning experience in the cybersecurity awareness training?

Desk research and interviews are used to answer those questions. Although the context of the interviews is mostly formed by the cases of public sector and non-profit organizations, the gained insights could also be used in other contexts.

2. Related work

2.1 Cybersecurity awareness training

Significant occurrences of cybersecurity attacks originate from inside the organization mostly due to the ignorance of users' and careless practices such as sharing passwords and opening unknown e-mails and attachments (Abawajy, 2014) (Bhardwaj, 2019). Changing landscape of cyberspace threats can be effectively aided by appropriate training (Kianpour, et al., 2019). Typically, these are the traditional and mainstreamed channels to "communicate cybersecurity requirements and appropriate conduct" (Bada, et al., 2015).

Training may contribute to the immediate increase in knowledge, but long-term outlook of the recipient does not always follow (Davinson & Sillence, 2010). Awareness and implementation of certain policies are known best solution to tackle cyberattacks (Bhardwaj, 2019). Success factor for a security awareness initiative lies in the "delivery methods" (Shaw, 2009). Awareness campaigns usually involve "lectures or presentations" imparting the emerging and recurring issues to students and employees (Coventry, et al., 2017). The design remains obscure depending on which perspective of the learning method, "presenter and time- conscious oriented" or "effective transfer of information"- recipient's point of view (Kianpour, et al., 2019).

Strategies to disseminate the cybersecurity awareness highly depend on the message, and resources available to come up with strategies such as "web-based, computer-based, teleconference, instructor-led, cybersecurity events, posters, social media, newsletter, knowledge café, and recognition or incentives program" (Nagarajan, et al., 2012). Bada, et al (2015), considered the form of the materials (interesting, current, and simple) as key for an effective awareness program. Learning details in implementing the cybersecurity awareness are repeatedly missed out which include users' absorption and retention capacity; stress levels affecting the decision-making during a cyber-attack; highly technical nature of the topic tends to be boring etc. (Cone, 2007) (Anneta, 2010).

Serious games as a type of experiential learning could be more effective and engaging than usual slide presentation and multimedia videos which go beyond entertainment (Bhardwaj, 2019) (Anastasiadis, et al., 2018).

2.2 Motivational factors

Human capital theory shows consequence of competence through time, it expires and depreciates (European Centre for the Development of Vocational Training, 2014). Adult learning covers the "formal and non-formal learning" after the initial education and competency training professionally (European Commission, 2013).

Adults learn best in an "interactive setting with focus on the practical application of knowledge" (Tweedell, 2000). Malcolm Holmes describes human beings having "innate tendencies of learning as people mature" (Collins, 2004). Accumulated "life experiences and knowledge" of adults are deemed to correlate to these stocks of knowledge and experiences (Lieb, 1991). Tweedell (2000) reiterates John Dewey's foundation of experiential learning, "the ability of individuals to flourish throughout life". Erik Erikson notes that adults seek meaning and purpose (Tweedell, 2000) (Lieb, 1991).

Motivational theories form the basis for a "life-span development" (Heckhausen, et al., 2010). Deep understanding allows transfer of knowledge and must be learned in a situation for it to be useable (Eyler, 2009). Erikson's psychosocial moratorium highlighted the creative tendencies of people when they feel no social drawbacks to making mistakes (Widick, et al., 1978). With the intervening responsibilities at work, family, or personal lives, adults are facing barriers in participating in learning.

Motivation plays a key role to enhance the learning experience of learners. Sources of motivation can be divided as follows: (1) social networks, (2) external outlooks, (3) social humanity, (4) personal development, (5) break from routine, and (6) cognitive curiosity (Lieb, 1991). The self-determination theory elaborates the role of competence, relatedness, and autonomy as key elements that motivate people to do a creative works beyond rewards and punishment (Deci & Ryan, 2012).

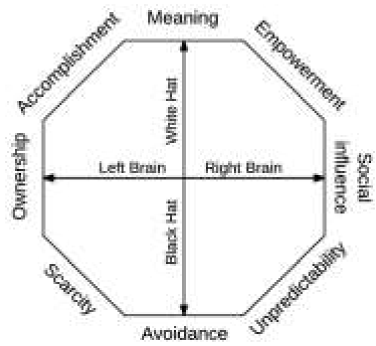

Figure 1: Yu-kai Chou's Octalysis Framework, Image Source: (Göschlberger & Bruck, 2017)

Yu-kai Chu (2015) divides the motivational factors into eight core drives (CD); Epic Meaning and Calling **(CD1),** Development and Accomplishment **(CD2)**, Empowerment of Creativity and Feedback **(CD3)**, Ownership and Possession **(CD4)**, Social Influence and Relatedness **(CD5)**, Scarcity and Impatience **(CD6)**, Unpredictability and Curiosity **(CD7)**, Loss and Avoidance **(CD8)**. Those categories form the Octalysis framework which can be interpreted as intrinsic and extrinsic, and black and white hat parts as shown in Figure 1.

2.3 Game-Based Learning

Game-based learning (GBL) relates to the "process and practice of learning by using games" (Laning, 2018). A known product of this learning method is called (*serious) games*. It is a type of experiential learning utilizing "entertainment and simulation" aspects as a process to present particular "learning objectives and incentivize the players" in the game (from decision making to solving a mission) (Crookall, 2010). This conforms to Erikson's explanation describing an environment of which mistakes are not mistake but encourages to try again and arrive to desired state (Widick, et al., 1978). GBL's potential as a learning technique or pedagogical benefits has gained a lot of attention from academe and industry (Compte, et al., 2015).

Yu-kai Chou (2014-2015) explained how games are human-focused designs. Humans are building blocks of "emotions, ambitious, insecurities, and justifications to start/continue/end doing things" (Chou, 2014-2015). Flow theory explains the role of motive, focus, goal, control, feedback, and transformation of time in the sense of enjoyment felt while doing a part on a preferred task and makes individuals hooked in activities (Csikszentmihalyi, et al., 2014). Games bring fun and consider as key motivation to learn because of enjoyment or categorized as "hard fun, easy fun, serious fun, and people fun" which allow the learners/ users to sustain the desire of continuing a task (Lazzaro, 2013).

GBL is being sought as a workable option among available delivery methods in raising awareness (Abawajy, 2014). "Games and simulations" gain traction as powerful teaching tools that may lead to an "instructional revolution" (Cone, 2007). An effective game design considers player experience with primary goal which "allows the player feel motivated" (Nagarajan, et al., 2012). Magic bullet model presents four (4) categories of learning in games; "things we can learn, we must learn, learning from a result of playing the game but not primary intention the game, learning beyond the game which are helpful in the game itself" (Becker, 2012). Serious games used for cybersecurity awareness are relatively new which limited to children, teenagers, and student and mainly focusing on the identified experts in the field (Hendrix, et al., 2016).

2.4 Octalysis Framework

Octalysis Framework is utilized to understand the context and core drivers of the existing digital game-based found online. This is used in various fields but limited in tackling cybersecurity awareness. It is formulated in creating a gamified experience/ gamification for non-game fields. While GBL and gamification are two different concepts, both share the use of game elements to improve the experience. Octalysis presents three (3) levels to optimize motivation. For this study, Levels 1 and 2 are used.

Figure 1 presents the eight (8) core drives of Octalysis Level 1 known to motivate a person (Chou, 2015). Yu-kai Chou identified positive motivations (White Hat) and not so positive ones (Black Hat). White Hat furthers an interest for the betterment of mankind or chosen community but without the sense of urgency. These motivations are the ideal state of a feel-good game. Topmost drives, Meaning, Accomplishment, Empowerment, Ownership (part), and Social Influence (part) are White Hat (Chou, 2015). Black Hat describes the drive of an individual to do things that are seemingly urgent and feel lack of control of one's behaviour. Scarcity, Avoidance, Unpredictability, Ownership(part), and Social Influence(part) can be found in the base of the framework. Black Hat does not signify necessarily negative motivators (Chou, 2015). This presents drives such us "uncertainty hype", competition (oneself and others), human instinct, adrenaline/hormone-rush, and sensation of pride when desired state is achieved. It might feel good at first but, if done frequently, might leave a "bad taste in your mouth" according to Chou (2015).

Chou (2015) described extrinsic motivations or the left side of the framework as goal-oriented "(goal, purpose, and reward)" while intrinsic or the right side of the Octalysis are motivations allowing you to enjoy doing a task (experience-oriented).

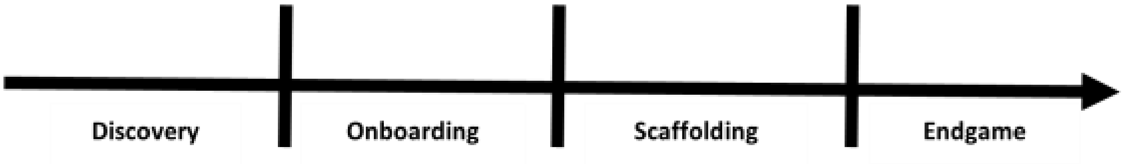

Figure 2: Yu-kai Chou's Octalysis Level 2

Octalysis level 2 describes users' journey (Chou, 2014-2015). **Discovery** pertains to the methods used to know about the system. It can be something you deliberately looked for, suggested by someone, or seen in various sites (e.g., social media). **Onboarding** involves learning the rules and ways to succeed in the goal of the game. The actual start of the journey is the **Scaffolding** which involves repetitive tasks in the journey to achieve a certain goal. **Endgame** aims to keep the participants engaged longer.

3. Methodology

The study undertook desk review of existing digital games to gain understanding of the motivational core drives and its strategic position in the game. An online search was conducted using keywords "cybersecurity awareness games", "cybersecurity games for adult", "cyber awareness games", and "cybersecurity games for public sector". The search was limited to free web-based, popular downloads, and captured by various studies run in Google Search, Google Play Store, Google Scholar, Scopus, and gaming sites (gamesspot.com and Steam). 6 games were identified and analysed based on the Octalysis levels 1 and 2 to understand core drives and learners' journey.

11 semi-structured key informant interviews (KII) were conducted using purposeful sampling. The same technique was employed to complete focus group discussion (FGD) with 4 participants. Snowball sampling was also utilized among participants of interviews and FGD. Transcripts were processed using NVivo software.

These methods provided micro and macro lenses on the motivational drivers on the cybersecurity games and users' perspective, and experts' valuable input in making GBL works for cybersecurity awareness.

4. Results and discussion

With the search parameters, 6 games were found, Targeted Attack (Trend Micro, 2016), CyberCIEGE (Naval Postgraduate School, n.d.), Cyber Land (Cybersecurity Challenge UK, n.d.), Keep the Tradition Texas (Texas A&M University, 2017), CDSE Cybersecurity Games (Defense Counterintelligence and Security Agency, n.d.), and Black Belt IT Security Training (Centrigade, n.d.). These were evaluated to assess the presence and positioning of the core drives using the Octalysis levels 1 and 2, respectively.

Participants of the KII were cybersecurity and awareness experts and implementers (Estonia 3, Singapore 1, and EU/European Commission 3), and game-based learning experts and implementers (Estonia 2 and international development organization 3). Through snowball sampling, FGD participants were identified (2 Management level, 1 Archivist, and 1 Business Analyst). Data sources were used to gain a better understanding from experts, implementers, and users' experience and perspective.

4.1 Online games and Octalysis core drives

Table 1: Mapping of Octalysis core drives to cybersecurity games

Games / Core Drives	Targeted Attack	Keep Tradition Secure	Cybersecurity Games- CDSE	Black Belt IT Security Training	CyberCIEGE	Cyber land
Epic Meaning	Objectives Story Challenges	-	-	-	-	Challenge
Accomplishment	Outcome	Progress Bar	Badges Sound	Badges/ Points	Progress	Badges/Points
Creativity and Feedback	Play Debriefing at the end of the game	-	-	Debriefing at the end of every task	Play	-
Ownership	-	-		Character	Resource accumulation	-
Social Influences	-	Challenges Story	-	-	-	-
Scarcity and Impatience	-	Rules	-	-	Rules	-
Unpredictability and Curiosity	Challenges Outcome	Challenge Outcome	Challenge	Challenge	Challenge	Challenge
Loss and Avoidance	-	-	-	Time	-	-

Table 1 summarizes core drives found in game elements while Figure 3 includes the mapping user's journey. Targeted attack, CyberCIEGE, and Cyber Land provide simulation and decision-making exercise on resource management and organizational functions. Black Belt, CDSE, and Keep Tradition Secure focus on the conceptual knowledge through practical exercises such as quizzes, identification or spotting mistakes.

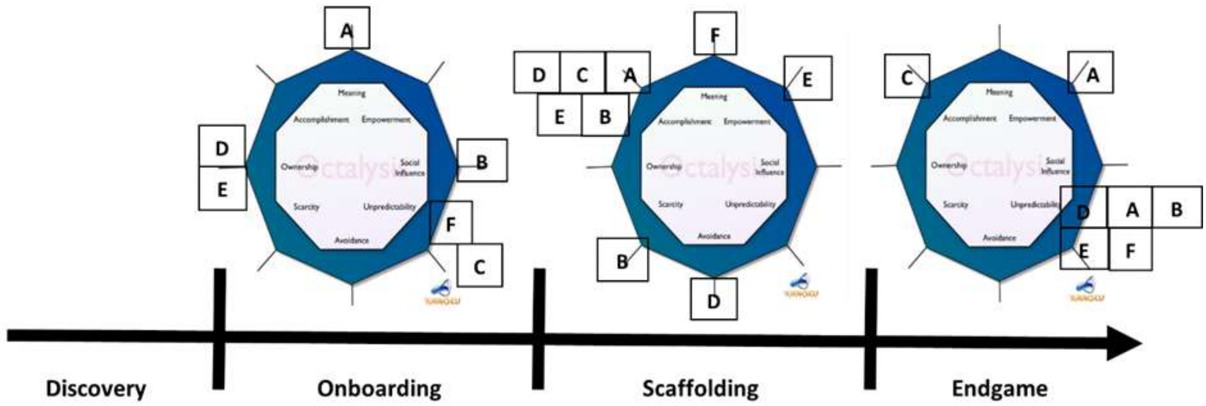

Figure 3: Core Drives in Users' Journey (Octalysis Level 2), where different games are marked as follows: A – Targeted Attack, B – Keep Tradition, C – Cybersecurity, D – Black Belt, E – CyberCIEGE, F – Cyber Land

Discovery is not applicable in this case as every game is purposively searched based on the parameters. Training programmes in public sector are mostly for compliance or mandatory tasks required. It creates a by-hook or by crook accomplishment because of the "otherwise clause" if not accomplished implies CD7/ black hat.

In onboarding phase, 4 out 6 cybergames pose intrinsic or experience-oriented both from white and black hat. Management of resources or creation of preferred personal identity evident from two (2) other games allow the learner to experience an immediate sense of control or goal-oriented feature of the extrinsic motivations.

In scaffolding, 5 out 6 games utilized extrinsic motivation. All games utilized white hat. In endgame, 5 out of 6 games utilized black hat and intrinsic motivation, CD7. Allowing the learner to re-do or repeat the game with other path or choices builds a sense of curiosity.

Chou (2014-2015) suggested dominant strategies in utilizing and balancing white and black hat core drives. According to him, white hat core drives should be highly considered to allow employees to have a feel-good sensation while growing with the organization while black hat is always an option to increase uncertainty and hype but with critical cautiousness.

For public sector, mandatory training (CD8) is the default discovery format of professional development. This can be reinforced by intrinsic motivations found in white hat that can build up interest and strengthen engagement. Motivations that restore control over a task, sense of relatedness, greater meaning on the task at hand, and increasing hype allows learners to divert their attention on the thoughts of having a mandatory training. For scaffolding, every quadrant can always be an option but cautiously be reminded of alternate use of intrinsic/ extrinsic and white/ black hat motivations as reinforcements of every core drive.

For endgame, learners should feel what Erik Erikson described as "no social drawbacks to make mistake" (Widick, et al., 1978), thus, it encourages the learner to create possibilities and try again the journey to arrive in win-state. It is also important to enforce this with feedback to contextualize learning. Learner does not only arrive in the win-state of the game, but also optimize the learning experience.

4.2 Cybersecurity awareness initiatives: Wins and pitfalls

Findings on the KII with participants from EU level, country level (Estonia and Singapore), and international level are summarized creating important themes to achieve win-state.

Interviewees with cybersecurity and capacity building backgrounds explained the participatory and multi-stakeholder approaches which support the coordinated and collaborative strategy of EU on cybersecurity awareness. Traditional approaches are being utilized such as instructor-led, training of trainers, simulation, tabletop, social media campaign (diffusion of networks through ambassadors), etc. Many are not scalable but can always identify audience for it.

Cybersecurity expert confirmed the gradual adoption of gamification in some of the processes and campaigns. A diversified approach is the primary strategy taken by EU considering variety of audiences. Recently established competency networks, aiming to create a common hub of experts, were also mentioned.

Cybersecurity expert from Estonia explained how the wide implementation of a cyber awareness platform in the public sector has enabled to gather anonymous data on the profile of the employees and aggregated results on the risk profile. The Information System Authority that is leading the mentioned cybersecurity awareness initiative considers GBL as a possible way forward.

Cybersecurity expert from Singapore confirmed the use of "interactive games" to empower Singaporeans to learn cybersecurity. It is considered important to be changing the mindset of learners continuously. Clear understanding of importance of the securing the cyber space should be instilled up to the core of the country's citizens.

All the cybersecurity experts agreed on the viability of interactive and innovative solutions such as GBL for cybersecurity awareness. Perception on games evolved from "play" to "strategic learning platform" have emerged in the discussion with GBL practitioners and implementers from academe and international organization. 11 out 11 participants in KII agreed on the feasibility of integrating games to most fields, if not all. GBL practitioners emphasized games as an environment to "learn from mistakes" without having real-life implications. Both interviewees referred it as a "safe place" for failure. Both agreed, however, that many of the target users associate "game" with fun which suggest least optimization of learning and can never be combined with more real-life tasks – thus, the word "serious" in Serious Games.

GBL implementers described UNESCO MGIEP's (Mahatma Gandhi Institute of Education for Peace and Sustainable Development) adoption of Games for Learning on its several projects. The initial strategy was to develop games for learning courses. UNESCO realized the required resources (time, expertise, funds) to develop and maintain a game are difficult to get hold of. As described by GBL implementers, UNESCO evaluated instead those online games already existing in the market. Licenses were paid for some, made membership in gaming sites, and tried out these games with a group of six (6) between 20-30 years old staff of UNESCO. Long list was first evaluated using the parameters, narrative-based, characters, and non-violent, before proceeding to actual testing. Overlapped themes and contradiction were discussed among reviewers. A co-design workshop with the K-12 students as target users of the game evaluated the short-list. Students shared their findings by confirming and adding to a more comprehensive review of the games.

UNESCO also reached to teachers and parents to address initial impression on games as a play and to eventually contextualize games as a learning platform. Games were finally made available to students. Pre and post assessment tools with 600 students as controlled and experiment respondents captured massive increase of knowledge using Games. This assessment turned into gaming design guidelines and shared among the gaming development industry which targets to influence the game designing. Gaming companies are always interested how games originally intended for entertainment are being used as learning platform. UNESCO deliberately opens more avenues for conscious game designs including ways in designing and maximizing games for learning.

GBL experts and implementers identified dominant gaming elements present in a learning platform; story driven, relatedness or sense of community, vocabulary reference, incentives not punishment, healthy competition with time, progress board/rewards, message for a meaningful task, balance between skills and challenge, and immediate feedback or debriefing. As emphasized by one of the game-based practitioners, debriefing after the game (built-in or not in the game) is critical aspect of design. This allows the processing of learning (what did you learn, what happened in the game, etc.).

All the interviewees on GBL emphasized the profile of learners as key consideration in building a game design. This includes but not limited to demographics (age, gender, etc.), and psychographics (attitudes, opinions, behaviours, etc.).

Some of the games searched on the internet for possible evaluation were found to be shutdown, or no follow through maintenance. One of the GBL implementers indicated the criticality of resources (funding, time, expertise, etc.) to sustain a GBL if creating a new/original game. Games are thriving. Organizations from which interviewees are part of consider the GBL as way forward for cybersecurity awareness platform.

FGD was subsequently conducted to consult the end-users' perspective. Participants were from Social Insurance Board of Estonia. The Insurance Board is nearly 700 employees serving 700,000 clients with 30 public services capturing sensitive individual-level of information. All participants have been employed in the Insurance Board for an average of 12.5 months from various units of the office. Participants' well-founded understanding of the role of cybersecurity in the organization opens more opportunity for discussion to improve or attain certain state of security.

Figure 4 presents the participants' point of view on various elements that can motivate learners on a GBL platform. Most of the cybersecurity awareness initiatives are designed as mandatory training among public sector in Estonia. Participants identified, however, the inclusion of strong message as the end-goal of the training for initial touchpoint (CD1). For Onboarding, learners suggested elements allowing learners to create their own character in the game (CD4). A feature of which learners will be able to discuss, share, and interact with other learners in the game as they try to get onboard (CD5) emerged as critical element among the participants. In scaffolding, participants see progress/ rewards (CD2) as gratifying element. Sense of relatedness (CD5) is suggested throughout the learner's journey to continuously engage with community of practice. 3 of the participants identified feedback (CD3) throughout every task to immediately process and put learning into context. As the platform fosters a safe space, game element encouraging learners to try again and explore other possible outcome (CD7) is also indicated by the participants.

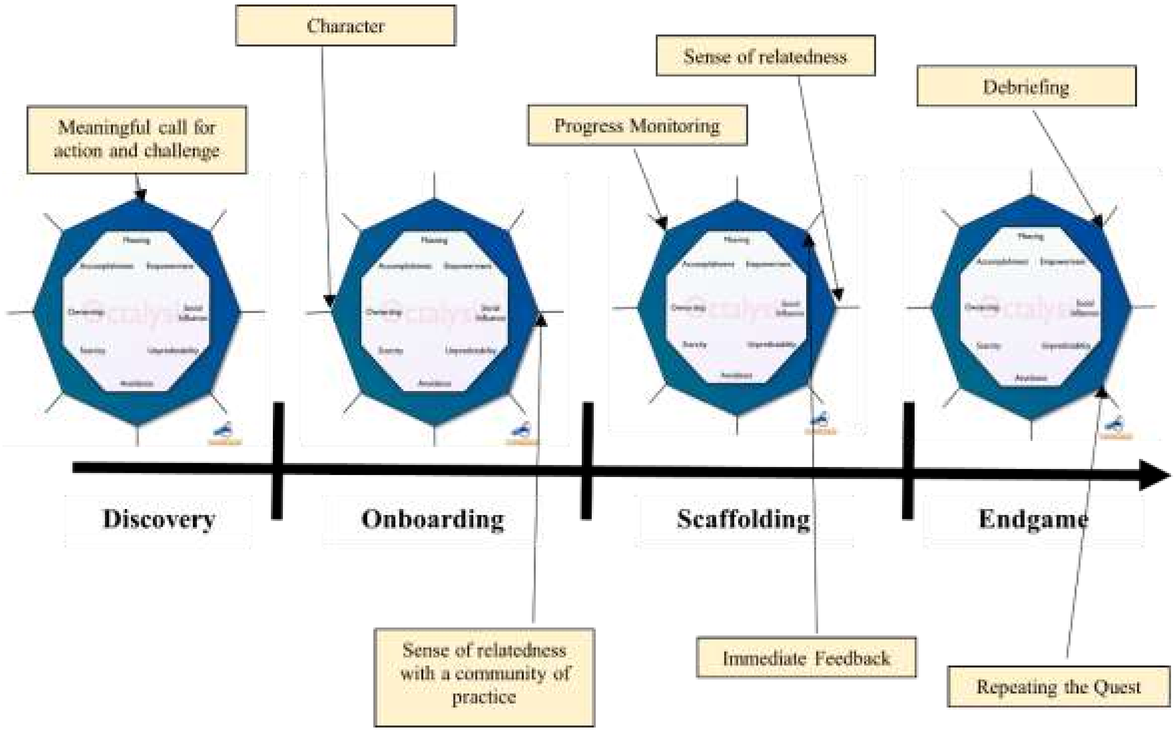

Figure 4: Proposed users' experience model

5. Conclusion

Cybersecurity games present various motivational core drives found in game elements position in every phase of users' journey. Octalysis framework explains further the effect of each core drive in every phase of learners' journey which evidently contribute to sustain an engaging cybersecurity awareness experience. Public sectors funds are always limited and under scrutiny of many, thus, investing to GBL might seem scary or risky at first. This study showed that it is possible to successfully apply GBL to increase engagement in cybersecurity awareness training programmes in the public sector. Octalysis framework was shown to be well aligned with other motivational theories and suitable to provide a more systematic approach to locate the best motivational factors. While the current study provides specific motivational factors (Figure 4) in different stages of a programme, the context of a specific organisation should be considered with care. Future research is highly recommended to expand on more cybersecurity games and diverse participants of the study. Hopefully, this research inspires more public sector organisations to apply GBL in a systematic and effective way.

References

Abawajy, J., 2014. User Preference of Cybersecurity Awareness Delivery Methods. Behaviour and Information Technology, pp. 237-248.

Anastasiadis, T., Lampropoulos, G. & Siakas, K., 2018. Digital Game-based Learning and Serious Games in Education. International Journal of Advances in Scientific Research and Engineering, December, 4(12), pp. 139-144.

Anneta, L., 2010. The "I's" Have It: A Framework for Serious Educational Game Design. Review of General Psychology Vol 12 Issue 2, pp. 105-113.

Bada, M., Sasse, A. & Nurse, J., 2015. Cybersecurity Awareness Campaigns: Why do they fail to change Behaviour. International Conference on Cybersecurity for Sustainable Society.

Baležentis, A. & Žemaitaitienė, G., 2013. The Benchmarking of the Government to Employee (G2E) Technology Development: Theoretical Aspects of the Model Construction. Social Technologies Vol 2 No 1, pp. 53-56.

Barzelay, M., 2019. Chapter 1. Encountering design-oriented public management. In: A Design-oriented Professional Discipline. Massachusetts: Edward Elgar Publishing, Inc.

Becker, K., 2012. A Magic Bullet for Assessing Games for Learning. s.l., Society for Information Technology.

Bhardwaj, J., 2019. Design of a Game for Cybersecurity Awareness. s.l.:North Dakota State University.

Centrigade, n.d. Cybersecurity Training Through Serious Games. [Online] Available at: https://www.centigrade.de/en/references/cyber-security-training-serious-games

Chou, Y.-k., 2014-2015. Actionable Gamification. s.l.:CreateSpace Independent Publishing Platform.

Chou, Y.-k., 2015. Gamification and Behavioral Design. [Online] Available at: https://yukaichou.com/gamification-examples/octalysis-complete-gamification-framework/

Collins, J., 2004. Education Techniques for Lifelong Learning. Lieflong Learning, pp. 1483-1489.

Compte, A. L., Elizondo, D. & Watson, T., 2015. A Renewed Approach to Serious Games for Cyber Security. 2015 7th International Conference on Cyber Conflict: Architectures in Cyberspace, pp. 203-216.

Cone, B., 2007. A video game for cybersecurity training and awareness. Computers and Security.

Coventry, L., Briggs, P., Blythe, J. & Tran, M., 2017. Using behavioural insights toimprove the public's use ofcyber security best practices, London: Government Office for Science, Gov. UK report.

Crookall, D., 2010. Serious Games, Debriefing, and Simulation/ Gaming as a Discipline. Simultion and Gaming, Sage Publications, pp. 898-920.

Csikszentmihalyi, M., Abuhamdeh, S. & Nakamura, J., 2014. Flow: Flow and the Foundations of Positive Psychology. s.l.:Springer, Dordrecht.

Cybersecurity Challenge UK, n.d. Cyber Security Challenge UK. [Online] Available at: https://cybergamesuk.com/cyber-city

Davinson, N. & Sillence, E., 2010. It won't happen to me: Promoting secure behaviour among internet users. Computers in Human Behavior, pp. 1739-1747.

Dawes, S. & Cook, M., 2007. Intergovernmental Digital Government through G2G Relationship and Applications. Encyclopedia of Digital Government Vol 5, pp. 1114-1119.

Deci, E. L. & Ryan, R. M., 2012. Self Determination Theory. In: Handbook of Theories of Social Psychology: Volume 1. s.l.:SAGE Publications Ltd, pp. 416-436.

Defense Counterintelligence and Security Agency, n.d. Center for Development and Security Execellence. [Online] Available at: https://www.cdse.edu/resources/games.html

European Centre for the Development of Vocational Training, 2014. Validation of non-formal and informal learning. [Online] Available at: https://www.cedefop.europa.eu/en/events-and-projects/projects/validation-non-formal-and-informal-learning/european-inventory/european-inventory-glossary#l

European Commission, 2013. European Commission. [Online] Available at: http://ec.europa.eu/education/lifelong-learning-policy/adult_en.htm

Eyler, J., 2009. The Power of Experiental Education. Liberal Education Fall 2009, pp. 24-31.

Göschlberger, B. & Bruck, P., 2017. Gamification in Mobile and Workplace Integrated Microleaning. New York, International Conference on Information Integration and Web-based Applications and Services.

Heckhausen, J., Wrosch, C. & Schulz, R., 2010. A motivational theory of life-span development. Psychological Review, pp. 32-60.

Hendrix, M., Al-Sherbaz, A. & Victoria, B., 2016. Game based cyber security training: are serious game suitable for cyber security training?. International Journal of Serious Games, 3(1), pp. 53-61.

Iacono, S., Vallarino, M. & Vercelli, G. V., 2021. Gamification in Corporate Training to Enhance Engagement: An Approach. International Journal of Emerging Technologies in Learning (iJET), 15(17), pp. 69-84.

Kesti, M., Leinonen, J. & Kesti, T., 2017. The Productive Leadership Game: From Theory to Game-Based Learning. In: M. Lewandowski & B. Kożuch, eds. s.l.:IGI Global, pp. 238-260.

Kianpour, M., Kowalski, S. J., Zoto, E. & Frantz, C., 2019. Designing Serious Games for Cyber Ranges: A Socio-technical Approach. s.l., s.n.

Laning, T., 2018. Serious games, gamification, and game-based learning: what's the difference?. [Online] Available at: https://grendelgames.com/serious-games-gamification-and-game-based-learning-whats-the-difference/

Lazzaro, N., 2013. The 4 Keys to Fun: Increasing Engagement with Games. s.l.:XEO Design, Inc IBM.

Lieb, S., 1991. Principles of Adult Learning. pp. 1-8.

Nagarajan, A., Allbeck, J. M., Sood, A. & Janssen, T., 2012. Exploring Game Design for Cybersecurity Training. Bangkok, IEEE, pp. 256-262.

Naval Postgraduate School, n.d. CyberCiege. [Online] Available at: https://nps.edu/web/c3o/cyberciege

Shaw, R., 2009. The impact of information richness on information security awareness training effectiveness. Computers and Education Vol 52 (1), pp. 92-100 .

Texas A&M University, 2017. Keep Tradition Secure. [Online] Available at: https://keeptraditionsecure.tamu.edu/

Trend Micro, 2016. Report on cybersecurity and critical infrastructure in the Americas, s.l.: Tren Micro.

Tweedell, C. B., 2000. A Theory of Adult Learning and Implications for Practice. Illinois, Institute of Education Science, pp. 2-17.

Widick, C., Clyde, P. & Knefelkamp, L., 1978. Erik Erikson and Psychosocial Development. New Directiosn for Student Services, pp. 1-17.

Yfantis, V. & Tseles, D., 2017. Exploring Gamification In The Public Sector Through The Octalysis Conceptual Model. Conference: eRA-12International Scientific ConferenceAt: Piraeus University of Applied Sciences (PUAS)

Building Better Online Communities in the Post Pandemic World

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DOI: 10.34190/EEL.21.037

Abstract: Recent world events have shifted our educational focus to a greater emphasis on online learning and working environments. Given the immediate and emergency moves to online learning, the effectiveness of these shifts has come into question in many institutions of higher education. What has become clear is that the longer the pandemic lasts, the more ingrained and assimilated virtual learning will become in our educational institutions. We argue that this crisis, while tragic, has also simultaneously created opportunities that would not have presented themselves in a slower, more controlled transition. The rapid changes caused by the pandemic continue to be a catalyst for the evolution of online education, in positive ways; through an unanticipated world event, acting as an essential precursor to disruptive, progressive innovation. This paper examines the critical elements of effective, online learning communities. The Organization for Economic Co-operation and Development (OECD) (2017) calls for immediate paradigmatic shifts in the way employment skills are addressed in educational institutions and society in general. These urgent demands derive from a wide variety of local, regional, national, and international sources, including the Conference Board of Canada (2016), and United Nations Educational, Scientific and Cultural Organization (UNESCO) (2017). These sources recommend increased emphasis on skills development in complex problem solving, critical thinking, creativity, negotiation, people management and collaboration. Our health as individuals and communities exists within a future that continues to be fraught with complexities related to pandemics, racial inequalities and unrest, climate change, and a digital news media laden with artificial information, misappropriation of facts and manipulation of knowledge to benefit those in power. We are at a critical juncture, and this paper describes key features of effective online learning communities to ensure better, stronger digital learning and working spaces.

Keywords: online learning communities, post-pandemic, digital learning

1. Introduction and context of the problem

It is clear that online learning is an educational concept that has become embedded in 21C learning environments. Frameworks for learning in the fourth industrial revolution must be redesigned, and dramatically changed, in order to meet the needs of a rapidly changing workforce. We need to develop digital competencies and skills, and to model learning environments capable of connecting individuals and teams across time zones, nations and cultures (Kaufman, 2013; Olson, 2015; World Economic Forum, 2016; Bates, 2019a; Bates, 2019b; OECD, 2019). The need for a requisite paradigmatic shift has never been more apparent than during our immediate global situation, where nations and individuals are working to provide collaborative solutions to complex global problems. These issues, while exacerbated by pandemic conditions, have revealed cracks in the scaffolding of social systems. Solutions can arise with the advent and evolution of effective, collaborative online learning environments that are based in a model of Fully Online Learning Communities (FOLC). These communities embrace social constructivist, interdependent learning spaces that focus on problem-based learning, and student-driven pedagogy.

During this evolving 4th Industrial Revolution, we are surrounded by a wide variety of definitions of what the term "online learning" can mean, and concomitantly, the quality of these learning environments varies greatly. Definitions of online learning vary from asynchronous, synchronous, hybrid, blended, distance, remote and hyperflex. While these terms may describe vastly different pedagogical models, they also do not take into account such critical factors in online learning success; factors such as student engagement, attrition, pedagogical approach and sense of community. The remote nature of online learning has resulted in isolation and discouragement, (Dabbagh & Kitsantas, 2004; Kizilcec & Halawa, 2015; Lehman & Conceicao, 2014) and often higher levels of attrition for online learners, and greater discouragement for online educators. Historically, there is evidence that students learning online often feel isolated, leading to attrition rates up to 20% higher than face-to-face learning (Angelino & Natvig, 2009). As a society, we need to find more accessible, economical, environmentally conscious and sustainable means to make learning available to everyone, while simultaneously providing facilitated learning environments for those educators new to digital realms of learning.

The increasing need for online learning is readily apparent. In 2013, 33,5% of American higher education students were taking online course(s) (Allen & Seaman, 2014). By 2015, more than 360,000 Canadian students were enrolled in at least one online course (Bates, 2017), accounting for approximately 29% of all Canadian university students. At that time, estimates indicate that 35% of post-secondary American students were taking a minimum of one online course (Hill, 2019a; Hill, 2019b). Fast forward to 2020, and we recognize that the COVID-19 pandemic has changed our lives and services in irrevocable ways. Through massive school closures and restrictions, higher education institutions moved rapidly to what was termed "remote emergency teaching". Under dire circumstances, face-to-face classes were abruptly transitioned to online learning management systems, in an effort to meet students' needs amidst the closure of their colleges or universities. In an extremely short time, this immediate and dramatic transition to online learning resulted in increased stress, pedagogical compromises and greater gaps in accessibility for disadvantaged or remote populations. It also led to an unfortunate interpretation, or misinterpretation, of the value of online learning, as many of the rapid shifts did not result in quality learning environments. Online learning spaces can, and must, be socially constructivist, engaging, and grounded, in a community framework where members are interdependent, accountable and productive. This paper discusses elements of the FOLC model for online learning that meet learners' needs, providing a timely and effective solution to post pandemic online learning situations.

While many still refer to the shift to online learning as "emergency remote teaching", we argue that the transition to online learning spaces has been inevitable, and necessary. Although we acknowledge that the pandemic created inexorable tragedy and loss, the authors argue that the change to online learning was already happening, quite successfully, in some institutions. While institutional changes often take considerable time, and effort, passing political and policy hurdles, the rapidity of the recent moves provided an opportunity to embrace a change that might not have happened under other circumstances. We believe that the pandemic has created conditions of "disruptive innovation" (Flavin, 2012); a chance to unpack and dismantle traditional models of education and rebuild in a way that meets the needs of 21C students. As the world recovers and moves forward post pandemic, we argue that several features of online learning can provide new ways to improve education, to make it more readily available in an 'anytime anywhere' model, and to shift the focus from an institution-centred or instructor-centred model to a student-centred, personalized approach to learning.

This paper examines the literature on online communities, and gathers together elements that appear to be essential for successful learning online, by discussing a validated theoretical model that meets these needs. This report will focus on an overview and discussion of the four areas we deem are essential to the redesign of online learning spaces. First, we examine the Fully Online Learning Community Model (VanOostveen et al, 2016), describing the intersection of social presence, cognitive presence, and collaboration in digital spaces. This will be followed by a brief examination of Problem-Based Learning (Savin-Baden, 2007) as a foundational pedagogical strategy that supports the model. Third, we survey how Authentic Assessment (AA) is a key element of a successful online learning community.

2. Literature review

There is a plethora of research in the area of online communities and online pedagogies. Clearly, the pandemic has offered us an opportunity to redefine the learning outcomes and competencies we need for 21C learners, and what is necessary to facilitate the growth of responsible digital citizens (Bates, 2019a; Bates, 2019b). This is what Littlejohn, Beetham and McGill (2011) refer to as "the capabilities required to thrive in and beyond education, in an age when digital forms of information and communication predominate" (p. 547). Kaufman concurs that "school is not simply about tests and 'checking boxes' of topics and assignments. Rather, schools today should have a mission of developing students as individuals and igniting their creativity" (2013, p. 79). Voogt et al (2013) also attest that it is generally agreed upon that "collaboration, communication, digital literacy, citizenship, problem-solving, critical thinking, creativity and productivity are essential for living in and contributing to our present societies" (p. 404). If students are to succeed beyond formal education, they need to learn competencies required in the world beyond higher education; in sum, they need to learn how to learn, adapt to change, and become competent in the effective use of online learning modalities. LittleJohn, Beetham and McGill (2012) indicate that the nature of the workplace has changed, and digital forms of information are changing the meaning of what it means to work. They state that these changes are being exacerbated by three factors

> *First, workplaces are being transformed such that production and practice are increasingly knowledge driven. Second, work problems are becoming more complex and third, people are regularly and repeatedly transitioning into new roles and careers, necessitating life-long learning. (2012, p.547)*

If education is to evolve, it must undergo a dramatic paradigm shift; the recent shift to online learning demands that educators look at models of online learning that facilitate engagement, as well as the development of the competencies required in the real world. (World Economic Forum, 2016; Conference Board of Canada, 2000; E-Week 2015; OECD, 2019). Wenger and Synder (2000) believe that "online communities facilitate virtual collaboration among community members with the potential of transforming the activities of off-line into an online context" (in Lin & Lee, 2000, p. 480). Lin and Lee (2006) state that "the online community can be defined as a social relationship aggregation, facilitated by internet-based technology, in which users communicate and build personal relationships" (p. 480). Kearney et al (2012) attest that learning "is a situated social endeavor" (p. 1). LittleJohn, Beetham and McGill (2012) agree that the social elements of learning are being embraced by students, and that "learners are responding to the new technical and social opportunities with little help from the formal education system" (p. 551).

In response to this, Canadian researchers present in this paper an online learning model that is ahead of its time, has been proven and validated over many years, and has been successfully implemented in an online undergraduate program. The Fully Online Learning Community (FOLC) model (VanOostveen et al, 2016). In general, the FOLC Model integrates elements of more foundational theories guiding practice in distance and online education, including the Theory of Transactional Distance (TTD) (Moore, 1993), and the Community of Inquiry (CoI) framework (Garrison, Anderson, & Archer, 2010). The CoI framework, in particular, recognizes three presences essential to supporting distance education: Social Presence, Teaching Presence, and Cognitive Presence.

Figure 1: Fully Online Learning Community model (VanOostveen et al, 2016)

3. Discussion of critical elements

3.1 Social and cognitive presence

Several strategies are used to develop community, including the Knowledge Forum (WebKF) indicated in Figure 2. This software was designed by a Canadian university and has an international following and conference where users share professional practices. Using this weekly social commentary web-based software, students and the instructor can visually comment on course topics, respond to others in a non-linear fashion, and include links, photos, and reflections. This tool can also be used to measure social presence, as its functionality allows us to see how often users interact, comment, and with whom they regularly connect. As such, it is one way to measure community engagement in an online class. Students are equal contributors to the instructor, and this changes the power dynamic in the groups, as all participants can post at any time. In this way, the social presence and cognitive presence interweave. Practical examples of this include students regularly taking leadership roles, asking and responding to other students' questions, offering technical or other assistance with course material, and working closely together to solve problems, think critically and interact socially.

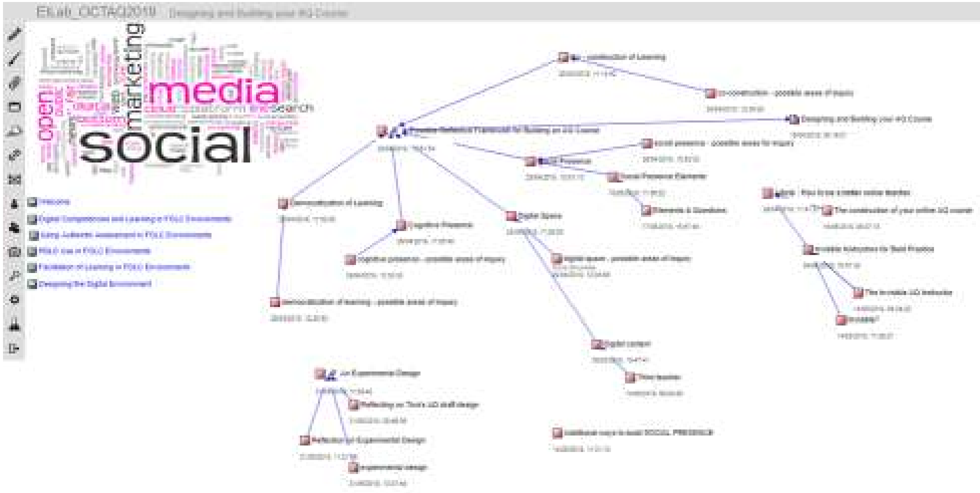

Figure 2: Web knowledge forum discussion page

3.2 Collaborative learning process

The FOLC model focuses on a collaborative learning process, and roles in the community are shared amongst all members of the learning community. This means that the instructor acts as facilitator, lurker, learner, organizer, and instructional partner. As such, leadership of class discussions, selection of problems, means of representation of data and visual presentations are negotiated. Figure 3 is a learner generated visual graphic of how collaborative learning is imagined by participants in the process. This work was created by a teacher involved in a FOLC process, and it is an example of the varied modalities whereby participants shared their learning and experiences.

Figure 3: Learning process model

3.3 FOLC model in practice

Our model has been successfully implemented in a fully online undergraduate B.A. in Educational Studies degree program that places students squarely at the centre of the process. A recent self-study of the overall program provided overwhelming positive feedback from students, who felt that their growth as adult learners had benefitted from the FOLC model and the PBL structure of the program. Most students maintained full time jobs while studying part time in a flipped classroom model, where video podcasts were available to them prior to a once per week tutorial session with the instructor. Students can learn anywhere, anytime, and this makes learning accessible to those who are adult learners, working full time, with families and other social responsibilities. Given the shifts to work at home due to the pandemic, we believe that many organizations may continue to have employees working from home, thus a fully online adult learning model such as the FOLC is both timely and efficient for adult learning, employee training and professional development

3.4 PBL in practice

The pedagogical foundation upon which the FOLC model rest is that of Problem Based Learning. We believe that this orientation, towards a learner-centred and problem-centred approach, allows for a social constructivist approach to learning, and provides a model of best practice for organizations to develop and cultivate digital competencies in employees. PBL as situated in the FOLC model has several key features including 1. A focus on complex real-world situations that have no one 'right' answer; 2. Students work in teams to confront the problem, to identify learning gaps, and to develop viable solutions; 3. Students gain new information through self-directed learning; 4. Instructors act as facilitators; 5. Problems lead to the development of problem-solving capabilities (Savin -Baden (2007). While there is often discomfort early on for many learners, we attribute this to their history of K-12 teacher-centred models of learning. Students enter their undergraduate degree from programs that are largely teacher-centred, focussed on curriculum designed by those in power and assessed in examinations and formal testing situations. It is a paradigmatic shift for them to take greater responsibility for their learning, to be part of the problem solving team, and to accept diverse solutions. Rather than having the instructor provide lectures, students use flipped classes and video podcasts, attending tutorial meetings weekly to share how the material provided has scaffolded their learning. Students are encouraged to share their own experiential knowledge, work or life context, and professional experience to shape and direct their own learning. By the end of our undergraduate program using the FOLC, students begin to thrive in the PBL framework, and they attain a level of growth that most had not anticipated, preparing them for further graduate studies or additional professional development.

3.5 AA in practice

Approaches to providing valid and reliable assessment and evaluation are an essential part of the fully online learning communities model (FOLC). Authentic assessment has been discussed in digital contexts by numerous authors. (McNeill, Gosper & Xu, 2012; Herrington & Parker, 2013, Herrington, Parker & Boase-Jelinek, 2012). Literature reveals a general consensus about some of the key elements of an authentic learning environment. These include

> *authentic context, authentic tasks, access to expert thinking and modelling of process, provision of multiple roles and perspectives, collaborative construction of knowledge, reflection, articulation to enable tacit knowledge to be made explicit, coaching and scaffolding, and authentic assessment of learning within the tasks.*
>
> *(Bozalek, et al, 2013, p. 631)*

This may be due to the fact that learners in the 21C exist in a world that continually redefines itself. The roles of teacher and learner are no longer defined in traditional ways, nor are they couched in traditional power structures. Thus, assessment can no longer reside solely in the hands of the instructor. In a co-designed and co-created environment, assessment must be an ongoing process that involves critical reflection and ubiquitous assessment that is seamlessly woven into the learning process. Because the development of new knowledge outpaces our ability to keep up with content, many authors have re-defined the essential skills required of the 21C learner (Bates, 2019a; Bates, 2019b; Kaufmann, 2013; Voogt et al, 2013). In our model, students are invited to dialogue with the instructor, to negotiate with their learning team, to construct the parameters of assignments and to evaluate what a quality product looks like. They also discuss and assess the learning process as their courses unfold. Students experience more than self or peer assessment, they become partners in the assessment process, taking a greater share of responsibility for self-directed learning, and, as a result, they more often than not produce original work of higher calibre. Authentic Assessment is a tool that invites students to be a partner in the process of assessment, allows them to articulate their learning goals, and to have a voice in how they are assessed. Again, this is usually an uncomfortable position for students at the outset, having graduated from traditional teacher-centred courses where grades, examinations and evaluations do not include an opportunity for dialogue, negotiation or student empowerment in the assessment process. We have found that by the end of their program of study, students have developed critical thinking skills, and the ability to articulate how, and why, they chose a particular technology to effectively solve academic problems. Also integral to the process, they express that they have learned skills in conflict resolution, collaboration and negotiation, that enable them to advance in a direction of their choice. Interestingly, we also find that some students maintain the relationships that they forged during the program long after they have completed their degrees. As such, they create their own networks outside the formal educational institution, and become collaborative learners for life.

4. Conclusion

The circumstances that emerged in the COVIC-19 pandemic created a unique opportunity for change. In essence, the disruption across education, the global economy, health care, environmental and political arenas combined to cause the conditions necessary to facilitate positive disruption. We need to adapt to, and use this moment in time by accepting that digital technologies can, and should, disrupt archaic and traditional models of education. Flavin (2012) refers to as "disruptive technologies" (p. 103). He states that "when digital technologies are brought into the classroom setting, the lecturer may have to relinquish some of their authority, thus impacting on the 'rules' and 'division of labour' nodes in order to enable enhanced learning" (Flavin, 2012, p. 104). Cochrane (2012) identifies this unique sharing of the digital learning environment as one of the critical success factors in digital learning. He states that features of a successful virtual learning environment include

> *Pedagogical integration of technology into the course and assessment, lecturer modelling of the pedagogical use of the tools, creating a supportive learning community, and creating sustained interaction that explicitly scaffolds the development of ontological shifts that is the reconceptualization of what it means to teach and learn within social constructivist paradigms, both for the lecturers and the students. (Cochrane, 2012, p. 125)*

McNeill, Gosper and Xu (2012) state, "universities increasingly acknowledge the value of skills such as problem solving, critical thinking and creativity, yet the curriculum needs to be designed to support and scaffold development of these skills. 92012, p. 283). They go on to state that "academics who were likely to introduce the development of student creativity in their curriculum found that confidence emerged as a key characteristic" (2012, p. 284). Not only are old educational models no longer a fit, they are incapable of providing learners with the exact types of problem-based scenarios that require collaboration, innovation and real change. The problems we face are not isolated, discreet or stuck in any one area of life, in fact, we face complex and multi-dimensional issues that affect all areas of life, even the life of our planet. Ultimately, 21C learners must develop the competencies to be problem-solvers, to think in socially constructivist ways. In this paper we posit the FOLC model as a potential solution. Our current global conditions require a necessary and immediate shift in pedagogical focus, towards a new model of collaborative learning; one that facilitates the creativity and critical thinking that emerges from fully online learning communities, and provides a foundation for sustainable solutions.

References

Allen, I. & Seaman, J. (2014). Grade Change: Tracking Online Education in the United States, *Babson Survey Research Group and Quahog Research Group*.

Angelino, L. & Natvig, D. (2009). A Conceptual Model for Engagement of the Online Learner, *Journal of Educators Online*, Vol. 6, No. 1, p. 1.

Bates, T. (2018). The 2017 National Survey of Online Learning in Canadian Post-secondary Education: Methodology and Results, *International Journal of Educational Technology in Higher Education*, Vol. 15, No. 1, p. 29.

Bates, T. (2019a). What are the key online learning markets over the next few years. Retrieved from https://www.tonybates.ca/2019/05/19/what-are-the-key-online-learning-markets-over-the-next-few-years/

Bates, T. (2019b). Rethinking the purpose of online learning for developing skills for a digital society. Retrieved from https://www.tonybates.ca/2019/04/30/rethinking-the-purpose-of-online-learning-4-developing-skills-for-a-digital-society/

Bozalek, V., Gachago, D., Alexander, L., Watter, K., Wood, D., Ivala, E. & Herrington, J. (2013). The use of emerging technologies for authentic learning: a South African study in higher education. *British Journal of Educational Technology.* Vol. 44, No. 2, pp. 629-638. doi: 10:1111/jbet.12046

Cochrane, T. (2012). Secrets of m-learning failures: confronting reality. *Research in Learning Technology, ALT-C Conference Proceedings*, http://dx.doi.org/10.3402/rlts2010.19186

Conference Board of Canada, *Employability Skills 2000+*, http://www.conferenceboard.ca/Libraries/EDUC_PUBLIC/esp2000.sflb, 2016.

Dabbagh, N. & Kitsantas, A. (2004). Supporting Self-Regulation in Student-Centered Web-based Learning Environments, *International Journal on E-Learning*, Vol. 3, No. 1, pp. 40–47.

eWeek.com (2015). *How the Skills Gap is Threatening the Growth of App Economy*,http://www.eweek.com/developer/slideshows/how-the-skills-gap-is-threatening-the-growth-of-app-economy.html

Flavin, M. (2012). Disruptive technologies in higher education. *Research in Learning Technology*, *ALT-C 2012 Conference Proceedings*. http://dx.doi.org/10.3402/rlt.v2010.19184
Garrison, D.R., Anderson, T. and Archer, W. (2010). The first decade of the community of inquiry framework: A retrospective. *The Internet and Higher Education*, Vol.13, No. 1-2, pp.5-9.
Herrington, J. & Herrington, A. (1998). Authentic assessment and multi-media: how university students response to a model of authentic assessment. *Higher Education Research & Development,* Vol. 17, No. 3, pp. 305-322. doi: 10:1080/0729436980170304
Herrington, J. & Parker, J. (2013). Emerging technologies as cognitive tools for authentic learning. *British Journal of Educational Technology*, Vol. 44, No. 4, pp. 607-615. doi:10.1111/bjet.12048
Herrington, J., Parker, J. & Boase-Jelink, D. (2013) Social presence and participatory media in authentic learning. In: Open and Distance Learning Association of Australia (ODLAA) 2013 Distance Education Summit, February2013, Sydney. http://researchrepository.murdoch.edu.au/13914
Hill, P. (2019a). Fall 2018 IPEDS Data: New Profile of US Higher Ed Online Education, *PhilonEdTech*, December 8. https://www.tonybates.ca/2019/12/17/online-learning-in-the-usa-in-2018/, 2019.
Hill, P. (2019b). US Higher Education Enrollment Trends by Distance Education Type, 2012-2018, *PhilonEdTech*, December 11 https://www.tonybates.ca/2019/12/17/online-learning-in-the-usa-in-2018/, 2019.
Kaufman, K. (2013). 21 Ways to 21st century skills: why students need them and ideas for practical implementation. *Kappa Delta Pi Record*, Vol. 49, No. 2, pp. 78-83. doi: 10.1080/00228958.2013.786594
Kizilcec, R. & Halawa, S. (2015). Attrition and Achievement Gaps in Online Learning, *Proceedings of the Second (2015) ACM Conference on Learning*. pp. 57 – 66.
Kearney. M., Schuk, S., Burden, K. & Aubusson, P. (2012). Viewing mobile learning from a pedagogical perspective. *Research in Learning Technology*, Vol. 20, No. 14406. doi: 10.3402/rlt.v2010.14406
Lehman, R. & Conceição, S. (2014). Concerns and Opportunities for Online Student Retention, In *Motivating and Retaining Online Students: Research-Based Strategies That Work*, San Francisco: Wiley & Sons, 2014.
Lin, H. & Lee, G. (2006). Determinants of success for online communities: an empirical study. *Behavior and Information Technology*, Vol. 25, No. 6, pp. 479-488.
Littlejohn, A., Beetham, H. & McGill, L. (2012). Learning at the digital frontier: a review of digital literacies in theory and practice. *Journal of Computer Assisted Learning*, Vol. 28, 547-556. doi: 10.1111/j.1365-2729.2011.00474.x
McNeill, M., Gosper, M. & Xu, J. (2012). Assessment choices to target higher order learning outcomes: the power of academic empowerment. *Research and Learning Technology*, Vol. 20, No. 17595 doi: 10.3402/rlt.v2010.17595
Moore, M.G. (1993). Theory of transactional distance. In Keegan, D. (Ed.) *Theoretical Principles of Distance Education*. New York: Routledge.
Olson, M.P., (2015). *A multilateral approach to bridging the global skills gap*. Retrieved from digitalcommons.ilr.cornell.edu
Ontario Ministry of Training, Colleges and Universities (2016). *Essential Employability Skills*, http://www.tcu.gov.on.ca/pepg/audiences/colleges/progstan/essential.html, 2016.
Organization for Economic Co-operation and Development (2019). *The OECD Learning Compass 2030*. Retrieved from http://www.oecd.org/education/2030-project/teaching-and-learning/learning/
Savin-Baden, Maggi. (2007) Challenging models and perspectives of problem-based learning. In De Graaff, E. & Kolmos, A. (Eds.) *Management of change: Implementation of problem-based and project-based learning in engineering*, pp. 9-30.
vanOostveen, R., DiGiuseppe, M., Barber, W., Blayone, T., & Childs, E. (2016, June). New conceptions for digital technology sandboxes: Developing a Fully Online Learning Communities (FOLC) model. In *EdMedia+ Innovate Learning*(pp. 665-673). Association for the Advancement of Computing in Education (AACE).
Voogt, J., Erstad, O., Dede, C. & Mishra, P. (2013). Challenges to learning and schooling in the digital networked world of the 21st century. Journal of Computer Assisted Learning, Vol. 29, pp. 403-413. doi: 10.1111/jcal.12029
World Economic Forum (2016). *The 10 Skills You Need to Thrive in the Fourth Industrial Revolution*, http://www.weforum.org/agenda/2016/01/the-10-skills-you-need-to-thrive-in-the-fourth-industrial-revolution.

Challenges in Educating Student Art Teachers in Technology Comprehension

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DOI: 10.34190/EEL.21.119

Abstract: This paper focuses on a study of what teaching competences technology comprehension requires (TC) for teacher education. The background for the study involved a national initiative about developing TC as a teaching subject and integrating it into the existing Danish school curriculum. To follow up on a large-scale national experimental project in primary schools, the ministry launched a small-scale qualification project to promote this integration and develop teacher educators' competences. The project involved teacher educators representing several school subjects, including visual arts, which was the scientific object of the study in this paper. The qualification project was framed as a network process with research input and peer discussions of learning designs among a group of 20 researchers and 40 teacher educators. The teacher educators applied their produced designs as a part of the ordinary curriculum for teacher education, with two interventions at their home university and shared experiences with the group. This paper reports these interventions. The theoretical framework of the study drew on subjects related to visual arts education, TC theory and social material insights. As part of the larger qualification project, the methodological approach employed design-based research (DBR). The study demonstrated how the implementation of TC in an existing teaching subject became a negotiation between the teaching subject, the students and the teacher regarding how to integrate a new aspect of professionalism into visual arts education. When incorporating elements from computer science into visual arts education, the levelling of two different paradigms are crucial. Although digital technology has been a tool for practicing visual arts for 20 years, both students and teachers found it difficult to implement programming and computational thinking elements and maintain the art focus. This created a new challenge for the art teacher, who was forced to develop re-conceptualisation skills by converting programming into hacking activities and thereby facilitating the students' artistic approach to TC.

Keywords: technology comprehension, student teachers, visual arts, programming, teacher educators

1. Introduction

This paper addresses the current discourse surrounding how students achieve relevant programming and computational thinking competences to tackle current and future societal challenges from the perspective of visual arts education. Although digital technology has been a component of Danish school subjects for years (e.g. Caeli & Bundsgaard 2018), a renewed focus on computational thinking and programming emerged and became a ministerial focus area in the Danish education system in 2018. This paper seeks to address the following questions: First, how should this be taught in a manner that effectively prepares students for meeting future societal challenges? Second, what are the relevant competences? Is it a matter for computer science? Is it a task for the so-called STEM disciplines already familiar with the computer science paradigm? Alternatively, should it instead include disciplines from the humanities? By launching a concept of computer science as a problem-solving competence, scholars such as Jeanett Wing (2006) have established a broader agenda for the subject to concern several educational disciplines and to apply to real-life problems. Wing argued that computational thinking should be regarded as a particular language of the future necessary to take on a career. Thus, computer science was asserted to be a transdisciplinary skill that concerned other disciplines in schooling. In Denmark, an expert group formulated a syllabus to obtain the necessary computer science skills by combining programming and computational thinking skills with designing activities and digital empowerment (Ministry of education 2019, Wagner et al 2020). The ambitious goal was to integrate computer science and the humanities into a new hybrid for schooling. The general approach using the term TC became the starting point for a ministerial focus area in both a national school experiment and a national further education project regarding teacher educators in Denmark from 2018 to 2021. The major question that arose concerned whether this new construction of TC should be practiced as a new and separate discipline or as an integration of existing curriculum disciplines. The ministry decided to attempt both a national school experiment and a qualification project involving teacher educators. The present study presented in this paper was part of the qualification project that concerned teacher educators TC in visual arts education. The research interest concerned how the teacher educator and the student visual art teachers negotiated TC as a new addition to the visual arts curriculum.

1.1 Background: The study as a part of a larger initiative

The national initiative to develop TC as a teaching subject to be integrated into the existing school curriculum in Denmark was launched in 2018 and applied to 1st to 9th grade in 46 schools (Ministry of Education 2018) in which visual arts education constituted one part (Buhl 2019, Buhl & Skov 2020). Prior to an experimental project[1], elements from the TC syllabus were added to the national curriculum for visual arts education from 1st to 3rd grade (Ministry of education 2019b). Based on the expanded national curriculum, project participants, being professionals in the field, developed six prototypes (Buhl & Skov 2020, 2021). The prototypes tested by schools participating in the project and their feedback informed the project developers' further reflections and contributed to the overall project (Buhl & Skov 2021).

Parallel with the large-scale national experimental project in primary school where learning content was developed, tested and evaluated, the ministry also launched a small-scale qualification project that intended to promote the implementation process for technology comprehension. The qualification project aimed to contribute to the conceptual development of TC and to simultaneously provide teacher educators with competencies to educate the future workforce of teachers for primary school. The project participants represented the singular subject of TC and three existing school subjects including visual arts education. The qualification project was framed as a design, intervention and evaluation process drawing on insights from design-based research (eg. Barab & Squire 2004, Amiel & Reeves 2008), organised in network meetings where 20 researchers and 40 teacher educators gathered and shared general and subject-specific research input through peer discussions and idea development for their own learning designs. The teacher educators tested their designs in two rounds (two x four hour) of interventions with student teachers at their home university. The interventions were conducted as part of the ordinary curriculum for teacher training, and the results were shared and discussed afterwards in the network. The present study reports how the two learning designs were met by student teachers in visual arts education based on data from the two interventions and with an interest in what occurred when a teaching subject in the humanities adopted the TC construction. The purpose was to illuminate visual learning potential and challenges to be able to discuss to what extent visual arts education might contribute to the overall ministerial agenda regarding a cross disciplinary approach to digitalisation and not least to discuss the potential in using TC as a renewal of visual arts education content.

2. Research design

The study focused on the part of the development project concerned with the trial implementation of two learning designs located at University College Copenhagen (UCC). In Denmark, teacher education for primary school is a four-year-long general programme. During the programme, the student teachers select four school subjects in which they specialise. The school subject visual arts education is one of these specialisation tracks, in which the student teacher has agency to select their subjects. The visual arts teacher track trains future visual arts teachers for primary school (1-9 grade). While the ministerial experimental project focused on implementing TC in schools between 1st and 3rd grade, the competence development project of visual arts teacher educators adhered to a broader perspective concerning how student visual arts teachers can be prepared to teach it in primary school.

The study aimed to reveal potential benefits and challenges of employing a digital technology integrated learning design in a visual arts education class based around the structure of the overall qualification project. This structure offered two iterations of a learning design developed and attempted by the visual arts educators at their home university and followed by new reflections with peers. This pedagogical intervention was integrated as part of the ordinary curriculum with a duration of eight hours each, one in the fall of 2020, and one in the spring of 2021. Two groups of student visual arts teachers (16 and 13) participated in the implementation of the learning designs. The first learning design was a 3D-modelling assignment using the software app Tinkercad. Informed by this first iteration, the second learning design was a video hacking assignment.

In the study of the implementation of the two learning designs, the arts teacher educator and the researcher formed a collaboration and conducted the process inspired by the research principles from design-based research (eg. Barab & Squire 2004, Amiel & Reeves 2008). The problem identification was based on research in digital technology and visual arts education (Kiefer-Boyd 1996, Knochel & Patton 2015, Buhl 2019, Buhl & Skov 2020, Buhl & Skov 2021), and it was informed by discussions with peers. This comprised the design principles for

[1] https://tekforsøget.dk/

the two iterations, which again involved discussions with peers before and after the pedagogical intervention. The empirical data consisted of learning design from the two interventions, including teaching plans and material, observations (two x four hours) such as photos and field notes, and oral and written student evaluations. Furthermore, co-researching oral evaluations between the educator and the researcher along with peer discussions in the development network before and between the interventions constituted a contextualisation of the observations. The observations took on a social material perspective in relation to the visual practices as hybrid assemblages of meaning-making. This notion of hybrid assemblages formed the empirical basis for the analysis of the social practices of art-making as well as the framework for understanding how the negotiation between art and technology was enacted. The empirical data from the intervention phase were approached and analysed from two perspectives. One perspective focused on how digital technology was entangled with other materialities in the student arts teachers' practices of meaning-making (Fenwick and Landri, 2012, Meyer 2016). This indicated how the designs were adopted as a means for art-making. The other perspective focused on how the students approached and engaged with the learning designs as curriculum. This indicated how the designs were negotiated in the collaborative processes and how the students and teachers attributed meaning to digital technology as a driver for renewing visual arts content (Wenger 2000).

3. Theoretical framework

The theoretical framework for studying the intervention with the two learning designs drew from subject-related theories developed in the field of visual arts education relating to digital technologies. The two learning designs tested in practice were anchored in Danish visual arts pedagogy generated by researchers in the field, where in a thematic outset forms the basis for art-making (eg. Buhl & Flensborg 2011, Pedersen 2004, Rasmussen 2017). The thematic framework promoted a pedagogical philosophy encapsulated in the German term Bildung (Klafki 2001) and represented visual art-making as a mode of promoting critical thinking and personal empowerment. This approach was renegotiated when the notion of visual arts education as social practice was added to the curriculum in 2009 through the term *visual culture.* This drew from scholars who boasted a new path towards visual practices drawing on contemporary arts currents and visual cultures to promote visual practices as interpreters and inventors in a rapidly changing world. This addition was consistent with international currents of developing a new and transdisciplinary approach to visuality that also included digital media (eg. Mitchell, 1994 2002, Sturken and Cartwright 2009). One analytical interest was how the thematic approach and technological practices were entangled and generated new meanings and art content. When TC was added to the national curriculum in visual arts education, this was seen in the historical context of the teaching subject. Technology's role in visual arts was a pendulum swing between a computer science-focused attention to programming to producing images digitally in the 80s, to a software attention to the use of image processing programs in the 90s, 00s and 10s (Buhl 2019, Buhl & Skov 2020, Buhl & Skov 2021). The early 20s have revealed a renewed attention to programming within computer science, reintroducing programming and computational thinking as key factors in TC and as means for art-making and societal education (Buhl & Skov 2021). The new perspective emerging from this re-entry to the school and teaching subject allowed the creation of tangible and intangible artefacts in a learning context. Furthermore, it permitted a renegotiation of the substance of the existing visual arts curriculum. Thus far, digital technology was comprehended as a tool for art-making in line with other tools such as a pencil, a brush, or a modeling stick. However, the increased accessibility to more digital devices, apps and advanced data processing challenged the tool-metaphor in the teaching of visual arts. This perspective formed another analytical interest in the study.

Knochel (2016) posited from an actor-network perspective that image-processing programmes are non-human didactics because they instruct students in how to perform visual actions. Inspired by Latour's (2005) actor-network-theory (ANT), his example adopted a broader perspective regarding how learning situations may be approached as a complex of social and material agency. On the one hand, image-processing programmes simulate recognisable analogue tools; on the other hand, they offer new and different production possibilities such as countless layers, multiple form manipulations and endless editing possibilities without destroying the material basis. Technology offers a new materiality and thereby new opportunities for art productions that might surface in situations of practice. Following the perspective of Knochel (2016), art-making could be approached as a social and material process with a new set of possibilities for visual production where digital technology was a co-productive partner. Fenwick and Landri (2012) contended that the agency of digital technology and other materialities challenge the well-established dichotomy between human intentionality and non-human objects. They suggest that this dichotomy must be overcome for a fuller understanding of learning processes, and their position supported Knochel's suggestion of the 'non-human didactic'. From this perspective, digital technology not only offers new digital activity forms; it exposes the traditional means of thinking about arts learning practices in education and offers another manner of conceptualising the art-making process. The social material approach offers a perspective on art-making practices that involves both human and non-human agency in a continuous flow of events involving schedules, bodies, digital access codes, desks, phones, pencils, stories, chewing gum, course syllabus, bananas and electricity as actors in the meaning-making process. An art-making class with 3D modelling and video hacking performed in a physical and online environment forms a 'continuum of materials, ideas, symbols, desires, bodies, natural forces, etc. that are always active, always reconstituting themselves' (Fenwick and Landri 2012, p. 3). Fenwick and Landri proposed the term *hybrid assemblages* to describe how learning emerges from a continuous social practice of materialities of 'doing', to which meaning is attributed (ibid). In the present study, this notion of hybrid assemblages formed the empirical basis for analysis of the social practices of art-making as well as the framework for understanding how the negotiation between art and technology is enacted.

4. Analysis

This section presents the content combined with the key findings from the study's two interventions. The following elaborates on the analytical perspectives regarding how the learning designs were conducted as an entangled technology and art-making process, and as a negotiation with digital technology in meaning-making as an impetus for renewing visual arts content.

4.1 An entangled process of technology and art-making framed by two learning designs

Intervention 1: 3D modelling

The aim in the first pedagogical intervention was developing both the students' visual arts competences and their technological comprehension of the 3D modelling program Tinkercad. The main idea in the 3D modelling was to highlight a digital means of modelling as opposed to a traditional analogue 3D modelling method (e.g., using clay) and to approach it from the perspective of digital aesthetic and architectural skills.

The learning design consisted of the following:

- 1. Working on-site in an urban environment aiming to improve architectural and aesthetic qualities and ensure experiences with urban architecture through photo documentation and sketching ideas.
- 2. Introducing national and international artists working site-specific.
- 3. Introducing 3D modelling in architecture, art and design in general, and to the Danish visual artist Morten Modin[2] andhis artistic processes and reflections on digital 3D modelling.
- 4. Insights in TC in the Danish school pilot programme and in the subject of visual arts.
- 5. 3D modelling prototypes for the urban site and testing the visual aesthetics in relation to code blocks, programming and construction produced by student teachers.
- 6. Use an image processing app to install the prototype in the selected urban placement.
- 7. TC content focusing on digital empowerment, computational thinking and technological capacity.

The educational intention was to comprehend the technology through hands-on experiences by performing experiential and reflective visual art activities, which was an approach familiar to the students (e.g. Buhl & Flensborg 2011, Buhl & Skov 2021, Rasmussen 2017). Furthermore, another aim was to relate to their future working field as art teachers in school, where TC is a growing focus point, as this would make a relevant competence. Thus, the computational modelling process was established in line with an analogue modelling process, but this time using data rather than clay as material. The thematic outset was urban architecture.

While working in Tinkercad, the students were urged to investigate the possibilities for changing the code blocks and the resulting effect on the aesthetic visual output. After several experiments with different shapes, repetition, constructing with holes, and respectively with or without transparency, etc. in the prototypes, the art students were encouraged to creatively reflect on the actions' impact on the constructed code and the visual expression. They were to analyse the code blocks and their function in the algorithm and to examine the effect of re-ordering the code and to assess whether some codes were more important than others. This was meant

[2]Modin, Morten: https://www.mortenmodin.com/

to establish coherence with technological comprehension in terms of code blocking and construction as well as contribute to critical reflection about the pros and cons of using technology in art-making. To connect experiences from everyday fields, the students were asked to identify experiences similar to programming and construction (e.g., Minecraft or LEGO). Moreover, the students were instructed to construct a common professional visual arts and technology glossary to support awareness of a visual arts perspective and a technological comprehension perspective as well as possible crossovers between the two disciplines, such as displacement, principles of construction, etc. However, it turned out to be quite difficult for the students to understand the possibilities in Tincercad for changing the code blocks and the resulting effect on the visual output as the students instead perceived it as 'just' a possibility of designing visual arts as opposed to being a matter of technological comprehension as well. Most of the students had never used a 3D- modelling program. Furthermore, it was their first real encounter with the concepts and perspectives of technological comprehension. The timeframe of about eight hours determined by the overall project design did not leave them much space to reflect and to feel in charge in the process.

Intervention 2: Video hacking

Based on the experiences from the 3D modelling intervention, the second intervention was designed in a different manner, still concerning both the possibilities for developing the students' visual art competences and technological reflections. This time, the learning design addressed two technological assets as the thematic core for art-making in order to investigate how they could engender new art forms. Their use of technology was guided by aesthetic methods and interests.

The main idea behind *Video hacking* was to focus on BIG DATA and artificial intelligence (AI) in relation to art and to visual art as a subject in its own right. This was done in combination with introducing two Danish visual artists' aesthetic methods and reflections, through theoretical perspectives, and through students' own video works.

The learning design consisted in a combination of the following:

- 1. Introducing the Danish visual artists Christoffer Ørum[3] and Cecilie Waagner Falkenstrøm[4], their aesthetic methods and their reflections relevant for the topic of BIG DATA.
- 2. Artist talks and discussions with a museum director on BIG DATA and art generated via AI (streaming event).
- 3. Theoretical perspectives on TC by Fibiger (2020) and technology phantasy by Toft Nørgaard (2020).
- 4. The visual arts students' own video productions and video hacking related to performing and understanding pattern recognition in AI.
- 5. TC focusing on digital empowerment and computational thinking.

In groups, students were instructed to produce a video on the theme *Landscapes*. After having produced videos that reflected different perspectives regarding the theme, each group was asked to hack another group's video either by hacking a colour, a pattern or the soundtrack. First, the students had to closely watch another group's video several times before discussing possible systematics for hacking. What would be an interesting take from a visual arts perspective - a colour, pattern or a new soundtrack? The students were then instructed to make a few tests and determine whether the video worked visually, regarding sound or perceptually before disrupting the other group's video. Finally, when showing both the original and hacked video versions, the other students were asked to attempt to crack the code and reflect on what meaning the hacking could have for the experience of the video.

4.2 A negotiation with digital technology in meaning-making as an impetus for renewing visual arts content

The first intervention produced empirical data that situated the software app as a prominent material actor. To some extent, it played a role as a non-human co-instructor due to the programmed automation that offered the students actions buttons for blocks, surfaces and colours in a grid construction environment. As they entered

[3]Ørum, Kristoffer (2016): Art Talk (in danish): https://vimeo.com/166496451 & Ørum, Kristoffer: http://www.oerum.org/
[4]Falkenstrøm, Cecilie Waagner: https://www.ceciliefalkenstrom.com/

the app, the 'machine teacher' guided them towards activating its functions (Knochel 2016). This 'machine teacher' took over instructions on a machine level, and the art educator's role was to create the overall connection between the students and Tincercad's constructions and the urban and architectural theme. The students were provided a manual and asked to become acquainted with the functions of Tinkercad beforehand. Nevertheless, the production process was accessed with reservations among some students. Others appeared to have understood Tinkercad and experimented with diverse functions on screen. Approaching the Tinkercad, other materialities were observed to be involved in the hybrid assemblage as well (Fenwick & Landri 2012). For instance, paper and pen acted in relation to the tablet with parallel utterances. There were several turns where the paper acted as the supporter and scaffolder for the modelling activity or even as the constructor. The making processes were often interrupted by the students checking their phone or moving on the chair, leaving the room, eating bananas or fetching coffee. In terms of time spent, it cannot be traced which one was the key activity. Students appeared insecure around the art-making process on screen and involved several material co-actors in the process. Although the students were experienced users of technology in their everyday lives, the construction of an architectural artefact for the urban place was not terminated.

Invention 2 made it easier for both the students and the teacher educator to focus on visual aesthetic qualities alongside a critical but curious perspective on AI as an increasing part of everyday life. The process was driven by their own experiences with AI and a general interest in video as a means of visual expression. The programme's obstacles from intervention one vanished. The hybrid assemblage of actors was still present but played the role of a product enhancer rather than a parallel solution or escape. They knew about hacking, specifically hacking in the sense of positive intervention. Involving artist talks and seeing how artists use and discuss AI and pattern recognition in relation to art eased the technological capacity building and capability to reflect on it. Furthermore, the entangled technology and art-making increased their comprehension of big data as a tool for art as well as a societal perspective and concern regarding the reciprocity of data for the use of data.

The period of about eight hours was a challenge considering the qualifications and the development project's goal of developing students' technological comprehension as well as enhancing their digital skills and their visual aesthetic productive skills. Likewise, it was a challenge for the art teacher educator to frame the educational course content while being in a learning position herself and exploring how to use digital technologies in art teaching with a new technology-comprehension focus. The content derived from computer science seemed to overtake the art-making process in intervention one. However, it appeared that the bridging of everyday experiences from video production and hacking and the new learning field of technology as material for art-making fostered the critical and reflective approach derived from the field of visual artistic cognition in the second intervention.

5. Conclusion

The transition away from the tool metaphor towards a technological comprehension approach involving programming, construction and computational thinking provided the visual arts curriculum new content and the opportunity to teach digital empowerment from a visual arts perspective. This approach was an unexpected paradigmatic shift for the students who possessed another conception their visual arts education rooted in technology adapted to analogue means and modes for production. The study demonstrated that when integrating elements from computer science with visual arts education, the levelling of two different paradigms is crucial. While the difficulties with operating the software app took over in the intervention and diminished the art-making perspective, the second intervention led to both new artistic insights as well as technological comprehension of the working of big data. The experience from the first intervention revealed the various material actors that were involved in the process, which provided insights regarding the functions of the hybrid assemblage perspective, which may inspire a wider perspective concerning how a digital learning environment should be equipped and the richness of learning modes students use. Finally, the study showed how the educator needed to develop reconceptualising skills by transforming programming into hacking activities and thereby facilitating another approach to technology comprehension. The study concluded that teacher education in visual arts holds potential for using computer science elements for renewing the curriculum and framework for artistic learning. However, the artistic entrance for both students and educators is crucial for effective integration.

References:

Amiel, T., & Reeves, T. C. (2008) "Design Based Research and Educational Technology: Rethinking Technology and the Research Agenda." *Educational Technology & Society*, 11 (4), 2008, pp. 29–40

Barab, S. and Squire, K. (2004) "Design-based research: Putting a stake in the ground." *Journal of the Learning Sciences*, 13(1). p.1–14.

Buhl, M. & Skov, K. (2021). Har i robotter til at male for jer? [Do robots your artmaking?] *Tech 10*

Buhl, M., & Skov, K. (2020). TechArt learning practices for 1st to 3rd grade in Danish schools. I C. Busch, M. Steinicke, & T. Wendler (red.), *Proceedings of the 19th European Conference on e-Learning, ECEL 2020* (1 udg., Bind 19, s. 73-79). Academic Conferences and Publishing International. Proceedings of the European Conference on e-Learning. https://doi.org/10.34190/EEL.20.047

Buhl, M. (2019) Computational thinking utilizing visual arts, or maybe the other way around. In R. Ørngreen, M. Buhl, & B. Meyer (Eds.), *Proceedings of the 18th European conference on e-learning,* (pp. 102–108). Academic Conferences and Publishing International. https://doi.org/10.34190/EEL.19.138

Buhl, M. & Flensborg, I. (2011) *Visuel kulturpædagogik* [Visual Culture pedagogy]. Corpenhagen: Hans Reitzels Forlag

Caeli, E. and Bundsgaard, J. (2019) "Datalogisk tænkning og teknologiforståelse i folkeskolen tur-retur, [Datalogical thinking and technological understanding in primary school back and forth]" Læring og Medier (LOM), *11*(19), 30. doi: 10.7146/lom. v11i19.110919

Danish Ministry of Education. (2019a) *Tilføjelse til læseplan i Billedkunst* [Addition to curriculum in visual art]. Retrieved from https://emu.dk/sites/default/files/2019-02/7592_Bilag_L%C3%A6seplan_Billedkunst_web_FINAL-a.pdf

Danish Ministry of Education. (2019b) *Fælles mål teknologiforståelse* [Common learning objectives for technology comprehension]. Retrieved from https://emu.dk/sites/default/files/2019-02/GSK.%20F%C3%A6lles%20M%C3%A5l.%20Tilg%C3%A6ngelig.%20Teknologiforst%C3%A5else.pdf

Fenwick, T. & Landri, P. (2012) Materialities, textures and pedagogies: socio-material assemblages in education. Pedagogy, Culture & Society, 20:1, 1-7, DOI: 10.1080/14681366.2012.649421

Fibiger, J. (2020): *Teknologiforståelser*. *[Technology understandings]* Frederiksberg: Samfundslitteratur

Klafki, W. (2001/1985). *Dannelsesteori og didaktik. Nye studier* [Org.: Neue Studien zur Bildungstheorie und Didaktik]. Klim.

Knochel, A. (2016). "Photoshop teaches with(out) you: Actant agencies and non-human pedagogy." *Visual Arts Research,* 42(1), 71-87

Knochel, A.D. & Patton, R. M. (2015) "If Art Education Then Critical Digital Making: Computational Thinking and Creative Code, *Studies in Art Education",* 57(1), 21-38,

Latour, B. 2005. *Reassembling the social: An introduction to actor-network theory.* Oxford: Oxford University Press.

Mitchell, W.J.T. (1994) *Picture Theory: Essays on Verbal and Visual Representation.* Chicago: University of Chicago Press.

Mitchell, W.J.T. (2002) Showing seeing. *Journal of Visual Culture 1*(2), 165-181.

Mirzoeff, N. 2000. *An introduction to visual culture.* New York: Routledge.

Meyer, B. T. 2016. Mobile devices and spatial enactments of learning: iPads in lower secondary schools. In I. I. Arnedillo and P. Isaias, eds. *Proceedings of the 12th International Conference on Mobile Learning* (1 udg., Bind 1, s. 3–10), Washington, DC: International Association for Development.

Ministry of Education (2018b) Handlingsplan for teknologi i undervisningen. [Plan for technology in teaching]. https://www.stil.dk/-/media/filer/uvm/udd/fgu/180201-nyhandlingsplan-for-teknologi-i-undervisningen-februar-2018.pdf?la=da

Ministry of Children and Education (2021): Technology Comprehension: https://emu.dk/grundskole/teknologiforstaaelse/technology-comprehension?b=t5-t34

Pedersen, K. (2004) *Rekonstruktion af billedpædagogikken. [Reconstruction of art pedagogy]* Copenhagen: Danish University of Education Press.

Rasmussen, H. (2017) *Kompleks betydningsfremstilling i digitalt billedarbejde og billedæstetisk kompetenceudvikling i skolen [Complex meaning-making in digital visual production and visual aesthetic competence development.* (Doctoral dissertation) Aalborg Universitetsforlag, Aalborg.

Sturken, M., and Cartwright, L. (2009) *Practices of Looking: An Introduction to Visual Culture*. New York: Oxford University Press. 2nd ed.

Toft Nørgaard, R. (2020) Teknologifantasi. [Technology Fantasy] *KvaN* 117/2020

Sturken, M., and Cartwright, L. (2009) *Practices of Looking: An Introduction to Visual Culture*. New York: Oxford University Press. 2nd ed.

Tuhkala, A., Wagner, M.-L., Nielsen, N., Iversen, O. S., & Kärkkäinen, T. (2018) "Technology comprehension: Scaling making into a national discipline." In M. Giannakos, M. Divitini, L. Jaccheri, & O. S. Iversen (Eds.), *FabLearn Europe '18: Proceedings of the Conference on Creativity and Making in Education* (pp. 72–80). Association for Computer Machinery. https://doi.org/10.1145/3213818.3213828

Wagner, M-L. Iversen o. s., Caspersen, M. (2020) Teknologiforetåelsens rationale. På vej mod compuationel empowerment i dan danske grundskole [tehcnological comprehension's rationale.Towards compuational empowerment in Danish primary School. *UP.* (81) 1, 2-15

Wenger, E. 2000. *Communities of practice: Learning, meaning, and identity.* Cambridge: Cambridge University Press.

Wing, J. M. (2006) "Computational thinking." *Communications of the ACM*, 49(3), 33-35. https://doi.org/10.1145/1118178.1118215

Building Organisational Capacity for Blended Learning: An Evidence-Based Approach

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Abstract: Blended Learning has become a vital part of Higher Education's teaching strategy. The Covid-19 pandemic has demonstrated the need and demand to combine the best from online and face-to-face; synchronous and asynchronous. Simultaneously, it has exposed deficiencies in the sector's capacity to deliver high-quality and effective blended learning. As a consequence, universities need a mechanism for identifying i) current capacity to deliver blended learning, ii) the work required to achieve the ideal state, and iii) a reliable measure of their progress towards it. Many models of blended learning have been proposed in the literature, along with numerous examples of good practice. However, there is no single framework that defines all the elements required to deliver a blended learning approach and allows Universities to easily benchmark their organisation's capacity. This paper presents the rationale for such a framework together with a high-level design; it explores its possible use in the implementation and evaluation of an HE blended learning programme. By combining previous experience in use of an e-learning Maturity Model to assess organisational capability, with an extensive review of current literature, the authors propose an evidence-based framework for blended learning. The framework defines the key elements required, including the environment, the curriculum, the educators and the learners. By clearly defining the relationships between the elements, and capturing the attributes for each, the model can be used to assess an organisation's capacity to deliver effective blended learning. The authors have curated and synthesised hundreds of good practice guidelines and quality criteria for blended learning and, drawing on their own experience in this area, have distilled them into a set of clear performance objectives for each element. This is presented as a checklist for organisations to determine their current state and provide clear goals to work towards. Regular monitoring and review of these objectives can be used to measure an organisation's progress and its relative maturity as a blended learning provider. The paper concludes with some early examples of its use to develop organisational capacity in a UK University, together with recommendations for future development and application in Higher Education quality management.

Keywords: blended learning, organisational capacity, implementation, blended learning framework

1. Rationale for an evidence-based model

Blended Learning is described in many ways by many different people with no single agreed definition. However, Blended Learning is more generally seen as an opportunity to leverage online activities completed outside of formal in-person timetabled activities, for the purpose of students achieving course learning objectives. Garrison and Vaughan (2008) suggest that Blended Learning provides students with the best learning experience because it incorporates the strengths of both face-to-face and online learning instructional pedagogies. Blended learning is now commonly employed in Higher Education (HE) to deliver, or support delivery of, degree-level and postgraduate taught programmes (Castro, 2020). Blended learning offers institutions the opportunity to leverage learning technologies to personalise the student learning experience, employing adaptive strategies to address individual learning needs.

The use of online technologies for content delivery means that institutions can make more strategic use of their physical environments, moving beyond the need to build and maintain large lecture hall spaces for didactic whole-cohort teaching into a new era heralding the use of mobile and laptop-based technologies. The move from in-person teaching to online teaching has also been catalysed by the need to limit large indoor gatherings, to prevent transmission of COVID-19. Social distancing has meant that for many disciplines, in-person teaching has moved to being significantly online-based and remote. Implementing blended learning programmes effectively requires a clear educationally underpinned design and co-ordinated planning to be successful. Garrison and Kanuka (2004) highlight the variety of policy and practical issues that universities need to consider. These include strategic planning of financial, technical and human resources, course scheduling (e.g., if fewer face-to-face lectures will take place), and tutor and student support. These key considerations sit within a broader ecosystem of tools and processes, however, so cannot be considered as isolated variables. A key challenge for organisations, therefore, is how to establish a whole-system view of their capability and capacity.

An ontological based approach offers a possible framework to articulate such a system view (Al-Yahya et al, 2013).

An ontology is a formal description of knowledge as a set of concepts within a domain and the relationships that hold between them. To develop such a description, the components such as individual objects, attributes and relations as well as restrictions and rules must be defined. Ontologies not only introduce a sharable and reusable knowledge representation but can also be used to develop new knowledge about the domain. Within this paper, we explore how a synthesis of literature can be used to build an ontological framework of blended learning, which can then be used as a tool to evaluate and develop organisational capability.

2. Review of current literature

Over the past two decades, much research has been carried out into the effectiveness of online and e-learning, with various models and good practice frameworks proposed. Schneider (2014) catalogued 108 different educational models on instructional design approaches alone. Beyond this, there are broader models that seek to articulate good practices in effective organisations. Some, such as Marshall (2010) and Lim (2001) have based these on Chickering & Gamson's Seven Principles for good practice in undergraduate education (1987), thereby ensuring a direct relationship to an evidence-based set of principles. Others, such as Henderson (2015) have created models by distilling good practices from successful and effective e-learning initiatives. Alongside the proposed models, there is a greater body of work into the effectiveness of e-learning and good practice generally. Some, such as Kwok (2015) have proposed hypotheses of what constitutes good practices, then tested these using various metrics, whilst others such as Swann (2001) have identified good practice based on student satisfaction and learning outcomes.

In more recent years, research specifically into Blended Learning has grown and a small, but growing, number of Blended Learning models proposed. Some such as Khan's Blended Learning Framework (Singh 2003) are extensions or adaptations of existing e-learning models, whilst others such Perris (2020) are new frameworks based on the capture and synthesis of good practice. Many however, such as The University of Northampton's report on Active Blended Learning (Palmer et al, 2017), are locally produced and distributed in order to inform and advise academics of a single institution. Such publications are often evidence based, using a combination of student feedback and the research literature to support their recommendations, and as such contribute to the growing evidence of good practice in this area.

So why, with such a large and expanding body of research and frameworks, the need for another? The need arises from the failure of current models to both capture all aspects of a blended learning implementation and to articulate each aspect in a way that allows an organisation to identify and rectify deficiencies. In seeking to implement Blended Learning into their respective organisations, the authors drew on their experience of using Marshalls e-learning Maturity Model (eMM) (Calverley et al, 2007; Cappelli and Smithies, 2008). Such a model:

> *"provides a clear picture of an organization's current capabilities and describe the practices that are needed to improve capability." (Marshall 2010)*

However, eMM does not take account of different practices and processes associated with Blended Learning that have emerged since the model was last updated. It is also very process orientated with underlying practices at an organisational level rather than dealing with practical operational activities. Other frameworks based on Blended Learning research do provide more operational practices, such as The Quality Assurance Rubric for Blended Learning (Perris and Mohee, 2020). Designed to "support making reasoned decisions in the development and use of blended learning" (Perris and Mohee, 2020) the rubric describes 48 quality 'elements' divided into 7 different categories. This rubric provided a useful starting point for implementing Blended Learning for the authors, but it too lacked key elements of a Blended Learning strategy. For example, it was clear from the literature that the skills of the tutor, and their interactions with students played a key role in the success of Blended Learning (Kwok, 2015; Manning, 2015) and yet these were noticeably absent from the Perris and Mohee model. Similarly, the Blended Learning Framework adapted from Khan's e-learning Framework (Singh, 2003) lacked key elements necessary for a complete, integrated implementation of Blended Learning. As Bowyer and Chambers point out, "The framework does not appear to contain any instruments for evaluation" (Bowyer and Chambers, 2017)

What was needed was a broad, comprehensive framework that described all aspects of a Blended solution. As Bowyer and Chambers state, "Implementing a blended learning programme requires coherent and co-ordinated planning to be successful. These include strategic planning of financial, technical and human resources, course scheduling… and tutor and student support. These will all need careful consideration if universities and/or schools contemplate introducing blended learning elements." (Bowyer and Chambers 2017). Henderson et al (2015) took a broader view, arguing any model needed to encompass the full 'ecology' of the organisation:

> *"Understanding the university 'ecology' therefore highlights the varied influences at the level of the individual student and teacher, alongside the layered 'context' of the classroom, department, faculty, university, local community, state and nation." (Henderson, 2015)*

No model fully articulated all aspects of such an ecology and more importantly, the relationship between them. There is a natural dependency between practices in these areas; for example, the skills of tutors to use technologies depends on the technologies being available to them. The relationship between these elements is therefore critical in realising how implementing new practices in one area, impacts on another. As Schwab points out, "Design of the 'right' blend between pedagogy, space and technology is crucial" (Schwab, 2017). Too often implementations fail because organisations focus on a single key aspect, such as tutor capacity, without ensuring the interdependent practices that enable this are addressed.

An ontological based approach could offer one way to articulate such relationships as proposed by Hayashi et al (2006), yet Hayashi's model focussed solely on the design of single learning activities and was too narrow to be useful. Hence, the authors sought to devise an evidence-based model that captured the practicalities of a maturity model rubric with the usefulness of an oncological framework.

3. Process - creating and populating a blended learning model

The process of creating a model started with a set of tenets on which to base the model. These were:

a. The model should describe the full set of elements that constitute a Blended Learning eco-system, the relationship between these elements and the attributes of each in an oncological-based approach. This was felt to be the best way to conceptualise a complex, interdependent system

> *"An Ontology provides a shared model for the conceptualization of a specific domain. It consists of a set of concepts in a taxonomic classification along with the relations between these concepts " (Al-Yahya et al, 2013)*

b. The model should provide a set of 'statements' that describe good practice, against which an organisation can allocate resources and measure progress

> *"In order to improve the maturity of the organisation, it was necessary to look at examples of best practice taken from the literature and existing competency models to provide our baseline." (Cappelli and Smithies, 2008)*

c. Finally, the model should be evidence-based. All examples of good practice, statements and recommendations used to build and populate the model should be based, directly or indirectly, on solid, researched evidence

The four-step process used successfully to create a Training Needs Analysis (Cappelli and Smithies, 2008) was utilised to create the model. This involved:

4. Select relevant statements from the literature

The initial step involved identifying relevant papers by completing library and internet searches on keywords. This resulted in over 100 papers that were quickly narrowed down to those that were both evidence-based and provided clear statements or recommendations of good practice. The search was then widened to include more specialised papers that focussed on particular aspects of blended learning, such as evaluation, before filtering again. This resulted in around 50 papers but continues to grow as the cycle is repeated.

As the statements were extracted, it became clear that although each described a particular aspect of the learning ecology referred to by Henderson (2015), they were described using a wide range of terminologies. This reflects Hayahsi's (2006) assumption that, "although many theories prescribe the same method for the same situation, these are described in different terminology", and he proposes an ontology to combine these theories, thus strengthening the case to use an oncological approach.

5. Group statements

The next step was to try and articulate a Blended Learning ecosystem by describing the various elements and their relationships and attributes, with the intention of grouping the statements into their appropriate element. Starting with the seven categories from Perris and Mohee's (2020) Blended Learning Rubric as the most current and relevant, the model was added to by taking elements from eMM (Marshall, 2010), Henderson (2015), Khan (2001) and Fullan et al (2020). As the model grew, elements were merged, sub-divided and re-named to reflect their relevance and interdependencies in the framework. With each iteration, the relationships between the elements emerged enabling the ontological model to be fully defined and articulated. The model is shown below in figure 1.

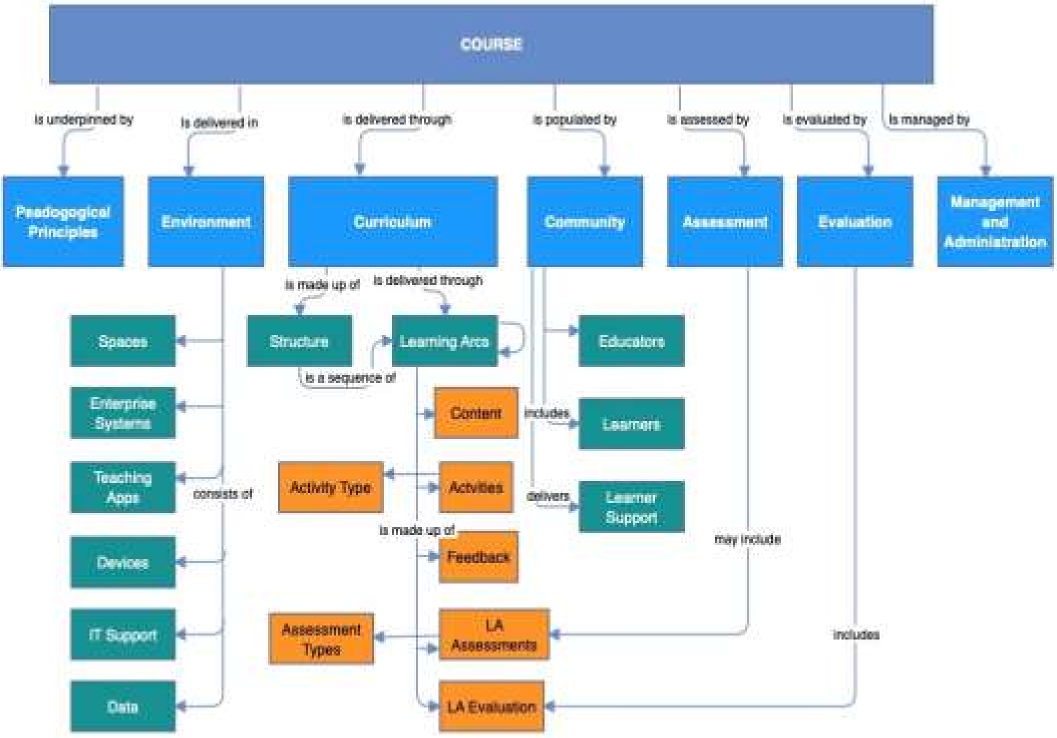

Figure 1: Blended learning model

At the heart of the system is the *Curriculum*, the *Environment*, and the *Community* (Educators and Learners) which reflects the key models on which the model is based. In order to articulate the constituent parts of the Curriculum whilst remaining agnostic, it was important to avoid terminology such as 'module' or 'unit'. Instead, the authors referred to the work of Vygotsky (Hall 2007) and Bruner (1960) who saw 'Learning as a process' that moves the learner from one level of understanding and ability to another, whilst building on previous knowledge. Thus, each learning episode was termed a 'Learning Arc' that reflects the journey of the learner from point A to point B; Learning Arcs can be constructed of, and build on, other Learning Arcs. The Curriculum Structure defines how the Arcs are sequenced and arranged to form the curriculum. Arcs consist of content, activity, feedback, assessments, and evaluation. These, together with the more recognisable elements such as Assessment and Evaluation, seemed to encompass the full scope of a Blended Learning ecosystem. The devised model was used to group the statements collected from the papers. This not only provided a way of populating the model with statements of good practice, but also acted to test the validity and integrity of the model. Since all statements fitted the model and all elements were populated, then we could be reasonably confident of the accuracy of the model.

6. Synthesis and re-articulate of the statements

Once grouped, some elements such as Educators had over 100 statements, whilst others had less than a dozen. It was clear than many of the statements in each element were essentially the same, or similar, though written in different terminology as Hayahsi (2006) predicts. The next step therefore involved synthesising the statements to both reduce duplication and to arrive at a common terminology. Since the statements were a mix of principles, criteria, recommendations or objectives, this involved re-phrasing statements into a common 'format'. The aim was to provide a condensed set of statements that provided an indication of what the 'ideal' ecosystem should contain so the definition of 'Desired State' from organisational development was utilised. The desired state defines what your business will look like and will have accomplished once your strategy is complete (Oakley-Browne et al, 2003). Hence, the final statements were written as a series of desired state objectives that defined a clear practice or competency that could be achieved and measured within each element. For example, many of the original statements stressed the need for educators to use different technologies competently and in a co-ordinated way. Through combining, filtering and re-editing these, this became:

> *"Be familiar with the different digital technologies in use and work fluently across them to achieve teaching and assessment tasks; be able to orchestrate the technologies in meaningful conjunction with teaching."*

This process reduced the 100 plus statements for Educators down to 28 core Desired States. Doing so, made it clear that these fell neatly into specific domains for each element. For example, the Educator statements fell clearly into 'Learning Design', 'Content Production', 'Teaching Delivery', 'Learner Support' and 'Use of Technology' thereby giving us a three-tier model of connected *Elements*, each made up of two or more *Domains*, with each domain containing a set of *Desired States*.

7. Verify the statements

Since each statement used was taken from evidence-based work, they already held a high degree of credibility. The fact that most statements were replicated, using varying terminology, supported that credibility and proved such practices were transferable, replicable, and consistent. The process of synthesis therefore provided validation that the statements could be used as a Desired State objective with a high degree of confidence. Any statements that were clearly different from any other recommendations, and not replicated elsewhere, have not been included. Instead, they have been marked for further investigation to determine if any other work can be found to support them or if they are indeed a random outlier.

8. Progress to date and early use

To date, the authors have reviewed over 100 papers and collected nearly 600 statements of good practice, recommendations, guides or criteria for success and added them to the model. The model is fully articulated with each element defined by its properties and relationship to other element and each element populated with statements. Some elements such as Educators, Learners and Curriculum were heavily populated, so have been synthesised, domains defined, and Desired State objectives articulated. Other elements are sparsely populated and require further research. There is still much work to do. The outlying statements need additional research and further cycles of search, filter and extraction need to occur before the model is complete and ready for use as a guide to implementing and monitoring Blended Learning. In addition, dependencies between individual Desired States will be mapped to ensure new practices are not implemented in isolation. The model will then enable leaders to identify sets of practices, across the ecosystem, that need to be achieved in order to ensure a coherent and sustainable Blended Learning implementation. However, even in this early iteration, the model has proved to be of value.

The genesis of this model was the need to implement a new Blended Learning Programme at a UK University. The short timescale available necessitated targeting areas in the greatest need of development that would have the greatest impact, whilst ensuring good practice was either followed or strived for. The early iteration of the model demonstrated the importance of educator skills, learner preparation and well-designed content. Having a set of '*Desired State'* objectives for each of these enabled the University to quickly identify which practices were currently followed and address deficiencies. For example, the Leadership Team worked with instructional Designers to establish new design principles and a new content framework based on good practice. Using a digital skills survey with students, the leadership team also identified how much and what type of support was needed to equip Learners with the best skills to complete the course successfully, whilst the links between '*Educators*' and '*Learners*' in the model identified the key role tutors had in that. Longer term, the model will be used to review the technological landscape and identify organisational practices in capacity building to ensure the Blended Learning implementation is sustainable and the University moves towards the optimal '*Desired State'* for Blended Learning.

9. Discussion

Over the last two decades, various attempts have been made to assess and benchmark organisational capability in online education (e.g. Marshall, 2010), but a number of limitations have been identified with these approaches. Extensive evidence is needed to assess any given process effectively and such approaches often seek to selectively isolate specific characteristics of learning and assessment provision, without due consideration to the context and broader organisation within which they sit. Processes are often agnostically assessed, abstracted from underpinning pedagogy, organisational culture and policy, systems affordances and practical limitations. When the drivers are to improve service delivery, alignment of these factors with evaluation approach and organisational strategy is key to enable meaningful synthesis of evidence. Without defined ontological linkages between these key organisational activities, it is the authors' experience that efforts to translate findings of extensive evaluations into action, with associated resource plans, become stifled by uninformed decision-making at executive level. Within this paper, we have described a method of synthesising literature to build an ontological framework. A proof-of-concept model has been developed using this method, demonstrating the interconnections between environment, actors, systems and processes. Whilst theoretical approaches exist to interpret educational systems, such as Activity Theory (Engestrom *et al*, 1999) and Actor-Network Theory (Latour, 2005), these are overly abstracted from formally defined processes and as such are often disconnected from the organisational aims of an institution. An empirically grounded ontological model has the potential to address this gap by providing a whole-system view of the organisation, leveraging the defined linkages between policy, structures and practice to enable effective strategy formulation and decision making for blended provision. Waering (2021) highlights that evaluation of educational processes is necessary to drive improvement, by identifying what works best and enabling information about the effectiveness of educational approaches to be shared amongst university staff and between institutions.

> *"There is clear evidence that educational performance and educational gains can be enhanced by adopting certain educational practices…Pooling data across such innovations… provides a valid basis to guide other institutions in the adoption of practices that are likely to be effective." (Gibbs, 2010).*

A methodology that employs an iteratively developed ontological model enables meaningful mapping of policies, initiatives, technologies, people and processes. This approach clearly has a number of advantages for organisations that are seeking to establish a unified overview of their capabilities. As highlighted, process-driven benchmarking models and the more theoretically driven methodologies are valid approaches that organisations may choose to employ for evaluation, but these serve defined and limited purposes. We hypothesise that through the development of an empirical evidence base, employing an ontological model, there is potential to trace through and effectively appraise the impact of changes to policy, resource and practice across an organisation.

10. Further development and next steps

The initial iteration of the model presented here is an initial step in developing and validating an evidence-based model. The methodology presented is novel and based on the authors' prior experience, conducting institutional mapping and benchmarking of eLearning provision at a large campus-based university (Calverley *et al,* 2007). The methodology and first version of the ontological model have been developed and validated within a single Higher Education institution, based in the UK. Further mapping can now be undertaken, to further evidence, validate and extend the model. The utility of rich evaluation data, elicited using a maturity modelling approach, has been proven to support rapid identification of organisational learning needs (Cappelli and Smithies, 2008). This demonstrates that evidence collected using an evidence-based model has the potential to catalyse adoption of new technologies and enable the workforce to more effectively leverage innovative pedagogies. An important next step is to further develop and establish the ontological model through its use at a range of different academic institutions, and to understand what cultural and organisational constraints impact on its adoption.

References

Adekola, J., Dale, V.H., Gardiner, K. and Fischbacher-Smith, M. (2017) Student transitions to blended learning: an institutional case study. *Journal of Perspectives in Applied Academic Practice*, *5*(2), pp.58-65.

Al-Yahya, M., Al-Faries, A. and George, R. (2013) Curonto: An ontological model for curriculum representation. In *Proceedings of the 18th ACM conference on Innovation and technology in computer science education* (pp. 358-358).

Bowyer, J. and Chambers, L. (2017) Evaluating blended learning: Bringing the elements together. *Research Matters: A Cambridge Assessment Publication*, *23*, pp.17-26.

Bruner, J.S. (1965) The process of education. *The Physics Teacher*, *3*(8), pp.369-370.

Calverley, G., Cappelli, T., Dexter, H., Petch, J. and Smithies, A. (2007) Changing practices in the development of digital resources. In *Proceedings of Solstice Conference 11th May*.

Cappelli, T. and Smithies, A. (2008) March. Learning Needs Analysis through Synthesis of Maturity Models and Competency Frameworks. In *Society for Information Technology & Teacher Education International Conference* (pp. 2448-2455). Association for the Advancement of Computing in Education (AACE).

Castro, R. (2019) Blended learning in higher education: Trends and capabilities. *Educ Inf Technol 24, pp.2523–2546*

Engeström, Y, Miettinen, R, Punamäki, RL, (1999). *Perspectives on Activity Theory*. Cambridge University Press.

Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. The internet and higher education, 7(2), pp.95-105.

Gibbs, G. (2010). Dimensions of quality. *The Higher Education Academy / Advance HE (Report)* *https://www.advance-he.ac.uk/knowledge-hub/dimensions-quality*

Hall, A. (2007) Vygotsky goes online: Learning design from a socio-cultural perspective. In *Learning and socio-cultural Theory: Exploring modern Vygotskian perspectives international workshop 2007* (Vol. 1, No. 1, p. 6).

Hayashi, Y., Bourdeau, J. and Mizoguchi, R. (2006) Ontological modeling approach to blending theories for instructional and learning design. *FRONTIERS IN ARTIFICIAL INTELLIGENCE AND APPLICATIONS*, *151*, p.37.

Henderson, M., Finger, G., Larkin, K., Smart, V., Aston, R. and Chao, S.H. (2015) Conditions for successful technology enabled learning. In *Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education 2015: Globally connected, digitally enabled* (pp. 134-142). Curtin University

Fullan, M., Quinn, J., Drummy, M., Gardner, M. (2020) "Education Reimagined; The Future of Learning". A collaborative position paper between New Pedagogies for Deep Learning and Microsoft Education. http://aka.ms/HybridLearningPaper

Kelley, B. (2016) Envisioning the Desired State. In *Charting Change* (pp. 63-72). Palgrave Macmillan, New York.

Khan, B.H. (2001) A framework for web-based learning. *Web-based training*, pp.75-98.

Kwok, D. (2015) Predictors of students' perceived course outcomes in e-learning using a Learning Management System. *ascilite2015*, p.155.

Latour, B., 2005. *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford: Oxford UP.

Leppisaari, I. and Vainio, L. (2015) Digital leap of teachers: two Finnish examples of rethinking teacher professional development for the digital age. *ascilite2015*, p.168.

Lim, B.R. (2001) Using "Seven Principles for Good Practice" to Teach Online Courses. *SNU Journal of Education Research*, *11*.

Manning, C. and Macdonald, H. (2015) The three pillars to building staff capability to create digital learning experiences *ascilite2015* p.502

Marshall, S. (2010) A Quality Framework for Continuous Improvement of E-Learning: The E-Learning Maturity Model. *Journal of Distance Education*, *24*(1), pp.143-166.

Mizza, D. (2018) Instructional Design for Blended Language Learning: Methodological Considerations and Course Applications Guiding the Effective Design of Blended Language Courses, *in Proceedings of the 3rd World Conference on Blended `Learning, International Association for Blended Learning* pp.132- 136

Mizza, D. and Rubio, F. (2020) *Creating Effective Blended Language Learning Courses: A Research-based Guide from Planning to Evaluation*. Cambridge University Press.

Oakley-Browne, H., Leigh, D., Watkins, R., Kaufman, R. (2003). *Strategic Planning For Success: Aligning People, Performance, and Payoffs*. Germany: Wiley.

Palmer, E., Lomer, S. and Bashliyska, I. (2017) Overcoming barriers to student engagement with active blended learning: Interim report. *Northampton: University of Northampton*.

Perris, K. and Mohee, R. (2020) *Quality assurance rubric for blended learning*.

Rahman, N.A.A., Hussein, N. and Aluwi, A.H. (2015) Satisfaction on blended learning in a public higher education institution: What factors matter?. *Procedia-social and behavioral sciences*, *211*, pp.768-775.

Sáiz-Manzanares, M.C., Escolar-Llamazares, M.C. and Arnaiz González, Á. (2020) Effectiveness of blended learning in nursing education. *International journal of environmental research and public health*, *17*(5), p.1589

Schneider, D.K. (2014) Educational (instructional) design models. *PDF generated using the open source mwlib toolkit. See* http://code. pediapress. com/for more information. PDF generated at: 02/0 5/2021 p.58.

Schwab, K. (2017) The *fourth industrial revolution*. Crown Business

Singh, H. (2003) Building Effective Blended Learning Programs. *Educational Technology,* Volume 43, Number 6, pp.51-54

Swan, K. (2001) Virtual interaction: Design factors affecting student satisfaction and perceived learning in asynchronous online courses. *Distance education*, *22*(2), pp.306-331.

Van Hees, J. (2018) How to Organize Blended Learning Support in Higher Education, *in Proceedings of the 3rd World Conference on Blended `Learning, International Association for Blended Learning* pp.46 – 50

Waering, S. (2021) Cases on Active Blended Learning in Higher Education, *in Measuring the Success of Active Blended Learning, IGI Global,* pp.292-302

Connecting the Dots: Putting Instructional Design Theory to Practice in Online Courses

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DOI: 10.34190/EEL.21.114

Abstract: Many higher education (HE) institutions struggle to connect their lofty goals for exiting students with their operational decisions around programming, especially when those programs are offered fully online. Scholarship is showing that the root of this disconnect often lies in the instructional designs (ID) of programs and the teaching and assessment approaches these designs support. The study forms part of a larger study whose aim was to apply a macro/meso/micro-driven action research initiative to align ID models being used by instructors with 21st century goals and contemporary learning theories. The aim of the study was to determine the impact of this initiative on learner profiles. The study focussed on working adult students (n=2,300), the majority from socially and academically disadvantaged backgrounds, enrolled in a 2-year full time technical institute in Chile. An action-based research approach was used involving both qualitative and quantitative data collection tools including focus groups, extensive field notes, observations and surveys. The data collection took place over 8 months, between 2020 and 2021, during which time changes to the ID model, teaching approaches and virtual pedagogical resources were mediated. Perceptions of students and teachers of the changes were collected through pre, mid and post questionnaires and in-depth interviews. Results show a salient transition among students from thinking and learning autonomously, i.e alone, in isolation, to self-directed behaviours that involve engaged participation in social collaborative learning opportunities within and beyond the virtual learning program. Importantly, evidence also revealed many students evolving from positions of disadvantage and lacking to ones depicting confident, communicative, involved and aspiring identities. These findings underline the potential that wider application of such ID models in online learning practice could have for educational development. The research could be a contribution to the emerging instances of online learning which are increasing rapidly in the wake of the COVID pandemic both in Chile and abroad. The results not only have theoretical relevance for e-learning research, but also provide empirical evidence for understanding and effective decision-making in a cross-section of institutions that offer programs through this modality.

Keywords: instructional design, higher education, distance learning, contemporary learning theories, 21st century learning goal, connecting theory to practice

1. Introduction and background

The demands on HE to balance the needs of a rapidly changing society and workplace with rising costs and funding issues have resulted in a steady migration to online learning programming. With these programs still in a relatively nascent stage, many institutions find themselves struggling to offer quality learning opportunities to a much broader spectrum of individuals than ever before. Institutions are often looking to e-learning research for answers to their struggles to ensure quality learning online. Scholars working to respond have produced a growing body of scholarship documenting promising theories and frameworks for online education (see Picciano, 2017). Yet according to recent scholarship, there is a glaring disconnect between that theory and actual online learning programs in practice (Pange and Pange, 2011; Medina, 2018). In many HE contexts, there are clear signs of a need for better solutions to close this gap. Disturbing levels of attrition in both large scale and smaller online programs (Tait & Gore, 2015) is one indication. Conventional classroom ID frameworks being used as the basis of online programs is another. Reliance on autonomous learning confined to LMS platforms, resistant faculty and adherence to standardized assessment practices (Charbonneau-Gowdy, 2018) are all further signs of the lack of clear direction of how to operationalize current e-learning theory into practice. Could it be that a blind eye is being turned on e-learning theory? More likely, as Margaryan, Bianco and Littlejohn, 2015 claim, these signs are the result of the obvious insufficient empirical evidence available in the literature on *how* to apply the promising theory for online learning that does exist into 'real' practice. Without such grounded examples and empirical evidence, institutions will continue to extoll the advantages of online learning (Allen et al., 2016) and set lofty goals for learners and learning, although with disappointing results. And in this scenario, learners and societies are the greatest losers. This study is in response to that dilemma.

The institution we report on in the study, a technical institute in Santiago Chile, acknowledged the inconsistencies that existed in the frameworks that guided their fully online programming. Leaders recognized that it failed to offer high quality returns to students based on their investments. While purporting to be focussed mainly on learners and their learning, they realized that their instructional design model instead focused primarily on teaching and on providing pedagogical and technical resources.

In the context of the study, the objective was to put in place action research involving all levels of the institution. The focus of the study was on cohorts of students entering the institution bi-monthly over an 8-month period in 2020 and 2021. The aim was to align the institution's goals with contemporary theory-based instructional design to initiate a pedagogical approach focussed on these learners and their learning. We argue that self-directed, empowered learners who seek opportunities to learn and who are convinced they have the competencies to meet the demands they will face, are the ones that will be best prepared and successful at responding to the uncertain times that lie ahead. With these preoccupations in mind, the following questions were used to frame the study:

- 1. What kinds of learner identities do these students arrive with when entering the institution for the first time?
- 2. How does exposure to instructionally designed pedagogy based on contemporary online learning theory influence their learning practices?
- 3. What impact, if any, do these e-learning experiences have on their identities as learners and professionals?

In the next sections, we describe the theoretical framework and literature on which we based the inquiry, then the methodology, research design and context. Our analysis and findings follow, and we end the paper with the implications of the results for future research.

2. Theory and literature underpinnings

The increasing visibility that contemporary learning theories, especially those based on sociocultural perspectives and 21st century goals, have gained in education scholarship over the last twenty years is encouraging. These theories and goals a) place learners and their agency at the centre of learning processes; b) are predicated on the understanding that learning is a complex social interactive phenomenon; c) involve learners in community collaborating on co-constructing knowledge based on their individual social contexts and experiences; and d) have important implications for learners' competencies and identities in a highly dynamic, technology-driven society.

2.1 Current online learning theories

Scholars working to develop theories of online education derived from these principles have offered a variety of perspectives and models. For example, Garrison, Anderson and Archer (2000) have developed the Community of Inquiry (CoI) Theory. This theory for online learning has a connection to Wenger and Lave's (1991) and Wenger's (1998) communities of practice and situated learning concepts. From this perspective, learning is a process that results from a deepening participation in a learning community. The CoI model supports IDs in which online learning takes place in active environments where instructors and students share ideas, opinions and ideas and where social presence is demonstrated through engagement in discussion boards, blogs, wikis, and videoconferencing. In 2004, Siemans introduced his connectivism theory of online learning. Appropriate to the context of our study, the object of this theory is to support designs where the aim is to *create* knowledge rather than solely to disseminate and consume it. The model illustrates the power of internet networks to move learning designs made up of internal, individualistic activities to group and community, and even crowd ones (Piccano, 2017). A third theory, the Online Collaborative Learning (OCL) theory developed by Harasim, (2012) again is focussed on collaborative learning and knowledge building supported by the Internet. Designs based in this theory then would encourage the collaboration of learners to solve problems through discourse and would consider the role of educators to be active facilitators and an essential part of the learning community.

2.2 Theory of online education models

In search of a combined theory-based model for online education, Anderson (2011) and Picciano (2009) offer individual perspectives to frame quality online distance education programs. What is particularly relevant to our study in Anderson's model is the emphasis it places on both Net-based synchronous and asynchronous activities. The model draws attention to the richness of these environments for the development of social skills, collaborative learning of content and the establishment of personal connections among participants.

Importantly, Anderson points out the incompatibility of self-paced ID models with community/collaborative ones. The changes we were making to the ID for institution-wide use was aimed at moving away from self-paced learning in isolation to a more social constructivist learning practice. A limitation of the Anderson model is that it does not take into account the affordances of distance learning courses to offer synchronous face-to-face classroom learning, i.e. blended learning scenarios. With the powerful videoconferencing applications now available to offer virtual face-to-face sessions, the model falls short of the study's intention to exploit those affordances in the design.

Unlike the Anderson model, Picciano's (2017, p.178) Multimodal Model for Online Education (Figure 1) was developed for blended learning education which aligned with the synchronous component of our design. This model is based on the premise that "pedagogy drives approaches that will work best to support student learning". Built on the work of other leading contemporary online theories for learning, it offers a viable, flexible framework for an institution-wide program, thus relevant to the changes being made in our action research study. The seven intersecting components of the model comprise the essential opportunities for learning available in a quality online program - that is through *media content*, *reflection*, *collaboration*, *assessment*, *dialogue, self-directed learning* and *social/emotional support*. These opportunities underscore the aims of the design applied in the study which were: a) to build community across macro/meso/micro levels of the institution; b) to influence the social/emotional makeup of student profiles, i.e. their identities; and c) to promote the collaborative development of 21st century skills.

Figure 1: Multimodal model for online education

2.3 Applying theoretical e-models and IDs

As pointed out above, one of the key debates in current scholarship is the lack of empirical evidence to support the viability of many theoretical models and designs (Margaryan et al., 2015). As Adinda & Mohib (2020) have shown, the benefits of the various and expanding affordances offered by technology in theory are not automatic, but rather dependent on the essential epistemological conformity that exists in *designs, approaches* and *practices* in online spaces.

IDs are one vehicle to ensure conformity between theory and practice. By ID we reference a systematic approach to *analyze*, *design*, *develop*, *implement* and *evaluate* programs (Branch and Donsay, 2015). These five conceptual phases, or ADDIE, are often used to guide the design process and ensure program quality. Yet, while many ID models for online learning have emerged over the last two decades, few are applied in practice (Margaryan, et al., 2015). One of the reasons, perhaps, is that in many instances, decisions are made in institutions to adopt ready-made designs developed for conventional learning spaces. In reaction, Sangrà et al. (2020, p.47) have argued that the concept of ID be replaced by a *techno pedagogical* design to reflect the unique pedagogical challenges in teaching and learning in online programs. Regardless of names tied to such designs, Smith et al. (2016) posit that without clear guiding design frameworks in institutions for online learning, teaching and learning practices most often revert to those in traditional settings.

A clear example of this fall-back phenomenon has been documented by Margaryan et al. (2015). In their study, they assessed and compared the ID quality, based on contemporary learning theory in the actual practice of over 76 randomly chosen massive open online learning courses, MOOCs. The 10-principle assessment framework was built on active, constructivist, collaborative and learner agentive practice criteria. The results of the assessment indicated that a majority of courses examined “fared poorly” in aligning contemporary ID with instruction and learning practices. These findings strongly underscore a justification for the present study and the need for further empirical work in connecting contemporary, *theory-based designs* to online *practice*.

3. Methodology

Our study was conducted between September 2020 and June 2021. We assumed a participatory action research approach (PAR) given our main aim to instigate gradual changes to an educational setting. Action research is well suited to investigate complex human activity and for uncovering participant voices (Creswell, 2007, Denizen and Lincoln, 2005). PAR is typically driven by a collaborative incentive to respond to challenges and effect changes in educational settings and organizations. Although PAR more recently is associated with teacher mediated change to classroom-based contexts (Manfra, 2019), the approach supported our interest to draw together macro, meso and micro levels of the institution to affect change at the classroom and learner level, as Charbonneau-Gowdy and Chavez (2019) have shown is a critical component in sustainability.

3.1 Context and participants

The study took place at a HE technical institute in Chile. Chile is considered an economically stable country, one of only 2 OECD members in South America. Despite its stability, for over a decade the deep socio-economic divide in the country has led to annual violent student protests seeking greater access to education. In the years between 2014-2018, HE enrolment numbers rose 140.7%. As a further indication of the demand for access to opportunities, in 2019 country wide rotating strikes protesting the inequality in education, privatization and high living costs rocked the country and brought it to a standstill for several months. Following a national referendum, plans are underway to draft a new constitution.

The institute where the study took place is privately owned, founded in 1985. Since 2017, it has offered 100% online programs, one of few HE institutes in Chile prior to the pandemic to do so. The institution provides technical courses in 15 careers organized in 5 areas: administration, education, industrial, health and social. Its mission statement not only includes the development of the professional skills and competencies of its students, but also the promotion of their well-being, attitudes and empowerment to respond to the current dynamic demands in work lives.

The student body consists generally of fully employed individuals, the vast majority from socially, educationally, and economically deprived backgrounds, seeking to upgrade their skills and/or obtain certification to enable career changes in technical areas. The programs receive an influx on average of 1,600 new students bi-monthly, made up of 58% female and 42% male students. The average attrition rate prior to the study was 44 %.

3.2 Research design

The research design consisted of three phases in which the five core ADDIE elements or steps of ID – *analyze, design, develop, implement, and evaluate,* were conducted. The phases also reflected the cyclical nature of a PAR approach. The phases aligned with the bi-monthly influx of three new cohorts of students into the institution: 1) those who had experienced a pedagogical approach based on a previous instructional plan; 2) those who were exposed to a partially modified ID approach; and 3) those who experienced only the new ID approach.

Table 2: Phases of the study and data collection

Phase of the Study	Type of Data	Description
Phase 1 **Analysis** November 2020 - January 2021	Survey	Student experiences in online courses based on existing ID (*n=356*)
	Interviews	5, 60-minute recorded online focus group sessions with students (*n=18)*
	Field Notes	-Faculty online collaborative capacity building sessions (*n=60*) -Institutional documents: previous ID, attendance records, mission statements, digital activity
	Survey	Faculty perceptions of students’ experiences in synchronous sessions/preconceptions of changes (*n= 57)*

Phase of the Study	Type of Data	Description
Phase 2 **Design/ Develop** February - March 2021	Interviews	-2, 60-minute student focus groups gathering background information from new cohort of students (*n=8*) -1, 60-minute student focus group (*n=3*), feedback on addition of synchronous learning sessions
	Field Notes	- Faculty perceptions of synchronous sessions (*n= 49),* -Collaborative capacity building sessions with faculty (*n=43*) - Newly adapted ID documents
Phase 3 **Implement/ Evaluate** April - June 2021	Survey	Feedback from general student body in reaction to changes (*n=298)*
	Interviews	Transcripts from 40, 20-minute online feedback sessions between individual tutors and students regarding changes (*n=40)*
	Field Notes	- Recorded feedback from area directors on ID changes (*n=3)* -Institutional documents, e.g. attendance records, digital activity

The first phase, November 2020 to January 2021, served as a period of analysis. Data from a survey to gather feedback from students *(n=356)* on their online learning experiences in the existing program was supplemented by data from in-depth, focus group interviews *(n=18)* with self-selected students. Analyzing and comparing this data with that gathered from field notes, i.e. the institutional mission statement, the current ID documents and recordings from capacity building sessions with faculty (*n=60*) revealed a disconnect between the kinds of profiles the institution aspired to promote and the actual identities and competencies of graduating students. Initial steps were taken to update the instructional program institution-wide to align pedagogical approaches in courses more closely with contemporary learning theories and 21st century goals. Essentially, the changes involved: a) adding synchronous sessions in all courses for building learning communities; b) providing increased opportunities and resources for student collaboration on both learning assignments/projects and assessment processes; c) using group project generated media as course content ; d) incorporating forums, padlets and career-designated community sites into courses for students to exchange ideas and opinions; e) creating separate institution-wide faculty and student online community sites.

The second phase, February - March 2021, involved designing an updated ID for all program areas and refocussing the so-called Education Community Design governing institutional policy and goals. In this period, a gradual roll-out plan to incorporate the new approach for incoming cohorts of students was developed. Interviews were held with self-selected students *(n=3*) who had taken part in the pilot synchronous classes, initiated in 30% of courses. A survey gathered observations from faculty (*n=57)* about their perceptions of the synchronous classes and impending pedagogical changes. This data was supplemented with that from faculty interviews (*n-49*) that documented experiences with students in synchronous classes during the pilot. Background data was gathered from an incoming cohort of self-selected students (*n= 8)* using in-depth interviews to gain insight into their previous educational experiences, their identities as learners when entering the university and imagined aspirations.

In the third phase, April – June 2021, final steps for the full roll-out of the updated ID approach in all courses was implemented. Students were surveyed again for feedback (*n=298*) and observations of the impact of the change was also recorded in meetings of faculty (*n=13*) and area directors (*n=3*). Feedback sessions between personal tutors and individual students (*n=40)* were conducted. Data from all data sets served to evaluate the changes.

3.3 Data collection and analysis

We situate our study within the qualitative paradigm. We recognize the epistemological advantages of researching within this methodological area for gathering a deeper understanding of the implications of significant change to educational settings and for uncovering participant voice (Denizen and Lincoln, 2005). Given the numbers of participants, we used both tools available within this methodology, i.e. in-depth interviews, field notes, observations, as well as numbers-based, Likert-scale, surveys typical of quantitative inquiries. We believe the combination of these multiple sources of data sets along with the iterative nature of the data collection process adds to the rigour of the study and the reliability and validity of our findings.

Qualitative data was analyzed using grounded qualitative coding methods involving a combined inductive-deductive process (Miles et al., 2014). After establishing a conceptual framework, a series of iterative steps were taken that included: i) inspecting the data sets for data that could inform the research questions; ii) multiple readings and considerations of the data sets; iii) condensing and coding the data for key concepts and ideas that related to the theoretical framework and literature review; iv) identifying and refining salient or common themes from coded data; v) forming a conceptual framework that could be corroborated by findings.

Descriptive statistics were employed to analyze the data tabulated from the three surveys conducted in the data collection process. This analysis provided an overall view of students' experiences online before, during and once the new ID approach had been implemented fully. These perceptions were uncovered from students' own perspectives and corroborated with observations and opinions from micro and meso level faculty. The analysis of these statistics also offered insight into the reactional differences in various program areas in relation to the pedagogical and technical changes initiated.

4. Analysis and findings

The main driver in the study was the realization on the part of institutional leaders of the disturbing discrepancy between the pedagogical and instructional models being practised in their online programs and the goals the institution aspired to and marketed. These practices, although well intended, for the most part promoted learners working in isolation and absorbing content, in which success primarily was dependent on their degree of autonomy and self-discipline. Gradually introducing an instructional and pedagogical design model based on contemporary online theories and 21st century goals into all programs across the institution became part of this decision – and not an easy step for any institution to take, let alone a Chilean one where the connection to conventional approaches is still strong. The follow-through process involved a well-constructed and executed 8-phase plan that implicated all levels of the institution – macro-level decision makers, meso-level program leaders, micro-level instructors and students. The active engagement of all three levels in the roll-out and its ongoing evaluation was considered crucial to the transition and the sustainability of the changes being introduced (Charbonneau-Gowdy and Chavez, 2019).

Analyzing the large body of data that emerged from the various data sets through the lens of learning and identity constructs revealed the impact of this move on actual online learning practices and the mediation that was taking place in learners' identities. Two major interconnected themes were uncovered that reflected a shift from isolation-based learning practices towards collaborative social learning-based ones *and* from identities as learners marked by hesitancy and lacking in confidence to empowered and self-directed ones. Table 2 shows the conceptual model that concisely synthesizes the findings of the study regarding the increasing interactive learning behaviours on the part of students and the mediation of evolving learner identities.

Table 3: Changes to practices and identities

Design Phases	Online Learning Practices	Learner Identities
Phases 1 – 6 Evaluation weight newly applied to forums, monthly meetings with faculty to build social learning instructional practice, joint meetings of macro and meso level administration with students	- Forums considered a burden, time consuming and confusing; students enter out of obligation and for grades - students work in individual silos - rare incidents of collaboration among students, including in informal networks (Facebook and Whatsapp groups); - problems with technology know-how - reluctance or unwillingness to seek instructor help, especially in writing - calls from students for more contact with others – teacher and students	-Apprehensive, fearful of failure in the program, nervous of expectations and ability to succeed, - intimidated by and lacking confidence in use of technology, - overwhelmed by demands of the program and balancing work and studies - feeling marginalized re educational background, - evidence of emerging feelings of "belonging" and being heard within the institution
Phases 7a -7b and 8 Addition of synchronous sessions to courses in pilot then extended to all courses, collaborative/group work	- - active participation in forums and synchronous sessions - community building practices – collaborative projects - constructivist learning practices – sharing expertise and benefitting from that of others - assuming leadership roles in group work	- self-confident about one's abilities - broadened in perspectives of effective learning practices - empowered both professionally and personally - goal-oriented and determined to succeed

Design Phases	Online Learning Practices	Learner Identities
becomes integral to instruction and assessment, online informal interactive sites, such as padlets, are established for individual careers; regular joint meetings of macro and meso level administration with students; online community networking sites for both students and faculty	- seeking advice and support from others - negotiating solutions to challenges - interactive expression of opinions in discussions - presentation skills being honed - working to increase one's abilities with new technologies – e.g. making videos - self -directed practices – raising topics, going beyond program materials, researching ideas	- open to challenges being presented in the courses - communicative in expressing opinions, listening to other perspectives and negotiating through challenges- - trusting in community support - committed to/engaged in learning - self-directed – looking for resources beyond those provided - secure with one's learning progress - team player even when confronting challenges - empowered and proud of oneself - emerging leader - critically minded in offering views - comfortable with technology

4.1 Early phase learning practices and learner identities

Data collected during the initial phases of the study and prior to applying the ID revealed that much of what was transpiring online was reflective of conventional learning practices. Students reported generally working on their own, disconnected mostly from others trying to absorb content and produce information for multiple choice assessments. An initial attempt to encourage interactive learning by attaching a grade to forum activity did increase online activity, but many learners reported finding the entries in the forum disorganized, overly burdensome and time consuming. Despite the availability of instructors to answer questions, hesitancy to express oneself in writing only resulted in concerns unanswered. Survey data from a student satisfaction questionnaire revealed weaknesses in learning practices. Importantly, 40.45% of students called for more interactive practices, 46.92% more robust online resources to presumably replace conventional text-based content and 53.08% expressed dissatisfaction with the involvement of their peers in course activities, insinuating a desire for more student-student engagement.

Images derived from the data sets of the kinds of identities new cohorts reflect upon arrival in the institution reveals hope – the hope for financial security, self-satisfaction, personal and work rewards, to meet employers' expectations, hope for continuous determination and drive "to go for it"- to be challenged and rewarded for one's efforts by a successful certification. Yet, once in the program, many appear constrained by self-images marked by a lack of confidence, suffering from being marginalized in their workplaces due to a self-awareness of low levels of cultural capital, nervous of their potential ability to succeed, overwhelmed by the technical complications of the LMS and fears of failure. On a more positive note, even prior to merging to new design approaches, macro and meso level calls for meetings with students for their views and feedback lead to students expressing an emerging sense of belonging to the institutional community and being heard. As one student poignantly remarked: "I appreciate this instance [opportunity to meet], to be able to chat and know each other, and know that you are concerned [sic], to improve all that; that's important it cheers you up, it is not like a platform where you login and that's it, like nobody cares, that's super important, it motivated you even more, so thank you for that as well." (Interview, Dec. 2020) This individual's words reveal recognition of the importance of being heard which is tied to feelings of motivation and belonging - important prerequisites to change.

4.2 Later phase learning practices and learner identities

Phases 7 and 8 were marked by the new ID roll-out. An analysis of the design confirmed that virtually all principles in the online design framework proposed by Margayan (2015) were evident in these roll-out changes. In practice, these included: 1) collaborative group work in course and assessment practices; 2) supplementing the LMS with community-building meeting places, or padlets for each career; 3) initiating synchronous classes in all courses to encourage learner-learner and learner-instructor interaction; 4) increasing learner-generated course content and authentic materials through collaborative project work; and 5) establishing online community network sites for both students and faculty. These changes reflected an entirely new set of learning practices shaped by interaction, expert guidance and facilitation, robust social learning technologies and community building, plus regular feedback and formative collaborative evaluation.

Analysis revealed that many students were embracing new contemporary theory design-based practices in their online learning. In survey results measuring reactions to synchronous classes (see Figure 2), responses indicated that: 68.34% of students profit from issues raised by classmates; 61.3% appreciate, and thus presumably attend, the synchronous discussion sessions; 80% use recordings of sessions if absent, acknowledging their value for learning; 71.54% actively seek support from instructors for learning issues; 55.87% build learning communities and networks with fellow classmates. In the same survey, responses to items on collaborative learning further indicated change to students' learning practices. For example, 54.16% acknowledge the value of their collaborative efforts to their learning; 58.25% note their use of new technology tools; 65.32% are aware of their building strong learning communities and networks with others; 51.34% use collaborative learning practices to clarify their questions and 51.34% for building their understanding; importantly, 59.73% attribute their collaborative assessment practices as the basis for increased incentive to participate in learning. These responses clearly indicate that learners in the program are assuming more engaged social learning practices. The figures increase in significance when a deeper analysis indicated that 40% of students from the health area had to refrain from working collaboratively due to work demands during the pandemic. Data from field notes corroborated the findings. Reports from the Directors of programs indicate their observations: active student participation – mics and cameras turned on in synchronous sessions, sharing of knowledge and opinions, productive teamwork, learners generating content and initiating discussions, signs of positive support for one another and building learning networks and community.

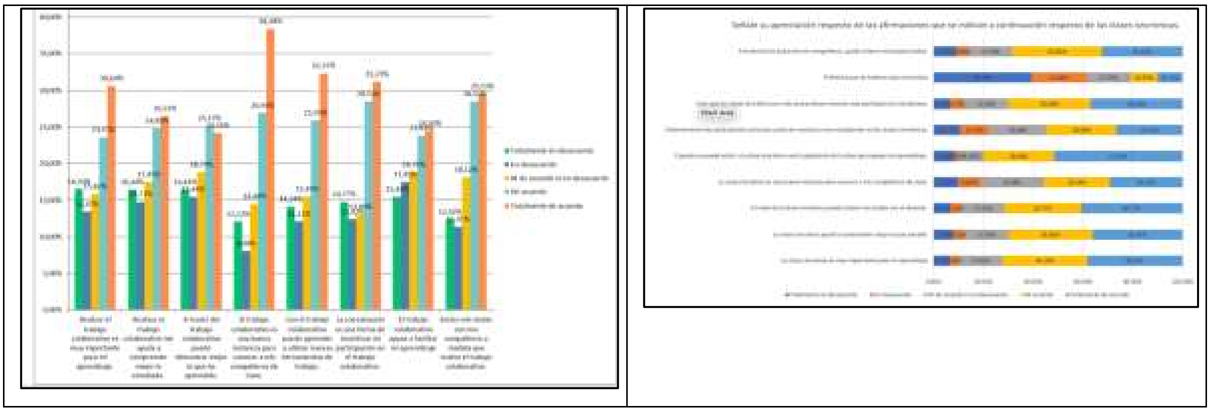

Figure 2: Student responses to survey on synchronous classes

Identity changes are more difficult to substantiate than practices. They are often woven in subtle nuances in the testimonies of participants. Many of the learners arrived in the institution with great hope yet lacking the kinds of learner identities that would lead to realizing their hopes and dreams. Exposed to novel ways of practicing learning eventually had an impact on how they are and how they see themselves as learners, their identities. Analyzing the data uncovered many examples of identity changes. The most salient ones are listed in the summary in Table 3. Yet, the direct words spoken by participants are often the most powerful indicators of change. Following are a few of the most representative in which many expressed identity changes: in terms of their feelings of empowerment: "*I learned that one must trust oneself and now I handle everything*"; of added confidence: "*I learned to do research and that makes me feel a better professional*"; of increased self esteem "*I look forward to the forum as that makes me a better professional, broadens my perspective and the knowledge I can apply in my work and that makes me improve my self-esteem and my quality of work*"; and of a motivated lifelong learner: "*Every day I have more desire to learn*". These excerpts and the data summarized in Table 3 can only provide a narrow view of the salient changes in identity that were uncovered. Yet, to the participants themselves, given the number of challenges they have faced in their lifetimes, they are impressive - both personally and professionally.

5. Conclusion

Recent leaps in information and communication technology development and even the global pandemic of 2020-21 have unequivocally added pressure to make deep changes to our educational systems. Indeed, current predictions of the future of HE are for a completely new paradigm. Improved student outcomes, increased inclusiveness to disadvantaged students and a greater focus on learning and learners will be important concerns in this paradigm. The study we report on is a story of one institution's bold effort to lead that charge, at least in Chile. In the limited space available here, the compelling evidence we provide of learners' practices and identities being aligned more closely to what is needed for these individuals to flourish and meet this century's challenges, are strong indicators of the success of those efforts. Scholarship (Charbonneau-Gowdy and Chavez, 2019) is confirming that such deep and broad institutional-wide efforts to connect ID theory to learning practice depends on *informed macro* institutional leaders, providing *ongoing collaborative support* and guidance to meso level administrators who likewise *guide and support* micro level instructors and students, and all through active listening and community building. Some may rightly question the sustainability of the changes reported here given the relatively short timeframe of the study. Yet, with such strong multi-level institutional support of new learning and learner-centred policies and with grounded ID firmly established, the chances of a fall-back to conventional practices are less likely. Plans for ongoing implementation and evaluation of the new paradigm that has been created will lead to further developments and enhancements. Much more e-learning research in a broad range of contexts of similar initiatives will certainly help inform those developments.

References

Adinda, D. & Mohib, N. 2020. 'Teaching and instructional design approaches to enhance students' self- directed learning in Blended Learning environments.' *The Electronic Journal of e-Learning*, 18(2), pp. 162 174.

Allen, E., Seaman, J., Poulin, R. and Straut, T., 2016. 'Online report card: Tracking online education in the United States.' Available at: https:// onlinelearningsurvey.com/reports/onlinereportcard.pdf.

Anderson, T., 2011. *The theory and practice of online learning* (2nd Edition). Edmonton, AB: AU Press.

Bosch, C., 2016. *Promoting self-directed learning through the implementation of cooperative learning in a higher education blended learning environment.* Johannesburg, SA: Doctoral dissertation at North-West University.

Bowen, W., 2015. *Higher education in the digital age.* Princeton, NJ: Princeton University Press.

Castro, M and Tumibay, G., 2021. 'A literature review: Efficacy of online learning courses for higher education institutions using meta-analysis'. *Education and Information Technologies,*26(2), 1367-1385..

Charbonneau-Gowdy, P. and Chavez, M., 2019. '3-M model for uncovering the impact of multi-level identity issues on learners' social interactive engagement online.' *Electronic Journal of e-Learning* 17(2), pp. 131-143.

Charbonneau-Gowdy, P., 2018. 'Beyond stalemate: Seeking solutions to challenges in online and Blended Learning programs.' *The Electronic Journal of e-Learning*, 16(1), pp. 56-66.

Creswell, J. W., 2007. *Qualitative inquiry and research design: Choosing among five traditions* (2nd ed.). Sage.

Denzin, N.K., and Lincoln, Y.S. 2005. Introduction: The discipline and practice of qualitative research. In N.K. Denzin and Y.S. Lincoln (Eds.), *The Sage handbook of qualitative research* (2011 ed.). Thousand Oaks, CA: Sage.

Gardner, J., 2011a. 'Investigating theoretical support for first principles of instruction: a systematic review.' *Midwest Journal of Educational Communication and Technology*, 5(1), 8-17.

Garrison, D. R., Anderson, T. and Archer, W., 2000. 'Critical inquiry in a text-based environment: Computer conferencing in higher education mode.' *The Internet and Higher Education*, 2(2-3), 87-105.

Harasim, L., 2012. *Learning theory and online technologies.* New York: Routledge/Taylor & Francis.

Margaryan, A., Bianco, M. and Littlejohn, A. 2015. 'Instructional quality of Massive Open Online Courses (MOOCs)'. *Computers and Education*, 80, p. 77-83.

Manfra, M., 2019. 'Action research and systematic, intentional change in teaching practice'. *Review of Research in Education*, Vol. 43, pp. 163–196.

Medina, L., 2018. 'Blended learning: Deficits and prospects in higher education'. *Australasian Journal of Education Technology*, 34(1), 42-56.

Merrill, M. D., 2013. *First principles of instruction: Identifying and designing effective, efficient and engaging instruction*. Hoboken, NJ: Pfeiffer/John Wiley & Sons

Miles, M. B., Huberman, A. M., & Saldaña, J., 2014. *Qualitative data analysis: A methods sourcebook* (3rd ed.). Sage.

Pange, A. and Pange, J., 2011. 'Is e-Learning based on learning theories? A literature review.' *International Scholarly and Scientific Research and Innovation*, 5(8), 932- 936.

Picciano, A. G., 2017. 'Theories and frameworks for online education: Seeking an integrated model.' *Online Learning,* 21(3), 166-190. doi: 10.24059/olj.v21i3.1225

Sangra, A. Badia, A., Cabrera, N., Espasa, A., Fernandez-Ferrer, M., Guàrdia, L., Guasch, T., Guitert, M., Maina, M., Raffaghelli, J., Romero, M., Romeu, T., 2020. *Descálgo para la mejora de la docencia online: Propuestas para educar en contextos presenciales discontinuos*. Catalunya, Spain: Fondació per a la Universitat Oberta de Catalunya

Schleicher, A., 2020. What will education look like in 20 years? Here are 4 scenarios. World Economic Forum Report 2020. Available at: https://www.weforum.org/agenda/2021/01/future-of-education-4- scenarios/

Siemens, G., 2004. Connectivism: A learning theory for the digital age. Paper retrieved from: http://www.elearnspace.org/Articles/connectivism.htm

Tait, A. and Gore, H., 2015. Student success in open, distance and e-learning: Research findings (ICDE Report Series). Online: http://www.icde.org/assets/WHAT_WE_DO/studentsuccessappendix.pdf

Wenger, E. & Lave, J., 1991. *Situated learning: Legitimate peripheral participation (Learning in doing: Social, cognitive and computational perspectives*. Cambridge: Cambridge University Press.

Wenger, E., 1998. *Communities of practice: Learning, meaning, and identity*. Cambridge: Cambridge University Press.

Exploring the fit Between Learner Characteristics and Learning Environments

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DOI: 10.34190/EEL.21.500

Abstract: Learner characteristics differ in many ways, e.g. learning styles, learning needs, and motivation. Such diversity means that learning methods and effectiveness are likely to vary in different learning environments. Each type of learning environment, whether it is face-to-face classroom learning, blended learning, or online learning, offers distinct design elements and features that make them more suited to some learners' characteristics than others. Therefore, a good understanding of how learner characteristics may account for their preferences for certain learning environments is a highly relevant area of investigation for today's educational institutions. Employing a two-stage exploratory sequential mixed methods research design, this study first conducted a qualitative study (i.e. focus group interviews) to understand learners' different reasons for liking or disliking a learning environment. These reasons provided the basis for the subsequent analysis of learner characteristics. A follow-up quantitative study (i.e. questionnaire survey) performed a factor analysis to further categorise these reasons into four learner characteristics: desire for direct support, digital readiness, learning independence, and online hesitancy. Another cluster analysis, based on the four learner characteristics, identified three groups of learners: classroom learners, insecure learners, and online learners. Analyses also found that learner demographics largely had no effect on their characteristics and their preference for a learning environment. This study helps provide some insights into why some learners perform well in certain learning environments, but others find it challenging. In addition, the findings can be useful for educational institutions when designing their learning environments to meet diverse learning needs.

Keywords: cluster analysis, higher education, learning environments, learner characteristics, learning needs

1. Introduction

Teaching and learning in today's higher education can occur through various delivery modes. Besides the conventional face-to-face classroom learning mode, blended learning and online learning have become two increasingly popular alternatives for learners and educational institutions. However, the teaching and learning process in a blended learning or an online learning environment is different from that of a face-to-face classroom learning environment (Ellis et al., 2006). Some learners may be more comfortable with face-to-face classroom learning, while others may prefer online learning (Kauffman, 2015).

Different learners learn differently (Speth, Lee and Hain, 2006), and learner characteristics affect how they learn (Kauffman, 2015). As learner characteristics differ, their learning strategies may also vary (Abyaa, Idrissi and Bennani, 2019). Because of their individual differences, learners may display different behaviours and have different expectations in their learning (Barker, 2012). Thus, to understand why certain learners are better suited for face-to-face classroom learning, blended learning, or online learning environment, it is essential to examine the role of learner characteristics in explaining why some learners prefer a particular learning environment over others.

The current trend towards blended learning and online learning in higher education makes it increasingly crucial for higher education to explore learner characteristics at greater depth. In view of the research gaps in the relationship between learner characteristics and learning environments identified in past studies, it is timely now to re-examine the learner characteristics that are more current, relevant and specific to today's face-to-face classroom learning, blended learning, and online learning environments. By combining qualitative and quantitative research methods, the study has the opportunity to better investigate the role of learner characteristics in explaining learners' higher or lower preference for certain learning environments.

The following sections discuss internationalisation of higher education and learner diversity, review learner characteristics and the research gaps that exist in past studies, introduce the research methods, present the data analyses and findings, and conclude the paper.

2. Research background

Considering that students are more diverse in large classes (Barrington, 2004), Abyaa, Idrissi and Bennani (2019) stress that the one-size-fits-all style of teaching and learning may have a deterrent effect on student learning effectiveness. Bengtsen and Barnett (2017) highlight that to increase student engagement, it is important for lecturers to have an understanding of and adapt to the learning needs of learners. Nonetheless, Vanslambrouck et al. (2018) contend that greater diversity of learners has made it challenging for academics in higher education to constantly monitor the motivation level of individual learners.

As student diversity is multidimensional, designing a learning environment to meet the diverse needs of all students from different backgrounds can be challenging (Hockings, Brett and Terentjevs, 2012). When designing an inclusive pedagogy, Hockings (2010) suggests considering a range of individual differences; e.g. social classes, ethnic backgrounds, full-time or part-time students, work and life experiences, learning approaches, and the effect of these differences on learning. Knowing about such learner characteristics can help academics adjust their teaching strategies and activities for more effective learning, and provide better support for their students (Ghorbani and Montazer, 2015; Law, Geng and Li, 2019).

Some researchers have attempted to categorise the wide-ranging characteristics of learners. For example, Thomas and May (2010) propose four dimensions: educational (e.g. skills, educational experience, learning approaches); dispositional (e.g. self-esteem, motivation, attitudes); circumstantial (e.g. age, flexibility, disability); and cultural (e.g. values, ethnicity, social background). Abyaa, Idrissi and Bennani (2019) highlight six categories of learners' characteristics: learner profile (e.g. age, gender); knowledge characteristics (e.g. knowledge level, competences); cognitive characteristics (e.g. learning styles, working memory capacity); social characteristics (e.g. social interactions, culture); personality traits; and motivation characteristics (e.g. interests, learning goals).

Past studies' findings on the relationships between learner characteristics and their performance in a learning environment have been contradictory at times. For example, Zacharis (2011) did not find a relationship between the learning styles of online or on-campus students and their preferred learning delivery approach. Hong (2002) also reported that learning styles were not associated with students' perceived satisfaction and achievement in Web-based learning. However, Harrell and Bower (2011) established that auditory learning style was significant in explaining online student success. Such inconsistency in findings may be a result of the differences in the scales utilised by these studies, as well as differences in research settings.

Furthermore, many past studies focused on online learning. Only a few were about blended learning or flipped classrooms (e.g. Balaban, Gilleskie and Tran, 2016; Kintu, Zhu and Kagambe, 2017; Roehling et al., 2017), or a comparison between face-to-face classroom learning and online learning (e.g. Fendler, Ruff and Shrikhande, 2016; Varnhagen and Wright, 2008; Zacharis, 2011). There has not been an attempt to investigate all three learning environments in the same study.

Past studies have not shown a clear consensus over the characteristics that can be used to best describe the diverse learners. Even though a vast number of learner characteristic variables have been proposed, Speth, Lee and Hain (2006) assert that defining and measuring learner characteristics is still an intricate endeavour. The relationship between learner characteristics and learning achievement in different learning environments warrants further investigation.

3. Research method

3.1 Mixed methods research design

This study employed a two-stage exploratory sequential mixed methods research design (Creswell, 2012). First, several focus group interviews were conducted to collect input from university students on their reasons for liking or disliking face-to-face classroom learning, blended learning, or online learning environments; and second, an online questionnaire survey was administered to collect data in preparation for a cluster analysis.

3.2 Focus group interviews

Students at a local university voluntarily participated in a total of five focus group interviews. Each interview involved five randomly recruited participants from the diploma, bachelor's or master's level. Each interview took about 30 to 35 minutes. Their responses were coded and analysed to reveal 26 common reasons why the respondents liked or disliked the different learning environments, ranging across such themes as learning styles, learning motivation, peer interaction, self-learning initiative, and learning attitude.

3.3 Online questionnaire survey

The survey questionnaire consisted of three sections. Section A asked three questions about learning experience with face-to-face classroom learning, blended learning, or online learning environments. Section B asked one question regarding each of the 26 reasons that were derived from the interviews. All items were measured using a five-point Likert-type scale, 5 being “strongly agree” and 1 being “strongly disagree.” Section C asked seven demographic questions. Multiple announcements on the university’s learning management systems (LMS) invited students to voluntarily participate in the survey. The data collection lasted about two weeks and received a total of 125 responses. A check was performed for multivariate outliers on the 26 items in Section B. Following the rule that a response is considered an outlier if the probability of its squared Mahalanobis distance is equal or less than 0.001 (Tabachnick and Fidell, 2007), 8 of the 125 responses were removed. Thus, 117 valid responses were used for later data analysis.

Of the 117 respondents, whose average age was 21.25 (SD=3.16), 52 (44.4.%) were female and 65 (55.6%) male. 94 of them (80.3%) were doing business-related studies and 23 (19.7%) computer-related studies. All of the respondents were full-time students. However, 28 (23.9%) of them were working part-time. A high percentage of them (76.1%) had prior work experience, while the remaining 23.9% did not. Table 2 provides a summary of the respondents’ demographics.

4. Data analysis and findings

4.1 Factor analysis

In preparation for a cluster analysis, which aims to separate the respondents into groups based on their responses to the 26 items in Section B, a factor analysis was first performed to reduce these items into a smaller number of factors (DiStefano, Zhu and Mîndrilă, 2009). Steinbach, Ertöz and Kumar (2004) highlight the need to reduce the number of variables for a cluster analysis as a large number may unwantedly produce marginal groups. Both the KMO (>0.5) and Barlett’s tests (p<0.05) were satisfactory for the factor analysis. To decide the deletion of items, two criteria were used: (1) items loaded <0.5 on any one of the factors, or (2) items cross-loaded >0.5 on two or more factors (Hair et al., 2014).

The first iteration extracted five factors, but one item had a low factor loading. After having the item removed, there existed a simple structure of five factors. A following reliability analysis showed that all the factors had good Cronbach α (>0.8), except the fifth factor (.575). The fifth factor comprised two items. Because of the low factor reliability, both items were removed in the second iteration. A further third and fourth interactions removed two additional items that had a low factor loading. The final factor structure consisted of 21 items loaded on four factors. These factors were labelled *desire for direct support*, *digital readiness*, *learning independence*, and *online hesitancy,* respectively. The scores of these factors were saved for the subsequent cluster analysis. Parallel analysis and Velicer’s Minimum Average Partial (MAP) tests were conducted to further confirm the number of factors. Although the parallel analysis test suggested two factors, the revised MAP test (Velicer, Eaton and Fava, 2000) suggested four factors. Having considered the possibility that parallel analysis may under-estimate the number of factors when the first factor has a large eigenvalue (Beauducel, 2001) and the unidimensionality of the factors, it was decided to adopt a 4-factor model as suggested by the revised MAP test. Table 1 provides a summary of these factors.

Table 1: Factor analysis results

Items	Mean	SD	Desire for direct support	Digital readiness	Learning indepen-dence	Online hesitancy
I can learn better under direct supervision of lecturers.	3.87	.896	.853			
I like to get immediate response from lecturers.	4.20	.833	.783			
I like to meet others face-to-face in class.	4.00	.861	.783			

Items	Mean	SD	Desire for direct support	Digital readiness	Learning indepen-dence	Online hesitancy
I prefer to ask lecturers directly whenever I have a doubt.	3.82	.943	.761			
I need regular guidance of lecturers in my learning.	3.68	.918	.758			
I like to use the physical facilities provided by the university.	3.63	.867	.671			
I like to have face-to-face interaction with others.	3.86	.870	.595			
I find it more attentive listening to lecturers in class.	3.69	1.078	.560			
I am comfortable with using digital technologies.	3.75	.899		.902		
I feel comfortable interacting with others online.	3.45	1.087		.862		
I like the flexibility of where I want to learn.	3.76	.906		.612		
I like to seek new information.	4.02	.743		.558		
I like to review learning materials at my own pace.	3.58	.958		.506		
I am disciplined enough to learn on my own.	3.52	1.022			.895	
I am clear about my learning goals.	3.74	.853			.735	
I am keen to learn on my own.	3.49	1.014			.723	
I am motivated to learn on my own.	3.44	1.021			.620	
I find it tedious to download learning materials online.	3.21	1.055				.938
I feel lonely learning alone.	2.99	1.148				.629
I am easily distracted by activities that are not related to my learning.	3.36	1.062				.624
I find online learning materials not as interactive as face-to-face lectures.	3.53	1.022				.553
% of variance explained			29.202	25.647	6.263	5.189
Eigenvalue			6.132	5.386	1.315	1.090
Cronbach α			.890	.835	.876	.799

Note: KMO (.835); Bartlett's test (<.001); extraction method: Principal Components Analysis; rotation method: Promax

4.2 Cluster analysis

A cluster analysis, using R and the mclust package, was performed based on the model-based clustering approach (Fraley and Raftery, 2007; Scrucca et al., 2016). To determine the best data-fitting model and the number of clusters, the model-based clustering approach compares different models of parameterizations and number of clusters. The best model is the one with the highest Bayesian Information Criterion (BIC) value among the models (Boehmke and Greenwell, 2019; Fraley and Raftery, 2007). Besides the BIC value, the integrated complete-data likelihood (ICL) value is also a useful criterion (Scrucca et al., 2016).

Figure 1 depicts the fitted models and their BIC values from the mclust analysis. The three-cluster VVI model had the highest BIC value (-1271.545). The best ICL criterion (-1289.299) also provided the support for a VVI model of three clusters. A VVI model indicates that the three clusters contain different number of cases and each has a different shape. In addition, the clusters have a diagonal distribution with an orientation parallel to the axes (Boehmke and Greenwell, 2019).

The three clusters comprised 81 (71%), 6 (5%), and 30 (24%) of the total 117 respondents, respectively. Considering the learner characteristics (and their relative means) that each of the three clusters is particularly associated with, the clusters are labelled *classroom learners*, *insecure learners*, and *online learners*, respectively.

Figure 2 depicts the means of desire for direct support, digital readiness, learning independence, and online hesitancy of each group. The classroom learners show relatively higher means than the insecure learners and online learners in desire for direct support and online hesitancy, but lower means than the online learners in digital readiness and learning independence. The insecure learners show relatively lower means than the classroom learners and online learners in desire for direct support, digital readiness, and learning independence, but a higher mean than the online learners in online hesitancy. A direct opposite to the classroom learners, the online learners show relatively higher means than the classroom learners and insecure learners in digital readiness and learning independence, but lower means than the classroom learners in desire for direct support and online hesitancy.

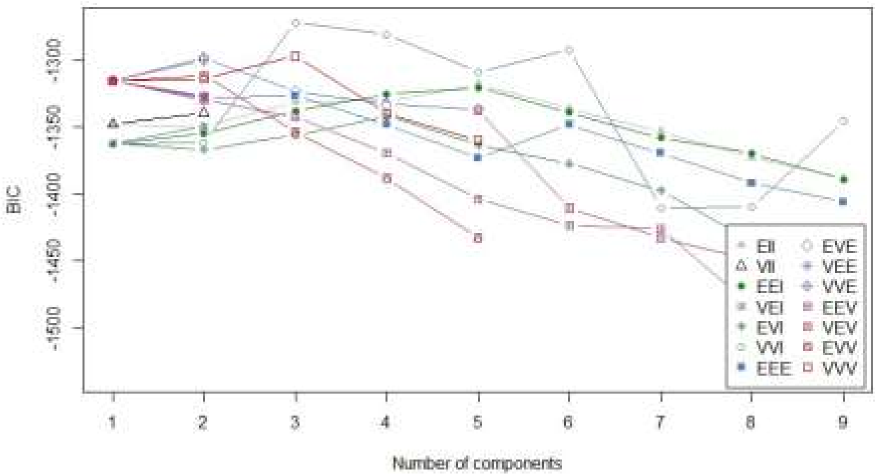

Figure 1: The BIC values and models

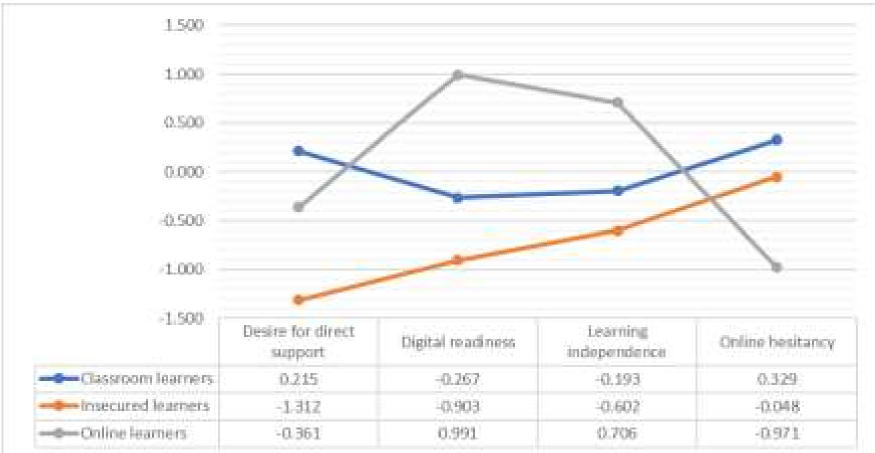

Figure 2: Means of learner characteristics

Figure 3 depicts the result of a classification analysis. The respondents were allocated to the individual groups at an uncertainty rate of less than 95%, providing the evidence of high membership probability of at least 95% for each respondent.

Table 2 provides a summary of the respondents' demographics, categorized by classroom learners, insecure learners, and online learners. The respondents were spread across the three groups and their numbers differed in terms of gender, programme, education level, semester, student status, and work experience.

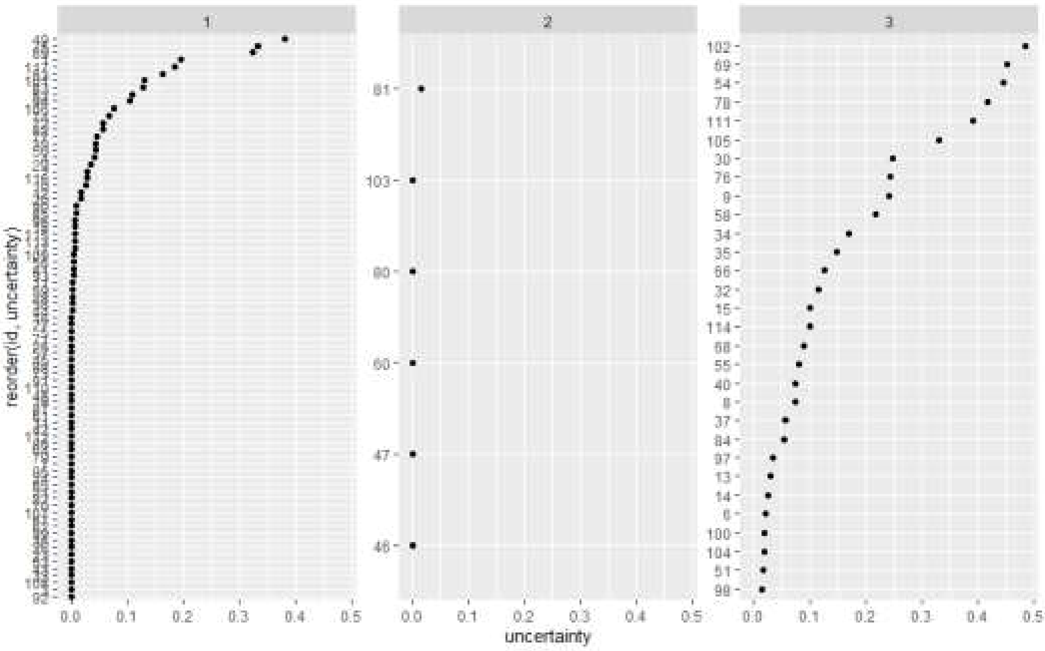

Figure 3: Classification analysis

Table 2: Respondents' demographics

Respondents' demographics	Full sample (n=117)	Classroom learners (n=81)	Insecure learners (n=6)	Online learners (n=30)
Age (mean)	21.25 (SD=3.16)	21.14 (SD=3.07)	21.00 (SD=2.10)	21.60 (SD=3.61)
Gender				
Female	52 (44.4%)	39 (48.1%)	2 (48.1%)	11 (36.7%)
Male	65 (55.6%)	42 (51.9%)	4 (51.9%)	19 (63.3%)
Programme				
Accounting and Finance	18 (15.4%)	12 (14.8%)	1 (16.7%)	5 (16.7%)
Business Administration	19 (16.2%)	13 (16.0%)	2 (33.3%)	4 (13.3%)
Business Information Systems	9 (7.7%)	6 (7.4%)		3 (10.0%)
Computing	14 (12.0%)	10 (12.3%)		4 (13.3%)
Logistics Management	21 (17.9%)	15 (18.5%)	1 (16.7%)	5 (16.7%)
Management	16 (13.7%)	10 (12.3%)	1 (16.7%)	5 (16.7%)
Marketing	10 (8.6%)	8 (9.8%)	1 (16.7%)	1 (3.3%)
MBA	10 (8.5%)	7 (8.6%)		3 (10.0%)
Education level				
Diploma	44 (37.6%)	28 (34.6%)	3 (50.0%)	13 (43.3%)
Bachelor's degree	62 (53.0%)	46 (56.8%)	3 (50.0%)	13 (43.3%)
Master's degree	11 (9.4%)	7 (8.6%)		4 (13.3%)
Semester				
1st semester	28 (23.9%)	22 (27.2%)	2 (33.3%)	4 (13.3%)
2nd semester	27 (23.1%)	19 (23.5%)	2 (33.3%)	6 (20.0%)
3rd semester	38 (32.5%)	27 (33.3%)	2 (33.3%)	9 (30.0%)
4th semester	8 (6.8%)	5 (6.2%)		3 (10.0%)
5th semester	6 (5.1%)	4 (4.9%)		2 (6.7%)
6th semester or later	10 (8.5%)	4 (4.9%)		6 (20.0%)
Student status				
Full-time student and not working part-time	89 (76.1%)	66 (81.5%)	6 (100.0%)	17 (56.7%)
Full-time student and working part-time	28 (23.9%)	15 (18.5%)		13 (43.3%)
Work experience				
No	28 (23.9%)	21 (25.9%)	3 (50.0%)	4 (13.3%)
Yes	89 (76.1%)	60 (74.1%)	3 (50.0%)	26 (86.7%)

4.3 ANOVA and independent sample t-tests

A One-way ANOVA test showed that learner characteristics were statistically significantly different for at least one of the groups. Three follow-up independent sample t-tests showed that there were significant statistical differences in the learner characteristics between any two groups. Table 3 summarises the results of the tests.

Table 3: ANOVA and independent sample t-tests

Learner characteristics	All groups	Classroom learners vs insecure learners	Classroom learners vs online learners	Insecure learners vs online learners
Desire for direct support	$F_{2, 114}$=9.688 P<.001***	$t_{80.044}$=13.740 P<.001***	t_{109}=2.561 P=.012*	$t_{29.009}$=-6.697 P<.001***
Digital readiness	$F_{2, 114}$=32.654 P<.001***	$t_{81.828}$=5.944 P<.001***	$t_{85.840}$=9.220 P<.001***	$t_{29.723}$=19.010 P<.001***
Learning independence	$F_{2, 114}$=14.468 P<.001***	$t_{61.898}$=2.989 P=.004**	t_{109}=5.000 P<.001***	$t_{33.961}$=-9.730 P<.001***
Online hesitancy	$F_{2, 114}$=32.114 P<.001***	$t_{80.627}$=4.136 P<.001***	$t_{99.119}$=10.401 P<.001***	$t_{29.339}$=11.281 P<.001***
*Note: ***significant at the 0.001 level; **significant at the 0.01 level, *significant at the 0.05 level*				

Subsequent one-way ANOVA tests showed that there were no significant statistical differences between learner characteristics and the respondents' demographic background, except for between desire for direct support and education as well as between digital readiness and student status. Table 4 summarises the results of the tests. A correlation analysis also showed that there were no significant correlations between age and learner characteristics at the 0.05 level.

Table 4: ANOVA tests

Learner characteristics	Gender	Programme	Education level	Semester	Student status	Work experience
Desire for direct support	$F_{1, 115}$=2.491 P=.117	$F_{8, 108}$=.870 P=.544	$F_{2, 114}$=3.866 P=.024*	$F_{5, 111}$=.823 P=.536	$F_{1, 115}$=.068 P=.794	$F_{1, 115}$=.310 P=.579
Digital readiness	$F_{1, 115}$=.001 P=.978	$F_{8, 108}$=1.763 P=.092	$F_{2, 114}$=1.634 P=.200	$F_{5, 111}$=.659 P=.655	$F_{1, 115}$=5.044 P=.027*	$F_{1, 115}$=1.327 P=.252
Learning independence	$F_{1, 115}$=.139 P=.710	$F_{8, 108}$=.925 P=.499	$F_{2, 114}$=2.009 P=.139	$F_{5, 111}$=.353 P=.879	$F_{1, 115}$=1.023 P=.314	$F_{1, 115}$=1.148 P=.286
Online hesitancy	$F_{1, 115}$=.061 P=.806	$F_{8, 108}$=.653 P=.731	$F_{2, 114}$=1.146 P=.322	$F_{5, 111}$=1.621 P=.160	$F_{1, 115}$=.059 P=.808	$F_{1, 115}$=1.610 P=.207
*Note: *significant at the 0.05 level*						

Fisher's exact tests showed that there was no statistical evidence to suggest an association between the respondents' demographic background and the groups, except student status (P=.013). Table 5 summarises the results of the Fisher's exact tests.

Table 5: Fisher's exact tests

Respondents' demographics	Groups	
	Value	P-value
Gender	1.464	.545
Programme	7.319	.987
Education level	2.388	.642
Semester	9.125	.448
Student status	8.297	.013*
Work experience	4.224	.117
*Note: *significant at the 0.05 level*		

5. Discussion and conclusion

To better understand the characteristics that can help explain why some learners are more inclined towards a learning environment, this study proposes that a good starting point is to simply ask the learners the reasons they like or dislike a learning environment. The findings indicate that these reasons have indeed provided the basis for the derivation of four learner characteristics, lending support to the study's assertion that an understanding of learners' likes or dislikes for a learning environment is useful in uncovering learner characteristics.

The four characteristics help explain the principal differences in the respondents' preference of learning environments, and divide the respondents into three groups: classroom learners, online learners, and insecure learners. It appears that the classroom learners and online learners are the two major groups. The respondents in both these groups have rather distinct characteristics in their preference for a face-to-face classroom learning or online learning environment. This finding also points to a plausible assumption that the respondents are in favour of either face-to-face classroom learning or online learning. A cohort made up of predominantly these two groups of learners would be well-served by a blended learning environment, a hybrid mode of learning delivery that brings together the best of face-to-face classroom learning and online learning environments.

The classroom learners have higher levels of desire for direct support and online hesitancy, as compared to the online learners. This finding is consistent with that of Stiller and Köster (2016), which found that students who dropped out from an online training course were more likely to have greater computer anxiety. As the largest of the three groups, over 80% of the respondents in this group are full-time students who do not work part-time. It may be that these students do not need to juggle studying and working, and thus find the conventional university life more enjoyable, preferring to interact with their lecturers and peers face-to-face rather than online.

Contrary to the classroom learners, the online learners have higher levels of digital readiness and learning independence. This finding concurs with that of Varnhagen and Wright (2008), which reported that online students were more independent than on-campus students. About one-third the size of the classroom learners, this group has approximately the same number of respondents who work or do not work part-time. It is reasonable to presume that these students are savvy with using technology in such activities as searching for information or interacting with others online.

Relative to the classroom learners and online learners, the insecure learners have the lowest levels of desire for direct support, digital readiness, and learning independence. The insecure learners are a minority group, making up only about 5% of the total respondents. Although the respondents in this group have a low degree of learning independence, coupled with a low level of readiness to use technology, it seems that they do not have a strong desire for obtaining direct support from their lecturers or peers. Although a minority group, this finding is significant because it shows that there may be students who face challenges in their studies and are in need of additional academic assistance, but do not realize that they should be reaching out for such assistance.

Past studies have reported no effect of demographic background on learner performance in different learning environments (Fendler, Ruff and Shrikhande, 2016; Kintu, Zhu and Kagambe, 2017; Roehling et al., 2017). This study finds that only student status, but not the other demographic factors, may influence learners' preference of learning environment. In addition, learners' demographics do not appear to have widely influenced the characteristics of learners either, with the exception of education level and the desire for direct support, as well as student status and the level of digital readiness. Although this study cannot conclusively infer a link between a specific education level with a greater or lesser desire for direct support, or a specific student status with a higher or lower degree of digital readiness, it still points to a prospective future research direction.

In conclusion, although different learner characteristics have made learners diverse in their learning approaches, this study has succeeded in identifying the characteristics that help distinguish three learner groups. A learning environment that recognises individual student learning needs and interests would more effectively engage the students. Only when the learners find a learning environment fitting would they become more engaged and motivated, and eventually improve their learning performance (Hockings, 2011).

References

Abyaa, A., Idrissi, K.M. and Bennani, S. (2019) "Learner Modelling: Systematic Review of the Literature from the Last 5 Years", *Educational Technology Research and Development*, Vol 67, pp 1105-1143.

Balaban, R.A., Gilleskie, D.B. and Tran, U. (2016) "A Quantitative Evaluation of the Flipped Classroom in a Large Lecture Principles of Economics Course", *The Journal of Economic Education*, Vol 47, No 4, pp 269-287.

Barker, M. (2012) Teaching International Students. In L. Hunt and D. Chalmers (Eds.), *University Teaching in Focus: A Learning-Centred Approach*, Routledge, London.

Barrington, E. (2004) "Teaching to Student Diversity in Higher Education: How Multiple Intelligence Theory Can Help", *Teaching in Higher Education*, Vol 9, No 4, pp 421-434.

Beauducel, A. (2001) "Problems with Parallel Analysis in Data Sets with Oblique Simple Structure", *Methods of Psychological Research Online*, Vol 6, No. 2, pp 141-157.

Bengtsen, S. and Barnett, R. (2017) "Confronting the Dark Side of Higher Education", *Journal of Philosophy of Education*, Vol 51, No 1, pp 114-131.

Boehmke, B. and Greenwell, B.M. (2019) *Hands-On Machine Learning with R*, CRC Press, Boca Raton.

Creswell J.W. (2012) *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research* (4th ed.), Pearson, Boston.

DiStefano, C., Zhu, M. and Mîndrilă, D. (2009) "Understanding and Using Factor Scores: Considerations for the Applied Researcher", *Practical Assessment, Research & Evaluation*, Vol 14, No 20, pp 1-11.

Ellis, R.A., Goodyear, P., Prosser, M. and O'Hara, A. (2006) "How and What University Students Learn Through Online and Face-To-Face Discussion: Conceptions, Intentions and Approaches", *Journal of Computer Assisted Learning*, Vol 22, No 4, pp 244-256.

Fendler, R.J., Ruff, C. and Shrikhande, M. (2016) "Evaluating Characteristics of Top and Bottom Performance: Online Versus In-Class", *American Journal of Distance Education*, Vol 30, No 2, pp 109-120.

Fraley, C. and Raftery, A.E. (2007) "Model-based Methods of Classification: Using the mclust Software in Chemometrics", *Journal of Statistical Software*, Vol 18, No 6, pp 1-13.

Ghorbani, F. and Montazer, G.A. (2015) "E-Learners' Personality Identifying Using their Network Behaviors", *Computers in Human Behavior*, Vol 51, pp 42-52.

Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E. (2014) *Multivariate Data Analysis* (7th ed.), Pearson, Essex.

Harrell, I.L. and Bower, B.L. (2011) "Student Characteristics that Predict Persistence in Community College Online Courses", *American Journal of Distance Education*, Vol 25, No 3, pp 178-191.

Hockings, C. (2010) "Inclusive Learning and Teaching in Higher Education: A Synthesis of Research", [online], Advance HE, https://www.heacademy.ac.uk/system/files/inclusive_teaching_and_learning_in_he_synthesis_200410_0.pdf

Hockings, C. (2011) "Hearing Voices, Creating Spaces: The Craft of the 'Artisan Teacher' in a Mass Higher Education System", *Critical Studies in Education*, Vol 52, No 2, pp 191–205.

Hockings, C., Brett, P. and Terentjevs, M. (2012) "Making a Difference-Inclusive Learning and Teaching in Higher Education through Open Educational Resources", *Distance Education*, Vol 33, No 2, pp 237-252.

Hong, K. S. (2002) "Relationships between Students' and Instructional Variables with Satisfaction and Learning from a Web-Based Course", *The Internet and Higher Education*, Vol 5, No 3, pp 267-281.

Kauffman, H. (2015) "A Review of Predictive Factors of Student Success in and Satisfaction with Online Learning", *Research in Learning Technology*, Vol 23, pp 1-13.

Kintu, M.J., Zhu, C. and Kagambe, E. (2017) "Blended Learning Effectiveness: The Relationship between Student Characteristics, Design Features and Outcomes", *International Journal of Educational Technology in Higher Education*, Vol 14, No 1, pp 1-20.

Law, K.M.Y., Geng, S. and Li, T.M. (2019) "Student Enrolment, Motivation and Learning Performance in a Blended Learning Environment: The Mediating Effects of Social, Teaching, and Cognitive Presence", *Computers & Education*, Vol 136, pp 1-12.

Roehling, P.V., Root Luna, L.M., Richie, F.J. and Shaughnessy, J.J. (2017) "The Benefits, Drawbacks, and Challenges of Using the Flipped Classroom in an Introduction to Psychology Course", *Teaching of Psychology*, Vol 44 No 3, pp 183-192.

Scrucca, L., Fop, M., Murphy, T.B. and Raftery, A.E. (2016) "mclust 5: Clustering, Classification and Density Estimation Using Gaussian Finite Mixture Models", *The R Journal*, Vol 8, No 1, pp 205-233.

Speth, C.A., Lee, D.J. and Hain, P.M. (2006) "Prioritizing Improvements in Internet Instruction Based on Learning Styles and Strategies", *Journal of Natural Resources and Life Sciences Education*, Vol 35, No 1, pp 34-41.

Steinbach M., Ertöz L. and Kumar V. (2004) The Challenges of Clustering High Dimensional Data. In Wille L.T. (Ed.), *New Directions in Statistical Physics*, Springer, Berlin.

Stiller, K.D. and Köster, A. (2016) "Learner Attrition in an Advanced Vocational Online Training: The Role of Computer Attitude, Computer Anxiety, and Online Learning Experience", *European Journal of Open, Distance and E-Learning*, Vol 19, No 2, pp 1-14.

Tabachnick, B.G. and Fidell, L.S. (2019) *Using Multivariate Statistics* (7th ed.), Pearson, Boston.

Thomas, L. and May, H. (2010) "Inclusive Learning and Teaching in Higher Education", [online], Advance HE, https://www.heacademy.ac.uk/system/files/inclusivelearningandteaching_finalreport.pdf

Vanslambrouck, S., Zhu, C., Lombaerts, K., Philipsen, B. and Tondeur, J. (2018) "Students' Motivation and Subjective Task Value of Participating in Online and Blended Learning Environments", *The Internet and Higher Education*, Vol 36, pp 33-40.

Varnhagen, C.K. and Wright, D.L. (2008) "Learning Characteristics of Veterinary Technology Students in a Distance-Education and an On-Campus Program", *Journal of Veterinary Medical Education*, Vol 35, No 3, pp 449-455.

Velicer, W.F., Eaton, C.A. and Fava, J.L. (2000) Construct Explication through Factor or Component Analysis: A Review and Evaluation of Alternative Procedures for Determining the Number of Factors or Components. In R.D. Goffin and E. Helmes (Eds.), *Problems and Solutions in Human Assessment*, Kluwer, Boston.

Zacharis, N.Z. (2011) "The Effect of Learning Style on Preference for Web-Based Courses and Learning Outcomes", *British Journal of Educational Technology*, Vol 42, No 5, pp 790-800.

Comprehending Entrepreneurship Learning Through the Lens of Innovative Teaching Pedagogy: India Vs Germany

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DOI: 10.34190/EEL.21.089

Abstract: This paper aims to understand the innovative teaching pedagogies used for entrepreneurship courses in Indian and German universities and its role in imparting entrepreneurial competencies among university students. The paper adopts an exploratory research design capitalizing on authentic and reliable secondary data through exhaustive studies of reputed journals/literatures, data sources from several universities, and international bodies/organizations. The underlying aim of this study is to identify the commonalities and differences between the approaches used by India and Germany. The findings presented in this paper will list down the innovative pedagogies and learning methods used in entrepreneurial education in Indian and Germany and will map its usefulness in developing entrepreneurial competencies among university students. The study will also present the comparative analysis between the various innovative pedagogies adopted by Indian and German universities for entrepreneurship courses. The value addition of this research lies in presenting a brief review on innovative pedagogy tools and techniques adopted by educational institutes in Indian and Germany. In addition, this study will also suggest the new learning methods that can be used for teaching entrepreneurship courses in universities. Furthermore, these methods can help in empowering students to be proactive and will help them to have an inclination towards entrepreneurial thinking. The review will be to the extent of considering research articles/journals/publications focusing primarily on innovative teaching, learning techniques/programmes run by educational institutes at University/College level for entrepreneurial education as primary focus of the study. Validation of Indian and German innovative pedagogical tools and techniques in a specific context can be studied further in order to understand that whether these approchesare100 per cent transferable to different cultural contexts.

Keywords: innovation, pedagogy, entrepreneurial education, entrepreneurial competencies, entrepreneurship courses

1. Background

Innovation is the buzzword with eternity. The learned learners of today's generation are well equipped with the information available at their disposal through innovative medium like you-tube videos, wats app sharing, Instagram reels and info graphic based knowledge sharing apps like YODA. The role of an educator enlarges and demands a higher degree of innovative teaching pedagogy to uphold the attention of the learner. The pedagogy designed should be innovative to an extent to grasp the attention of the learners. The innovation in pedagogy should also be focussing on unlearning the inappropriate information available to the learner and focus on the relevant education-oriented information. Mynbayeva, et al., (2017) describes there is a major shift in the didactics and method of teaching, the pedagogical change in the twenty-first century can be attributed to the phenomenon of internationalisation of society and infusion of digitalisation in learning as compared to twentieth-century teaching pedagogy.

OECD (2018) exerts "innovation at the level of practice must be seen as a normal response to addressing the daily challenges of a constantly changing classroom" and further explain change is not an extra effort rather pedagogy is built on the creativity, intuitive and personal competencies of the faculty. The teacher is believed to play an important role in the creation of future of the learner's in both the countries India and Germany (Darji, 2014). The entrepreneur education has always been in debate as how it develops the skills and intention to become entrepreneurs. The thought as entrepreneurs are born or made has been supportive on entrepreneurs can be made with studies suggesting the entrepreneurial ability can be polished with the university education where in the teaching pedagogy plays a vital role. Ismail et al., (2018) found there is a relationship between entrepreneurship education and entrepreneurial intention mediating with the learned skills.

The Blended learning mode with the integration of technology and digital medium has been a part of pedagogy both in India and Germany as an innovative tool for better experience to the learners. The current pandemic led to complete shift of offline classes to Online and the earlier adoption of blended learning served as a boon for a quick switch to a complete online format of learning in the COVID contingency for the entrepreneurship courses as well.

2. Literature review

The literature has been reviewed for Pedagogy tools and techniques, innovative pedagogies in entrepreneurship courses and Entrepreneurship education and innovative pedagogies (India and Germany briefly overviewed).

Teaching pedagogy is a defined and well curated way of teaching to impart the maximum benefits of educating process. The creativity and innovative methods adopted in the teaching techniques can be expressed as innovative teaching pedagogies. The earlier exposure of teaching pedagogy of the learner will have an impact on the learner's adoption to the pedagogies in the teaching, curriculum and assessment (Ramsden, P. and Moses, I. 1992), "Innovation is the successful introduction of a new thing or method. Innovation can be categorized as evolutionary or revolutionary" (Osolind, 2012, as cited in Chowdhury, F. (2019). The case study approach of teaching is one of the engaging method of teaching pedagogy but it has always been in debate as the case teaching concentration might lead to diluted focus on concepts, however the case study teaching is adopted with some prior understanding of the concept (Narayanasamy, S. 2020).

D' Aquila et al. (2019), The video lectures developed by the teacher themselves has a greater learning impact on the learners and also states these videos cannot be a complete replacement for the class room teaching it can be an addition to the lectures in the classroom setup. Brewer and Tierney (2012), exerts the existence of technology in innovative teaching cannot be denied the innovative education system is largely based on technology with the technological revolution the digitalised systems like learning management systems (LMS), technology based platforms like Skype and facetime and technology based tools to our disposal like IPads has become a means to develop new skills. Blended learning is a thoughtful and well-defined integration of face-to-face teaching and online technology based teaching (Graham, 2006). Blended learning as an integration of class-room and online teaching demands a higher degree of dependency on the hardware, software and reliable infrastructure in addition to a proper knowledge and skills of the instructor (Chowdhury, F. 2019). Information and communication technology (ITC) in education is a potential aid to innovative teaching pedagogies but it's not the only component for the success of pedagogy. They also stated the application of ICT in teaching should be with a large focus on student learning (UNESCO, 2013, cited in Chowdhury, F. 2019). Concluded the entrepreneurship courses needs versatility in teaching-learning approach, and a consideration to the gender of the learner should be taken while designing the padegogy to impart entrepreneurial orientation among the learners (Varamäki, 2015). Huq, A., & Gilbert, D. (2017) found the integration of notion of justice and equity plays an integral role in teaching-learning methods development. The outcome of designing the course delivery process in constructive and humoristic manner bridges the gap between the instructor and the learner.

3. Objective of study

The objective of the study is to understand the various innovative teaching pedagogies used for entrepreneurship courses in Indian and German universities and its role in imparting entrepreneurial competencies among university students.

4. Methodology

The in depth review of literature in the area of entrepreneurship courses and pedagogical innovation had been done. In depth study of literature on pedagogical innovation and entrepreneurship courses have provided insight on various innovative pedagogies used in India and Germany. This study adopts an exploratory research design capitalizing on authentic and reliable secondary data through exhaustive studies of reputed Journals, data sources from government agencies, private organizations, consultants and international bodies. A comparative analysis have been done using Rank method for understanding the similarities and dissimilarities between India and Germany in terms of understanding the preference for innovative teaching pedagogies used by both countries.

5. Results

Literature review has resulted in identifying various innovative teaching pedagogies used by Indian and Germany for imparting entrepreneurship courses. The various pedagogies can be understood on the basis of the orientation of entrepreneurship courses i.e. theoretical, practical and new learning innovating teaching pedagogies used by both countries. A summary of these Innovative pedagogies and brief has been presented in Table1.

Table 1: List of universities adopting innovative teaching pedagogies (Indian & Germany)

S.NO	THEORETICAL ORIENTED COURSES (Using these Pedagogies as part of their Entrepreneurship Coursework)	INDIA	GERMANY
1.	Passive Learning	IN1,IN2	GER1, GER2
2.	Stand and Deliver Approach	IN1-IN6	GER1-GER4
3.	Linear Teaching	IN2 & IN3	GER2,GER3
4.	Guest Lecture	IN1-IN6	GER1-GER4
5.	Case studies	IN1-IN6	GER1-GER4
6.	Debate	IN1,IN2,IN3,IN4,IN5	GER1-GER3
7.	Drama	IN5,IN6	NA
8.	Games	IN1,IN2,IN3,IN4	GER1-GER4
9.	Discussion	IN1-IN6	GER1-GER4
	PRACTICAL ORIENTED COURSES (Using these Pedagogies as part of their Entrepreneurship Coursework)	**INDIA**	**GERMANY**
10	Active Learning	IN1-IN6	GER1-GER4
11	Team teaching	IN1-IN6	GER1-GER4
12	Mentoring		GER1,GER2
13	Networking with entrepreneurs in residence	IN1-IN4	GER1,GER3
14	Pitching business ideas /team presentations	IN1-IN3,IN5	GER1,GER2,GER4,GER3(Few)
15	Simulations	IN1-IN5	GER1-GER4
16	Project based learning(Teaching with entrepreneurs)	IN1-IN5	GER1-GER4
17	Internship	IN1-IN4,IN7	GER1-GER4
18	On-site visit	IN1-IN6	GER1,GER2,GER3(Few)
19	Business Plan	IN1-IN5	Few of GER1,GER2,GER3
20	Training	IN1-IN4	GER1-GER3
21	Brainstorming	IN1,IN2,IN3,IN5	GER1-GER4
22	Workshops & Seminar	IN1-IN6	GER1-GER4
	NEW LEARNING PEDAGOGIES(For Theory & Practical) Using these Pedagogies as part of their Entrepreneurship Coursework)	**INDIA**	**GERMANY**
23	Blended learning	IN1,IN2,IN7	GER1-GER3(Most of them)
24	TAP Learning Model	IN1,IN7	GER2
25	MOOC's(Massive open online courses)(Self Regulatory learning Models)& Digital learning through Dhoch3, Moodle etc	IN7,IN2,IN3	GER1-GER3(few of them)

*Note: CLUSTERS FOR INDIA	*Note: CLUSTERS FOR GERMANY
IN1= Indian Institute of Technology (all inclusive)	**GER1**= Business/Management Schools
IN2= Indian Institute of Management (IIM's) (all inclusive)	**GER2**= Applied Sciences Universities
IN3= National Institute of Technology (NIT's) (all inclusive)	**GER3**= Public Universities
IN4= BITS Pilani (Hyderabad & Pilani Campus)	**GER4**= Others (International Universities)
IN5= State universities (Most inclusive)	
IN6= State Government Universities (Few Inclusive)	
IN7= Other (Central & other Privates)	

After going through the in depth literature, the curriculum for 25 universities from Germany and 57 universities from India have been studied in order to understand the various innovative teaching pedagogies used by both countries. It has been found that a total of 304 entrepreneurship courses were offered by Indian universities and 142 entrepreneurship courses were offered by German universities. In India, Out of 304 courses, 113 courses were offered at Undergraduate level, 144 at post graduate level and the rest 47 courses are short term certification. In Germany, a total of 142 courses were found out of which 40 were offered at graduate level, 77 at post graduate level and the rest 25 were offered as short term certifications.

A detailed analysis were presented in Table 2 in order to understand the distribution of entrepreneurship courses at undergraduate, post graduate and short term certification levels along with the innovative pedagogies used at various levels for both countries. Furthermore, frequency, percentage and rank analysis was carried out in order to get the insights on the various innovative teaching pedagogies used by India and Germany for teaching entrepreneurship courses. The results are presented in Table 2, comparing the ranks of pedagogical tools usage by course and programme type for both countries.

It has been clearly observed through analysis that Pedagogical tools (P2, P12, P4,P5,P10,P24) i.e. stand and deliver approach, mentoring, guest lectures, case studies , active learning and TAP learning model are highly consistent in terms of preference of their usage by Indian University across different types of courses and programmes. On the contrary, the preferred pedagogical tools by German universities includes guest lecture, discussion, stand and deliver approach, project based learning and blended learning. A detailed descriptive analysis has been presented in table 3 and table 4.

Table 2: List of teaching pedagogies used by Indian and German Universities for entrepreneurship courses(on the basis of programme type)

Pedagogies	Innovative Teaching Pedagogies	Under Graduate (INDIA)			Post Graduate (INDIA)			Short term Certification (INDIA)			Under Graduate (GERMANY)			Post Graduate (GERMANY)			Short term Certification (GERMANY)		
		Fre	%	Rank	Fre	%	Rank	Fre	%	Rank	Fre	%	Rank	Fre	%	Rank	Fre	%	Rank
P1	Passive Learning	85	75.2	12	89	61.8	15	18	38.2	6	12	30	13	52	67.5	15	19	76	8
P2	Stand and Deliver Approach	113	100	1	144	100	1	12	25.5	10	40	100	1	67	87.0	8	10	40	14
P3	Linear Teaching	81	71.6	15	45	31.2	18	11	23.4	12	18	45	14	53	68.8	14	15	60	12
P4	Guest Lecture	111	98.2	3	104	72.2	14	14	29.7	8	40	100	1	77	100	1	20	80	7
P5	Case studies	113	100	1	138	95.8	4	43	91.4	3	23	57.5	11	77	100	1	22	88	5
P6	Debate	104	92.0	4	113	78.4	11	11	23.4	12	30	75	9	69	89.6	7	25	100	1
P7	Drama	103	91.1	5	57	39.5	17	3	6.38	14	0	0	15	0	0	16	0	0	16
P8	Games	113	100	1	139	96.5	3	44	93.6	2	40	100	1	73	94.8	4	25	100	1
P9	Discussion	96	84.9	8	141	97.9	2	47	100	1	38	95	3	71	92.2	5	23	92	4
P10	Active Learning	101	89.3	6	114	79.1	10	43	91.4	3	40	100	1	75	97.4	2	24	96	2
P11	Team teaching & Peer Teaching	112	99.1		130	90.2	7	18	38.2	18	37	92.5	4	62	80.5	10	19	76	8
P12	Mentoring	103	91.1	2	111	77.0	13	14	29.7	8	32	80	7	59	76.6	12	21	84	6
P13	Networking with entrepreneurs in residence	34	30.0	19	124	86.1	8	47	100	1	40	100	1	52	67.5	15	22	88	5
P14	Pitching business ideas to investors (team presentations).	113	100	1	133	92.3	5	17	36.1	7	30	75	7	59	76.6	12	18	72	9
P15	Simulations	77	68.1	16	112	77.7	12	13	27.6	9	29	72.5	10	66	85.7	9	20	80	7

Table 2: List of teaching pedagogies used by Indian and German Universities for entrepreneurship courses(on the basis of programme type)(..contd)

Pedagogies	Innovative Teaching Pedagogies	Under Graduate (INDIA)			Post Graduate (INDIA)			Short Term Certification (INDIA)			Under Graduate (GERMANY)			Post Graduate (GERMANY)			Short Term Certification (GERMANY)		
		Fre	%	Rank	Fre	%	Rank	Fre	%	Rank	Fre	%	Rank	Fre	%	Rank	Fre	%	Rank
P16	Project based learning	82	72.5	14	124	86.1	8	41	87.2	4	37	92.5	4	71	92.20	5	17	68	10
P17	Internship	113	100	1	144	100	1	47	100	1	38	95	3	74	96.10	3	16	64	11
P18	On-site visit	87	76.9	11	132	91.6	6	43	91.4	3	29	72.5	10	61	79.22	11	2	8	15
P19	Business Plan	92	81.4	10	141	97.9	2	21	44.6	5	39	97.5	2	73	94.80	4	19	76	8
P20	Training	84	74.3	13	121	84.0	9	0	0	15	37	92.5	4	69	89.61	7	11	44	13
P21	Brainstorming	111	98.2	3	144	100	1	44	93.6	2	34	85	5	62	80.51	10	19	76	8

P22	Workshops & Seminar	98	86.7	7	121	84.0	9	5	10.6	13	37	92.5	4	57	74.02	13	20	80	7
P23	Blended learning	93	82.3	9	85	59.0	16	12	25.5	10	38	95	3	70	90.90	6	25	100	1
P24	TAP Learning Model	38	33.6	3	18	44.4	19	13	27.6	11	28	70	10	67	87.01	8	15	60	12
P25	MOOC's(Massive Open inline learning courses) and Digital learning through Dhoch3, Moodle etc	57	50.4	17	103	71.5	15	47	100	1	34	85	6	73	94.80	4	25	100	1

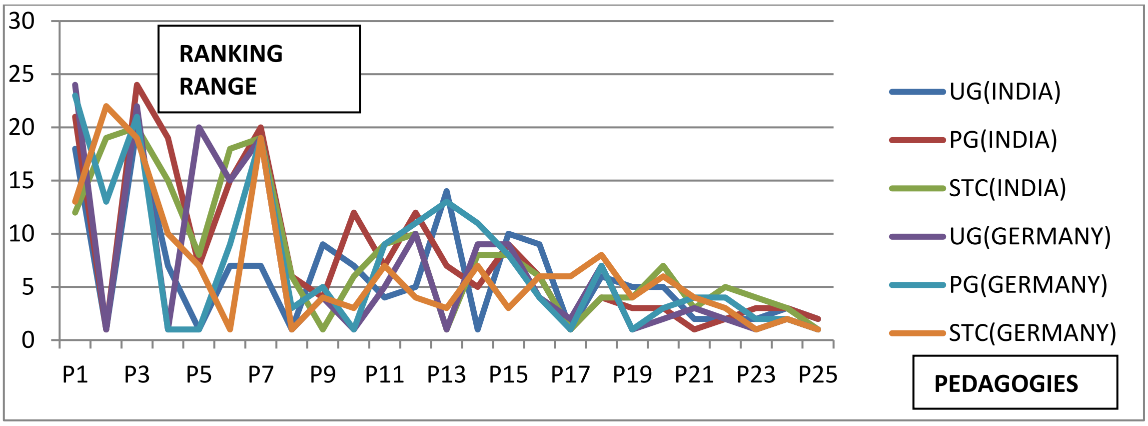

Figure 1: Rank comparisons of innovative teaching pedagogies(India Vs Germany)

Note: **UG**= Under Graduate, **PG**= Post Graduate & **STC**= Short term Certification

Figure 1 presents the graphical view on rank comparisons for innovative teaching pedagogies used by both countries. To gain more insight in terms of similarities and dissimilarities that has been observed between India and Germany, a descriptive analysis was done as presented in Table 3 & 4.

Table 3: Similarities observed in terms of education & teaching pedagogies used by India and Germany

Descriptions	India & Germany
Innovative teaching pedagogies(Focus shift from traditional to innovative teaching)	In terms of teaching pedagogies, both countries have shifted their delivering approach for entrepreneurship courses to innovative learning methods.
Common preferred Teaching pedagogies	The teaching pedagogies like guest lecture, case studies, brainstorming, internship, mentoring are few common preferred pedagogies that are used by both countries.
Less preferred teaching pedagogies	Both India and Germany were found to be low on ranks for pedagogies like drama and TAP model learning approach.
Programme Types	Both Indian and German universities were found to offer entrepreneurship courses at undergraduate, post graduate and executive levels(Short term certifications)
Majority of Entrepreneurship Courses	Both Indian and German universities offers majority of entrepreneurship programmes at post graduate levels

Table 4: Dissimilarities observed in terms of education & teaching pedagogies used by India and Germany

Descriptions	India	Germany
Entrepreneurship Education at Universities(control)	The education system in India falls under the control of both Union and the State Governments (UGC, AICTE).	The responsibility for the German education system lies in the hands of states with a minor involvement of federal government.
Project Based learning teaching pedagogy	The analysis clearly mentioned that India is till adapting to project based learning curriculum at universities.	German universities seems to prefer project based learning as their primarily approach for teaching entrepreneurship courses.
Most Preferred teaching pedagogies on the basis of Rank	The most preferred teaching pedagogies in India includes guest lecture, case studies, discussion, activity based learning, internships and workshop and seminars	The most preferred teaching pedagogies by German universities includes project based learning, activity based learning, blended and MOOC learning.
Less Preferred teaching pedagogies on the basis of Rank	It includes drama, blended learning, networking and simulations.	It includes drama and TAP learning.
Blended & MOOC learning teaching pedagogies	India seems to have just started to adapt these innovative teaching pedagogies.	German universities seem to have adapted these methods way earlier.
Government support on new learning initiatives by universities & Reservations	In India, most of the universities (government and state) seem to reserve few seats for certain specific population. In addition, recently the government has started new initiatives for implementing new teaching pedagogies for curriculum at universities.	In Germany, few seats reservations are there for international students. Federal ministries of education plays an important role in fostering entrepreneurship education in Germany.
Theoretical Vs Practical oriented approaches	The education system in Indian universities was primarily on theoretical based knowledge but now slowly India is adapting to practical oriented approaches for delivering entrepreneurship courses	In Germany, the focus of university education for entrepreneurship was primarily focussed on practical orientation.

6. Discussion and conclusion

In the study it was observed that both India and German universities have shifted their delivering approach for entrepreneurship courses to innovative learning methods like blended learning, MOOC and digital learning in order to impart entrepreneurial competencies. Moreover, it was very interesting to observe that pedagogies like case studies, seminars and guest lectures plays an important role for delivering entrepreneurship courses. On the contrary, it has been found that the focus of entrepreneurship courses in India is more on learning the concepts of entrepreneurship more than the practical approach to implement these concepts. The study concludes to express the innovative teaching pedagogies are well thought, customised and designed to map learner's capability of absorption to the curriculum by the Indian and German universities. The pedagogies adopted are contributing to the increased level of entrepreneurial competencies among the learners. Also, there seems to extreme variations in the usage of pedagogical tools in the certificate programs and this needs further investigation.

This study provides a comprehensive review on innovative teaching pedagogies adopted by Indian and German universities for imparting entrepreneurship education. Although, the enough evidence was found in India and Germany for using innovative pedagogies in entrepreneurship education but the study does needs an in-depth study using primary data to understand the nuances of using the same. The innovative teaching pedagogies for entrepreneurship courses can be further studied specifically to undergrads or Post Grads and also can be studied by considering the demographics like age, gender, basic degree, prior work experience etc., of learners impacting the various pedagogies used in their journey of learning.

References

Anis ur Rehman, Dr. Yasir Arafat(2012), "Entrepreneurship Education in India – Scope, challenges and Role of B-schools in Promoting Entrepreneurship Education", *International Journal of Engineering and Management Research*, Vol. 2, Issue-5, pp.5-14.

Chowdhury, F. (2019),"Blended learning: How to flip the classroom at HEIs in Bangladesh?", *Journal of Research in Innovative Teaching & Learning*, Vol. 13 No. 2, pp. 228-242.

Darji, B. B., & Lang-Wojtasik, G. (2014), "Preparing Globally Competent Teachers: Indo-German Perspectives on Teacher Training", *International Journal of Development Education and Global Learning,* Vol.6, Np.3, pp.49-62.

D'Aquila, J.M., Wang, D. and Mattia, A. (2019), "Are instructor generated you tube videos effective in accounting classes? A study of student performance, engagement, motivation, and perception", *Journal of Accounting Education*, Vol. 47 No. 2, pp. 63-74.

Graham, C. R. (2006), "Blended learning systems. The handbook of blended learning: Global perspectives, local designs", Vol. 1, pp.3-21.

Huq, A., & Gilbert, D. (2017), "All the world'sa stage: transforming entrepreneurship education through design thinking*", Education & Training,* Vol. 59, No. 2, p155-170

Ismail, A. B., Sawang, S., & Zolin, R. (2018), "Entrepreneurship education pedagogy: teacher-student-centred paradox", *Education & Training*, Vol. 60 No. 2, pp. 168-184.

Jehangir Bharucha(2019), "Entrepreneurship education management in India", *International Journal of Business Excellence*, Vol. 17, No.4, pp. 456-463

Klapper, R. and Tegtmeier, S. (2010), "Innovating entrepreneurial pedagogy: examples from France and Germany", *Journal of Small Business and Enterprise Development*, Vol. 17 No. 4, pp. 552-568.

Klandt, H. (2004). Entrepreneurship education and research in German-speaking Europe. Academy of Management Learning and Education, 3(3), 293-301

Mynbayeva, A., Sadvakassova, Z., & Akshalova, B. (2017), "Pedagogy of the twenty-first century: Innovative teaching methods. New Pedagogical Challenges in the 21st Century-Contributions of Research in Education", pp.3-20

Narayanasamy, S. (2020), "What makes accounting interesting for learners? Viewpoint of a teacher from India", *Asian Journal of Accounting Research,* Vol. 5 No. 1, pp. 103-118.

Norbert Kailer(2009), "Entrepreneurship Education: Empirical Findings And Proposals For The Design Of Entrepreneurship Education Concepts At Universities In German-Speaking Countries", *Journal of Enterprising Culture*, Vol. 17, No. 02, pp. 201-231

OECD (2018), "What does innovation in pedagogy look like?", Teaching in Focus", No. 21, OECD Publishing, Paris.

Radha Iyer(2017), "An examination of the current pedagogy in entrepreneurship education", Center for Entrepreneurship and Small Business Management (CESBM), Maharshi Dayanand Saraswati University, June 2017.

Ramsden, P. and Moses, I. (1992), "Association between research and teaching in Australian higher education*", Journal of Higher Education*, Vol. 23, pp. 273-295.

Varamäki, E., Joensuu, S., Tornikoski, E., & Viljamaa, A. (2015), "The development of entrepreneurial potential among higher education students". *Journal of small business and enterprise development,* Vol. 22 No. 3, pp. 563-589.

Learning L2 Through the use of Technology Outside Class

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Abstract: With the development of information and communication technologies autonomous learning is increasingly a self-initiated process that is taking place in informal contexts not mediated by and without the knowledge of teachers. Thus, the current discussion on supporting structures for freedom of action demands a greater understanding of the complexity of learners' autonomous learning beyond the classroom. This paper explores student self-initiated language learning practices and their attitude towards out of class learning in order to support their foreign language learning process as well as their more general attitude towards out-of-class language learning. Since current research on computer-assisted language learning (CALL) has suggested a number of technological opportunities for language acquisition, students benefit from being encouraged to use technology for language learning on their own outside class. Therefore, the use of technology outside of the classroom by Japanese university students to self-initiate their language learning is investigated by this paper. A questionnaire was sent to 150 students over the internet and followed up by 20 targeted in person interviews. The responses revealed that most students were actively engaged in the use of technology, however there were differences among the students including in their skills of language acquisition. Findings in turn leads to a better understanding of students' actual practices and learner use of English outside class to provide opportunities for teachers, policymakers, and the wider community to gain insight into this phenomenon for fostering learner autonomy in the EFL context.

Keywords: out-of-class learning, technology, self-regulated learning

1. Introduction

Learning can occur in both formal and informal settings. Formal learning refers to purpose-based, mandatory, and institutionally sponsored classroom-based learning that leads to highly structured and formal qualifications. Informal <autonomous> learning, on the other hand, is learning that takes place outside of the formal educational institutions (Marsick and Watkins, 2001). For example, a homework that was done by learners for compulsory education-related goals is considered formal learning, and a homework that was done for non-compulsory education-related study is considered informal learning. Informal learning involves voluntary learning programs that do not lead to formal qualifications (i.e., informal learning or informal education) and unplanned learning (Malcolm et al, 2003).

Learning experiences in both formal and informal settings often result in a unique yet complementary set of results (Blyth and LaCroix-Dalluhn, 2011). Given that students engage in informal learning outside the classroom, failure to understand the nature of the student undermines the educator's efforts to improve the quality of education. Lai (2017) argued that over the last decade, more attention has been given to out of class learning. This attention stems from the rise and widespread acceptance of communication language learning theories that emphasize broad language exposure and interaction. This can be achieved through a technology-enhanced, technology-mediated environment that provides easy access to these important language learning conditions. Therefore, learning beyond the classroom provides the physical resources available to learners in their immediate environment and mediated by technical resources to build an ideal language learning environment. Very needed to be available (Lai, 2017)**.** Despite the growing focus on out-of-class language learning, researchers are informed about their nature, function, quality indicators, interactions between various components, and their internal relationships. "Most of the research on autonomy in language acquisition is related to institutional settings and pays relatively little attention to non-institutional learning" (Benson, 2008, p.20). Littlewood (1996, 1999) defined autonomy by classifying it into two main types: proactive autonomy and reactive autonomy. Proactive autonomy is the type in which the learner autonomously participates in setting goals on his own, and reactive autonomy is the resource that allows the learner to reach the goals set by the teacher.

In this paper, the process of learner autonomy is divided into two stages. The first stage entails setting the major learning goals. The second stage entails the self-regulation necessary to achieve these goals on a day-to-day basis. Accordingly, on the one hand, proactive autonomy process is associated with informal learning and initiated with setting non-compulsory study related goals by learners, followed by the necessary self-regulation and behavior to achieve these goals on a day-to-day basis as shown in figure 1. On the other hand, reactive autonomy process is associated with formal learning and initiated with setting compulsory study related goals by teachers/institutions, followed by the necessary self-regulation and behavior to achieve these goals on a day-to-day basis as shown in figure 2. Furthermore, both incidental learning and intentional learning can occur with self-regulation. However, they differ in terms of the type of associated autonomy, its process of goal setting and self-regulation.

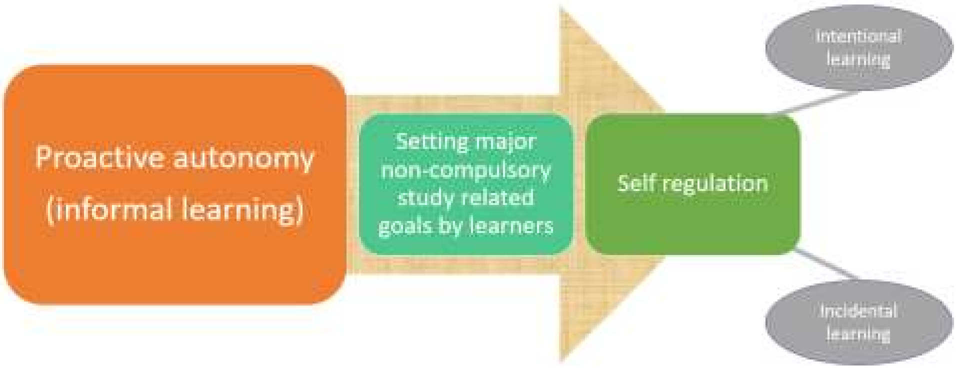

Figure 1: Proactive autonomy process

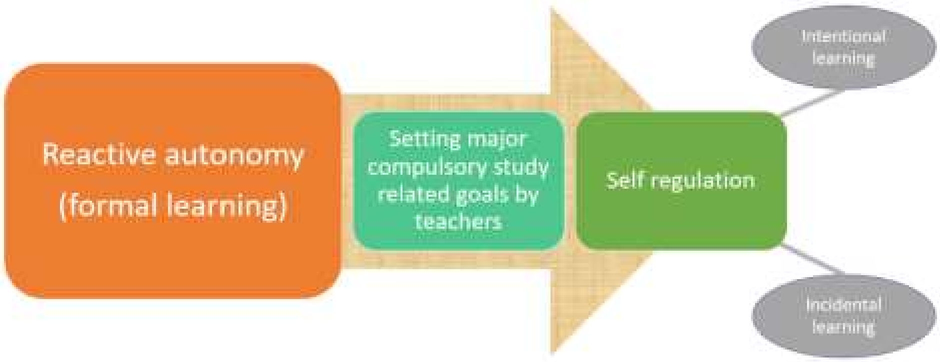

Figure 2: Reactive autonomy process

Based on the above classification, a homework that was done by a learner for a compulsory study related goal is considered associated with formal reactive learning while a homework that was done for a non-compulsory study related goal is considered associated with informal proactive learning. However, at present, researchers' understanding of autonomous out-of-class language learning is still quite limited. Thus, this paper provides some insights into the issue and ~~thus~~ enhance<s> our understanding of learners' self-regulated use of technology outside the classroom for foreign language learning in the Japanese context.

2. Literature review

As various social networking tools permeate people's lives, technical tools and platforms become ever more interactive, such as online dictionary sites adding discussion boards. When it comes to informal learning with technology, this is especially true and, in this environment, instructor obligations need to be restructured (Benson, 2008) and the influence of other social agents and learner interactions need to be considered. As a result, human social abilities are becoming more and more relevant to informal learning with technology (Lewis, 2013, 2014, Oxford, 2011, Paulfreyman, 2011). In addition, learning outside the classroom is very contextual, and "the learner himself is part of the context" (Kelley and Hager, 2015, p.377). Therefore, a theoretical lens that emphasizes the learner's overall interaction with various aspects within the context is particularly helpful in understanding the nature of informal learning (Hamilton, 2013; Luckin, 2010). Learners who use self-regulated learning strategies to control their cognition, motivation, behavior, and emotions in order to attain various learning, performance, and avoidance goals are referred to as self-regulated learners (Panadero and Alonso-Tapia, 2014). Current research comprises two types of self-regulated learning models: component models and process models, which reflect differing perspectives on self-regulated learning. Educators and researchers can use these models to help them design, administer, and evaluate intervention programs focused at improving learners' autonomy with technology outside of the classroom. Language learners use a number of electronic resources for language acquisition. Steel and Levy (2013), for example, surveyed 587 university undergraduate foreign-language students in Australia about their use of technology outside the classroom and discovered that discipline-specific technologies (e.g., online dictionaries, web-based translators, conjugation websites) were the most frequently used technological tools, and that students valued tools that helped them acquire the basics. Li, Snow, and White (2015) polled 623 sixth–eighth graders in the United States about their preferences for various technologies in language and literacy development and concluded that YouTube was the most popular among the kids for its potential in vocabulary development. Trinder (2016) asked Austrian advanced EFL learners about their use of technology and discovered that social media such as Facebook, Instagram and instant messaging applications were widely used (38 percent of learners used it daily and 20% frequently), whereas Skype and instant messaging sites were only used by a small percentage of the participants. Blogs and discussion forums were also infrequently used. 70% of them stated that they watch online movies and video clips daily or weekly. When it comes to disciplinary skills, 94% of participants used online dictionaries daily or frequently, but only 5% regularly visited grammar and language learning websites. Most of the online activities they participate in are receptive in nature and focus on listening and vocabulary acquisition. In addition to graphing the learner's technology usage for out-of-class language learning, researchers have seen a variety of these during the learner's voluntary and voluntary learning outside the classroom. We also documented how it interacts with resources and platforms through technology. Listening to songs is one of the most mentioned out-of-class activities performed by learners, so researchers have investigated what the learners pay attention to when listening to songs. It was. Olmedo (2015) found that learners pay more attention to meaning than linguistic form when processing English media. She reported that the majority of primary and secondary EFL learners / participants in her study tried to understand the general meaning of the song rather than paying attention to the lyrics. They also first joined the soundtrack before reading the subtitles while watching the movie. The focus on this meaning was also reported in a study by Sockett and Toffoli (2012), which reported that participants were listening to songs for the point. Only if they like the song, they will follow up on this by listening to the song again, referring to the written lyrics website. To understand the use of the Internet for learners' learning, Sockett and Toffoli (2012) conducted an 8-week activity log survey of five undergraduate students at a French university on online activities in English. Did. Student logs showed that internet interaction showed a "user" status. This allowed them to access the internet primarily for researching areas of interest, getting information, listening to music, watching TV series, and chatting with friends and acquaintances. In addition, the interaction with the Internet was of a durable nature, characterized by high frequency over a temporary sustain period. The use of Internet resources often involves encountering unknown words, and the behavior of seeking help from learners associated with unknown words has received particular attention from researchers. Levy and Steel (2015) specifically investigated the use of online dictionaries by university foreign language learners. They found that students value online and mobile app-based dictionaries because they are time-efficient and easy to use. Students learning character-based languages appreciated the ability of mobile app-based dictionaries to allow handwritten character-based searches to be entered on the screen.

2.1 Research questions

There has been a lack of research with a focus on SRL and technology-enhanced learning among undergraduate students in Japan. The results of this study based on findings will provide information on the nature of language learners' selective use of technology to regulate several aspects of their language learning experience. The research questions are:

- RQ1: How do language learners take charge of their language learning outside of the classroom using technology?
- RQ2: How does language learners' use of technology affect their ability to self-regulate their language learning?

3. Methodology

This study was conducted at a Japanese national university in central Tokyo with an enrollment of approximately 4,000 students and instruction on world languages and cultures in 26 language departments, including the School of Language and Culture Studies (1,480 students). A total of 150 language learners from the School of Language and Culture Studies participated in this study. Students were enrolled in an interactive communication course with a focus on fostering English speaking and writing skills. At the time of this study, all the students were in their first year (18-19 years old) and were of intermediate language proficiency, with TOEIC scores between 500 and 600. In response to a mass email solicitation, it was the students choice to participate in this study.

3.1 Data collection

Items were rated on a scale of 1 to 6, with one showing a strong mismatch and six showing a strong match. They were based on the dimensions highlighted in most SRL social cognitive models (Dorney, 2001; Pintrich, 2000, 2004; Zimmerman, 2000), and the various contributions of technology to language learning enhanced by literature (Ducate & Arndt, 2006). Self-report on the knowledge, use, and perceived usefulness of 20 ICTs in language acquisition was included as well as 19 items of computer literacy self-evaluation, self-report on access to computer hardware components, and demographics and background information on language learning (age, major, year of study, motivation for language learning, years of language learning, etc.). Interview questions were based on the survey responses of each invited participant and are designed to motivate them to selectively use technology for language acquisition.

3.2 Procedure

In the spring of 2019, the survey was conducted. The study was announced by a few course coordinators from the School of Modern Languages' foreign language departments and instructors from the Centre for Applied English Studies' large-size courses, who gave their assistance when asked. The students received the online survey through mass email. The online survey was completed by 150 students as a result. Twenty students were <selected and> called for follow-up interviews, with 18 of them agreeing to take part. Based on their survey replies, students were randomly selected from the high-user, medium-user, and low-user groups to get a full picture of the reasons for their selective use or non-use of technologies for language acquisition. Each interview lasted around an hour and was conducted one-on-one.

3.3 Data analyses

The self-reported use of technology for self-regulated language learning has been subjected to exploratory factor analysis. The researcher adopted a correlation between the coefficient alpha and the item and total. For the remaining 38 items, spindle factor analysis was used as the extraction approach and Promax was used as the rotation method. 18 of learner SRL items were created with an average score to show the learner's attitude towards self-regulated language learning. The seven belief items in language learning were divided into two categories: (i) language learning as the acquisition of a knowledge system taught in a language classroom, and (ii) language learning beliefs as the use of language outside the language classroom. Correlation between some technical, linguistic, ~~and~~ demographic characteristics and distinct aspects of technology use in self-adjusting language learning was found using correlation analysis and t-test. Inductive analysis of interview data reveals a comprehensive theme that reflects many of the reasons that influenced the decision to use (or not use) technology to take charge of certain components of the language learning experience. The themes were distilled by reading the entire corpus to find commonalities in topics from interview transcripts. The segments of text found in the survey data detailing the use of different types of self-regulatory language learning tools were pooled among individuals to see if they were repetitive themes in the interview data.

3.4 Results

From the 150 participants were students of the first year of language learning<, 25% of the participants learned Chinese and English, and 75% learned German, Russian, Spanish, Hindi and Arabic. A high percentage of participants reported either ICT ownership or easy access. 99% for computers and the Internet, 99% for mobile phones, 95% for headphones and microphones, 86% for MP3 players. All participants started using computers in junior high school, which took an average of 1 to 18 hours week. The majority of them evaluated most off-the-shelf technical applications available alone or with minimal assistance. However, many students reported that they have little or no experience of voluntarily using various Web 2.0 technologies such as wikis, online meetings, and online communities. Participants also reported limited knowledge of how different technologies could be used for language learning. Therefore, participants in this study were consistent with the technical profiles reported in previous studies (Winke & Goertler, 2008; Zhang, 2010). Participants reported using technology to regulate language learning outside the classroom, despite the infrequent use of technology in the language classroom. The majority of participants reported that technology was used in language classes less than 3 hours a week in the last 6 months, and only 24% reported that technology was used more than 4 hours a week. did. In contrast, 72% of participants reported using technology for language learning outside the classroom for more than four hours a week. Interview data also suggested that participants were using technology to varying degrees to regulate out-of-class language learning. Most of them knew the language learning environment in a broad sense. For the majority of them, classroom instruction and the direct physical environment outside the classroom (online friends, etc.) were considered the most important part of their learning experience but were enhanced by technology.

Due to the nature of technology use, exploratory factor analysis provided six different factors that could explain 60.3% of the differences in technology use to regulate the language learning experience. Six aspects of self-regulation enhanced by language learning technology include the use of technology. It regulates emotions and makes learning more attractive. Among the six factors, participants reported positive awareness and involvement in the use of technology for goal commitment regulation, resource regulation, cultural learning regulation, and affection regulation. In contrast, their response to the use of technology to connect with native speakers and seek help from fellow learners around the world is the least positive and shows the largest variation of all technology use categories. In the interview, participants demonstrated the use of these six categories of self-regulation enhanced by language learning skills.

Participants reported cases of exploring opportunities to use real languages using technology. Participant's use of technology has also changed over time. At the same time, interview data also showed that participants were skeptical, using technology to create opportunities for social learning and supporting them beyond direct social networks. The majority of them used only online technologies such as MSN and Facebook to connect with their former school and study abroad classmates and native speaker friends. Participants in this study found that they used technology to regulate language learning and were actively aware of such experiences. They reported that they selectively used different technologies to meet different learning goals and needs at different stages of learning. However, they were willing to use technology to expand social ties and support. Both factor analysis and interview data revealed that participants were least responsive to the use of technology to regulate social connections and support.

One of the main benefits of technology is to expand the learner's social realm and learning community. Therefore, it is essential to understand the reason behind this (Kern, Ware, and Warschauer, 2008; Thorne et al., 2009). Some participants were not confident in their online interactions. Others have chosen not to connect to native speakers online for fear of not receiving error feedback from native speakers. Thus, for a variety of reasons, participants were not keen to engage in social activities through technology with people beyond their direct friends and classmates. In addition, various individual factors have different relationships or influence on the aspects of language learning that learners choose to regulate using technology. First, participants' self-adjusting language learning tendencies are strongly associated with the use of technology to plan and monitor learning progress ($r = 0.62$), with the remaining technology use categories excluding cultural learning. It was found to be moderately relevant (range $r = 0.35$ to $r = 0.47$). All correlations were statistically significant. Therefore, in line with the general literature on SRL (Bernacki et al., 2011), self-adjusting language learning is closely related to the use of technology for learner-initiated language learning. Second, participants' language learning beliefs were associated with technology-enhanced self-regulation. The strong belief in looking for language use opportunities throughout the classroom was positively linked to the potential for participants to use technology to regulate learning, especially to expand learning resources ($r = 0.40$). Then commit to your learning goals ($r = 0.43$). In contrast, the correlation between knowledge-oriented beliefs and the various categories of technology use was negative and approaching zero. The link between participants' language learning beliefs and the use of technology was a recurring theme of interview data. Most of the participants believed that building basic knowledge and skills about the language was a prerequisite for using the language in real-life situations. Third, learners' proficiency, or rather their perception, influenced whether they used technology to look for language learning resources and opportunities. Participants who have studied a language for more than four years are not statistically significant, but they are more likely to use technology to regulate social connections and support than participants who have less than four years of learning experience ($t = 1.73$, $p = 0.08$). Active users of technology also demonstrate metacognitive knowledge and strategies on how to learn a language through online chat.

3.5 Conclusion

Japanese college students have been working on using technology to regulate various aspects of their language learning experience. However, there is great diversity, especially when it comes to the use of technology for social purposes, and there are several reasons why there are obvious differences in the use of out-of-class technology to regulate language learning. Some of these reasons were contextual variables such as study duration and could not be changed. Others include digital literacy, recognition of technologies that support language learning, metacognitive knowledge of how to use them effectively, preparation for effective communication with native speakers, general learning beliefs, especially language learning. Language educators need to work on ways to assist learners on these issues. In fact, various researchers have discussed the importance of such preparation and support in the use of effective technology (Blake, 2008; Hoven, 2006; Winke & Goertler, 2008), and in some studies online resources. Effective use and improved learning outcomes (O'Bryan, 2008; Romeo & Hubbard, 2008). In addition, teachers at least consciously encourage students to use technology outside the classroom to regulate language learning and, more importantly, to support technology even if it is not integrated into class education. This support can take many forms, including information about useful technologies and technical resources, and guidance on how to use specific technical resources. Whatever format the teacher adopts, it is important to give this encouragement and support an important part of the conscious effort and language curriculum so that students can enjoy the benefits of technology that supports language learning. This paper reveals that language learners use technology to engage in out-of-class activities and regulate various aspects of the language learning experience. However, because the online survey was delivered to students via a large number of emails, the samples may have been biased by students who are or are interested in technology or language learning. The study also identified a number of factors that influenced participants' selective use of technology for language learning.

References

Benson, P. (2008, November). Autonomy in and out of class. Paper presented at a TESOL symposium on learner autonomy: what does the future hold? University of Sevilla, Spain. Bernacki, M.L.,

Black, R.W. (2006). Language, culture, and identity in online fanfiction. E-learning, 3, 170–184.

Blake, R. (2008). Distance learning for second and foreign language teaching. In N. van Deusen-Scholl & N.H. Hornberger (Eds.), Encyclopedia of language and education (Vol. 4), (pp. 365–376). New York: Springer.

Blyth, D. A., & LaCroix-Dalluhn, L., 2011. Expanded learning time and opportunities: Key principles, driving perspectives, and major challenges. New Directions for Youth Development, 131, 15-27.

Dorney, Z. (2001). Motivational strategies in the language classroom. Cambridge: Cambridge University Press.

Ducate, L., & Arnold, N. (2006). Calling on CALL: From theory and research to new directions in foreign language teaching. San Marcos, TX: Computer Assisted Language Instruction Consortium.

Ellis, R. (2008). Learner beliefs and language learning. Asian EFL Journal, 10, 7–25. Ewald, J.D. (2004). What I learned from my dentist about language learning. Essential Teacher, 1(3), 15.

Hannafin, M.J., & Hannafin, K.M. (2010). Cognition and student-centered, web-based learning: Issues and implications for research and theory. In J.M. Spector, D. Ifenthaler, P. Isaias, & K. Sampson (Eds.), Learning and instruction in the digital age (pp. 11–23). New York: Springer Science þ Business Media.

Hoven, D. (2006). Communicating and interacting: An exploration of the changing roles of media in CALL/CMC. CALICO Journal, 23, 233–256.

Hubbard, P. (2008). Pervasive CALL learner training for improving listening proficiency. Retrieved September 28, 2010, from the World CALL Proceedings website http://www.j-let.org/*wcf/proceedings/d-060.pdf

Kern, R., Ware, P., & Warschauer, M. (2008). Network-based language teaching. In N. van Deusen-Scholl & N.H. Hornberger (Eds.), Encyclopedia of language and education (2nd ed., Vol. 4): Second and Foreign Language Education (pp. 281–292).

Lai, C. (2017). *Autonomous language learning with technology: Beyond the classroom*. Bloomsbury Publishing.

Littlewood, W. (1996). “Autonomy”: An anatomy and a framework. System, 24(4), 427-435. Doi: 10.1016/S0346-251X (96)00039-5

Littlewood, W. (1999). Defining and developing autonomy in East Asian contexts. Applied Linguistics, 20(1), 71-94. Doi :10.1093/applin/20.1.71

Mahwah, NJ: Lawrence Erlbaum Associates. Zimmerman, B.J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P.R. Pintrich, & M. Zeidner (Eds.), Handbook of self-regulation: Theory, research, and applications (pp. 13–39). San Diego, CA: Academic Press.

Marsick, V. J., & Watkins, K. E. (2001). Informal and incidental learning. New directions for adult and continuing education, 2001(89), 25-34.

Malcolm, J., Hodkinson, P., & Colley, H. (2003). The interrelationships between informal and formal learning. Journal of workplace learning, 15(7/8), 313-318.

O'Bryan, A. (2008). Providing pedagogical leaner training in CALL: Impact on student use of language learning strategies and glosses. CALICO Journal, 26(1), 142–159.
Pintrich, P.R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P.R. Pintrich, & M. Zeidner (Eds.), Handbook of self-regulation (pp. 451–502). San Diego, CA: Academic Press.
Pintrich, P.R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. Educational Psychology Review, 16, 385–407. Romeo, K., &
Thorne, S., Black, R.W., & Sykes, J.M. (2009). Second language use, socialization, and learning in Internet interest communities and online gaming. Modern Language Journal, 93, 802–821.
Winke, P., & Goertler, S. (2008). Did we forget someone? Students' computer access and literacy for CALL. CALICO Journal, 25, 482–509.
Zhang, G.M. (2010). Technology uses in creating second language learning environments: When learners are creators (Unpublished doctoral dissertation), Michigan State University, Michigan.
Zhao, Y. (2003). Recent developments in technology and language learning: A literature review and meta-analysis. CALICO Journal, 21(1), 7–28.
Zhao, Y., & Lai, C. (2007). Technology and second language learning: Promises and problems. In L.L. Parker (Ed.), Technology-mediated learning environments for young English learners: Connections in and out of school (pp. 167–205).

Innovative Remote Laboratory to Enhance Remote Learning for HE Digital Electronics Subjects

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DOI: 10.34190/EEL.21.073

Abstract: The COVID-19 pandemic has forced engineering disciplines to rethink practical activities which are imperative for development of engineering skills in higher education. The main challenge is developing new practical activities that suit remote learning whilst maintaining the experiences of an in-person lab session. This paper outlines the development and implementation of a remotely accessible undergraduate laboratory exercise using off the shelf equipment and remote learning software. In the described lab, students learn the fundamentals of digital systems and the process of using software to design logic circuits, through to implementing and analysing these circuits on an electronic board. The remote lab was successfully implemented using a camera, NI ELVIS II device with a Digital System Development Board (DSDB) and programmed using NI Multisim. The paper describes the development and transition of a traditionally in-person lab to a remote application whilst keeping the same intended learning outcomes and making sure a blended approach can be used in the future. Students remotely trigger inputs (as they would do in-person) to see the cause and effect of their design on the real hardware by pairing visual switches on screen to the physical switches on the board. The students use the camera pointed to the device to see how their designs behave when implemented on the real hardware. The designed lab has already been undertaken by more than 100 undergraduate students from a variety of engineering programmes over a series of multiple sessions. The paper discusses the feedback received from the use of surveys, semi-structured interviews and focus groups of students and academics involved in the development of these remote labs. The discussion focus includes the ease of use, relevance to core subject material and if the practical activities help with their understanding of theory. The paper then concludes by exploring future developments as well as the lessons learnt.

Keywords: remote learning, remote laboratory, digital electronics, blended learning, online delivery

1. Introduction

The importance of laboratory-based learning for developing critical thinking skills is well understood in Science, Technology, Engineering and Mathematics (STEM) subjects. The responses and policies in response to the COVID-19 pandemic made it necessary to change the delivery of teaching in many countries where lockdowns or social distancing measures have been put into place. In many HE institutions, large classrooms – where it is particularly difficult to maintain social distancing – have transitioned to online only methods of delivery. Many HE Engineering degree programmes rely on practical activities to deliver key learning outcomes and it has been a particular challenge for institutions to redesign them to suite an online environment (Anderton, et al., 2021) within a short space of time.

The concept of using remotely controlled laboratories for use as a learning technology is not new at the author's institution (Williams, et al., 2014) and implementation of remote laboratories can extend further than as a pandemic response. As a result, there are an increasing number of studies in the literature that focus on the differences between in-person and remote laboratories. A study by Ogot et al. (2003) conclude that there were no significant differences between the learning outcomes from students participating in a lab remotely than to those participating in the in-person version. A study by Corter et al. (2004) summarises that remote labs can be comparable to hands-on labs for teaching basic applications of course content. Conversely, a study by Lindsay & Good (2005) suggests that remote laboratories learning outcomes of remotely accessible laboratories may differ to those of simulated or in-person modes and conclude that care must be taken when delivering remotely.

This paper presents a case study on the design and delivery of a remote laboratory for digital electronics subjects in response to the COVID-19 pandemic restrictions by combining remote working and communication software with hardware which can be controlled using a computer. The combination of these technologies should allow lab designers to focus on the technical content related to their programme without having to spend additional resources on bespoke software for remote control.

2. Background

Within the author's institution, combinatorial and sequential digital logic is introduced as part of a Digital Systems module. The module is taught to students on various engineering degree programmes and these students will experience the initial digital electronics theory with varying levels of familiarity. Students on the module are timetabled for lab-based activity on digital circuits once a week for five weeks, and each lab is designed to reinforce the understanding of elements taught during traditional lectures in the same or previous weeks.

Due to the relatively short amount of time given to design the laboratory exercise for remote participation, it was necessary to design around the existing in-person exercises and use as many of the existing resources as possible. The team already had experience in designing remote laboratories for MSc students (Williams, et al., 2014) and despite being a different intended audience, were able to translate this experience and lessons learnt for undergraduates.

2.1 Existing lab

In the previous – in-person – version of the lab exercises, the introductory sessions include exercises in simulating circuit design on NI Multisim software (National Instruments, 2017). This program allows students to design and simulate digital circuits in combinatorial and sequential logic to reinforce their understanding of the underlying theory. This is achieved by placing down components and virtual LEDs (Light Emitting Diodes) in a view familiar to Engineering designs. Students were given a lab sheet that directs them how to use the software and to design digital logic concepts. At an introductory level, single gates are tested but the student is expected to experiment with various combinatorial and sequential logic design to test their understanding of digital circuits. At the end of the academic year, students are expected to know how to apply digital logic to implement real-world applications such as a seven-segment display. Practical and project-based learning provides students with the opportunity to bring together transferable skills from various subject areas and apply them to real-world solutions. (Graham, 2010)

Students were expected to use banana cables to physically connect logic gates to physical switches and LEDs as shown in Figure 1. The standalone box featured only a connection to a standard power socket to power the logic gates, and the LEDs. The box did not have any capacity to connect to a computer or a method of automating the experiment.

Due to the large numbers of students participating in the module, students were separated into smaller groups and the same lab was delivered multiple times in a single day.

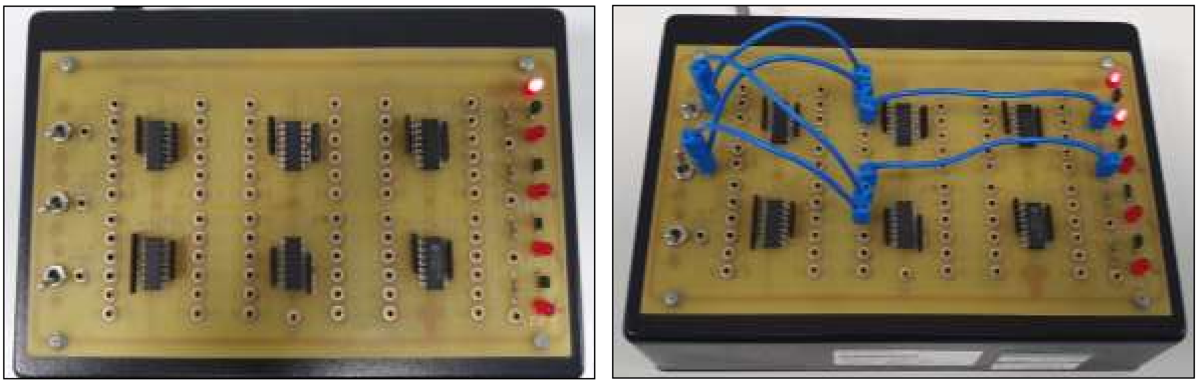

Figure 1: Photo of equipment used in previous lab design, showing board as presented to students (left) and example of completed wiring for OR AND NOR logic (right)

Originally, the simulation designs were repeated on real hardware, however student feedback indicated that repeating the same circuits multiple times did not add value to the learning experience. This had an influence on the design of the next iteration of the lab where the applications using the hardware would be different to the ones demonstrated simulation software only.

For the 20/21 academic year, the lab was scheduled to run under COVID-19 restrictions as mandated by UK government. These restrictions prevented the delivery of the lab as described above. A new lab had to be designed with the same Intended Learning Outcomes (ILOs) but had to be delivered completely online, for many of the delivered sessions, students needed to access the lab from their home using their own home internet connection. Some students needed to connect from countries outside the UK.

3. Remote lab design

Based on the restrictions outlined above, the hardware previously used for the lab had no remotely controllable features and therefore it was clear that the hardware used for the lab would not be useful for online delivery. It was necessary to see what equipment was already available for use and what needed to be purchased. It was determined that the minimum required for a remote application was:

- 1. Hardware that can be controlled by software.
- 2. A camera and application to show student and teacher real-time live footage of the physical object.
- 3. A method for remotely connecting to the software.

The considerations for selecting these different components are outlined in the following sections.

3.1 Hardware selection

Building on the experience of using NI equipment for previous remote labs (Williams, et al., 2014), the lab was designed around the use and repurposing of an NI ELVIS II platform (National Instruments, 2011) used in other labs. This instrumentation suite can trigger analogue and digital signals using NI software and allows add-on boards to be added for more specific functionality. The Digilent Digital Electronics Board (DSDB) (National Instruments, 2018) was selected for use of this lab as it features many peripherals for real-world applications and potentially could be used for different digital electronics topics in the future.

Figure 2 shows how the NI ELVIS II, DSDB and camera were set up in the room. This equipment was connected to a Windows 10 PC via USB connection and additional power was supplied to the board with a standard power plug.

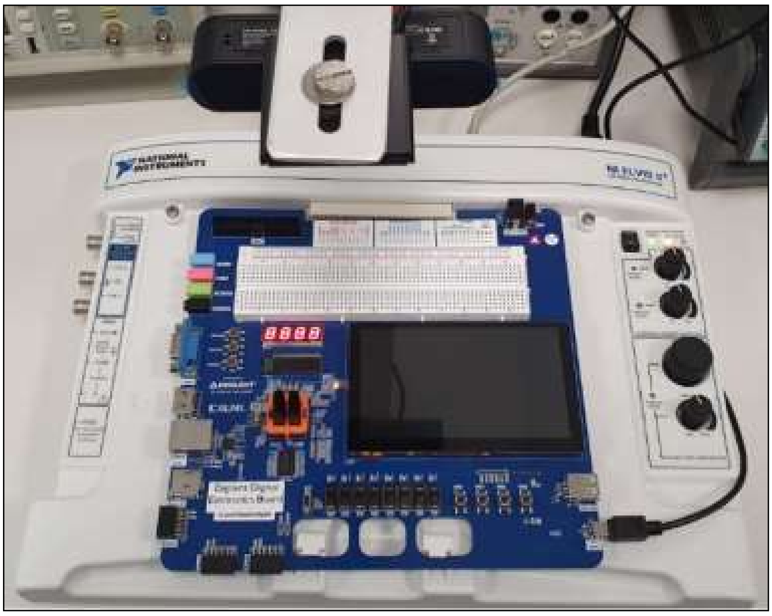

Figure 2: Front (left) and side (right) facing photos of the NI ELVIS II and Digilent Digital Electronics Board with mounted camera setup

3.2 Real-Time view

An off the shelf webcam was used and mounted to an inhouse bespoke built stand facing the board. The connected computer was used to ensure that the camera had full view of the hardware used. At this point, the LEDs needed to be tested and the board positioned carefully so that the features of the board could be seen during a variety of lighting conditions. Figure 3 shows a screenshot of the computer's default camera application, at the bottom of the image captured shows the LEDs used to indicate logic changes can be seen and whether they are on or off (to represent high and low logic) is clearly visible.

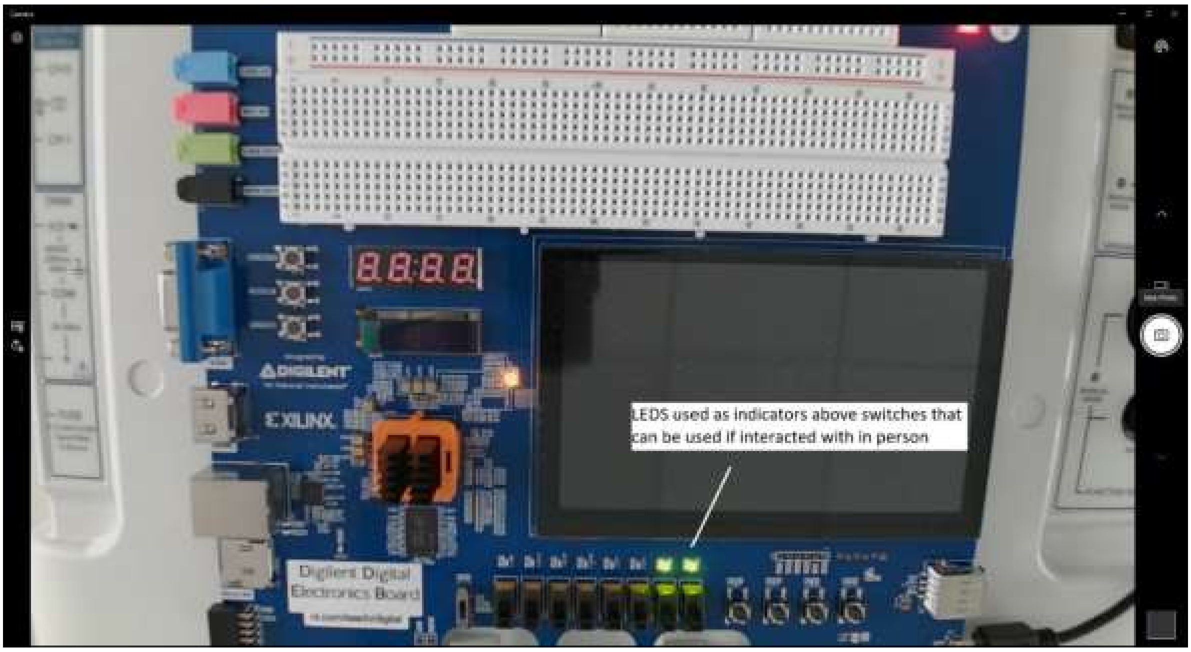

Figure 3: Camera feed showing full view of the laboratory hardware as viewed from the Windows 10 default camera app. The image has been annotated to highlight the position of the LEDs

3.3 Remote access

During design of the lab, all students needed equal access to the equipment. Therefore, the plan for remote access needed to be as inclusive as possible. Whilst studying remotely from home, students were using their own devices to study, this meant that the software used in the lab needed to be as compatible with as many different devices as possible.

The institution's IT infrastructure meant that whilst connected to a Virtual Private Network (VPN), students were able to remotely access the computers in the laboratories. Remote desktop clients are freely available to most operating systems, so students were able to access the machines regardless of the type of computer they used.

Using the remote desktop application, students can remotely access the computer connected to the lab equipment. When doing so, they are instructed to open two separate applications. As shown in Figure 4, the first application is NI Multisim which is installed on the Lab PC and is used for designing the logic circuits. The second application is the computer's default camera application, which is used for viewing the board while testing the correct logical function of the designed circuit.

Since the remote access application is designed to imitate using the connected computer in person, responses to user input are produced with relatively little latency. The live feed is using a standard USB webcam with a default camera app, so the real-time view uses relatively few resources on the computer which makes it seem instantaneous. The combination of the camera view and using the software to trigger events with very little latency allows the students to experience the lab closer to as if it was being done in-person.

3.4 Delivery

Using the bespoke combination of the technologies described above; twenty machines were connected to the equipment for students to use. For the initial lab sessions of the year, cohorts were divided into two halves and taught over separate sessions and put into groups. Microsoft Teams was the recommended communication platform for online teaching at the authors' institution. The main features of Teams used for content delivery included the ability to create breakout rooms and randomly assign students into groups as well as the ability for students to share their screens and for instructors to take control.

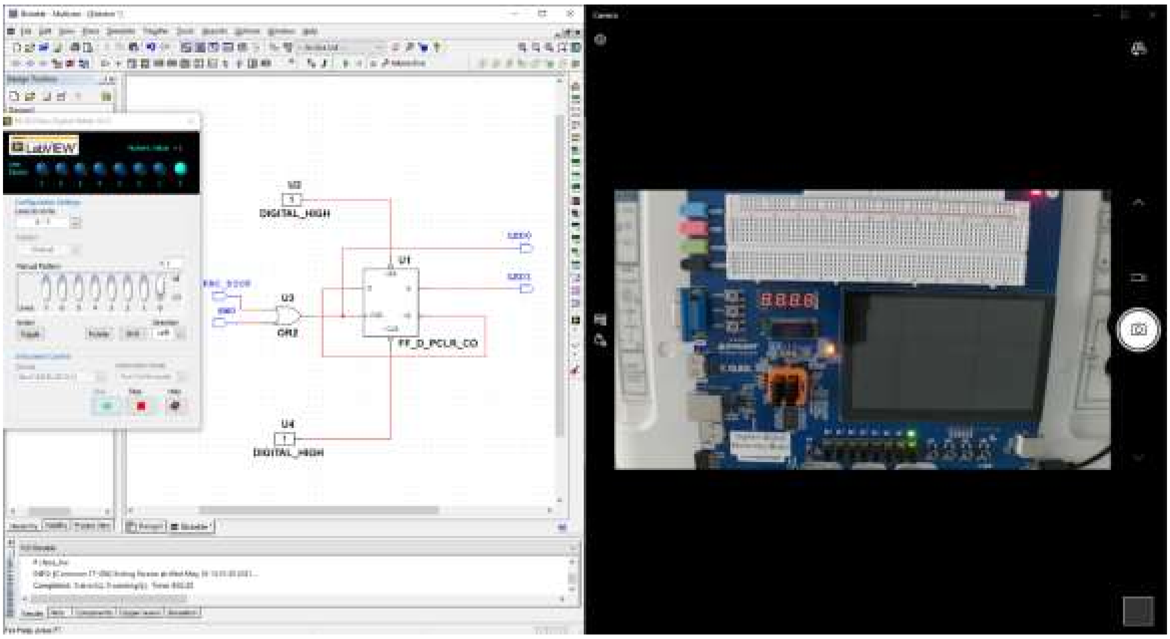

Figure 4: A screen capture showing what the student would see whilst interacting with the lab remotely

To monitor the lab online, the teaching members of staff hosted a channel for all participating students. Students followed instructions and answered questions guided by a lab sheet and could enter a separate communications channel with the teaching staff for direct guidance, staff were able to demonstrate further by using a machine in the lab reserved for them. After the initial setup of the machines, only one member of staff needed to be present in the room just in case there were any issues with the hardware on the day. Once set up properly, the devices hosted in the lab needed no physical interaction. Over a period of three months students were given varied access to the remote lab including timed monitored sessions and bookable self-study sessions, as national restrictions on in-person studies eased, some (but not all) students were able to use the same equipment but interact with the physical switches on the DSDB board.

4. Discussion

Feedback from the students was obtained primarily through two methods, the use of group discussions and using a survey caried out after the first couple of exercises. Out of the students that participated in the lab, 41 students responded to the survey, and the results were recorded anonymously. The questions asked focused on relevance to core subject material and if the practical activities help with their understanding of theory.

Table 1: Responses to closed form questions about the remote lab activity

	Disagree	Disagree slightly	Neither agree or disagree	Somewhat Agree	Agree
It was easy to connect to the lab:	0	0	1	7	33
The lab resources (simulation tools, hardware equipment, virtual experimental kit,) were appropriate:	0	0	0	10	31
The lab instructions and guidelines are clear and coherent:	0	0	1	15	25
The content is appropriate for your level, abilities and needs:	0	0	1	7	33
The learning and teaching methods employed are suitable to the size of the group:	1	0	1	6	33
My theoretical understanding has been enhanced after these practical activities:	0	1	3	19	18
I understood the differences between simulation and implementing it on real hardware:	0	2	1	14	24

Whilst the agree/disagree format of these type of questions asked may be subject to acquiescence bias (Krosnick, 1999). The students' response to open ended questions asked in the same survey provided additional insight that aligns with the responses. Out of the 41 total students responded, 27 gave a valid (not "N/A" or "nothing" etc) response to the for the entry titled: "What I liked about the online digital electronics lab sessions:" whereas 19 gave a valid response to "What I did not like about the online digital electronics lab sessions:" and 13 gave a response to "What I would suggest to improve these online digital electronics lab sessions:".

The feedback concerning the group work was mixed, 23 responses indicated that they enjoyed doing the activities in the group, while 14 responses indicated that they didn't mind either way and 3 stated that they didn't enjoy the group work. During discussions amongst the teaching staff, the lab demonstrators agreed that whilst useful for students to socialise with other members of the cohort and discuss the work in groups, it was difficult to manage the numbers of groups and ultimately it would be better for students to have more time with the devices individually.

During the completion of the later lab exercises, when it was possible for students to be physically present at the lab, a selection of students were asked about their experiences with the variety of methods of implementing digital logic. Many found it trivial to transfer their knowledge obtained from completing the first experiments online to doing it when physically present at the computer, however the majority of students preferred physically touching the switch to drive the input signals, rather than relying on mouse clicks to drive virtual switches when remotely accessing them. A possible reason for this, suggested by one of the participating students was that the position of the LEDs in relation to the input switch on the physical board made it easy to relate the cause and effect, whilst changing it online needed a change in focus to click the virtual switch using a computer mouse.

During discussions, some students found it particularly useful to remotely connect to the equipment outside of their timetabled slot, which allowed them to take control of their own learning. These outcomes align with similar findings by Croker et al. (2015), who showed how the use of supplementary digital video guides can enhance students' learning.

5. Conclusions

Details of the development of a remotely accessible lab have been given and it has been shown that this can be successfully completed if four major requirements are met. Firstly, IT infrastructure needs to be in place for students so that they can use freely available remote desktop applications to access and use the institution's desktop computers. Secondly, the hardware used must be able to be controlled by software on the connected computer in some capacity. Physical responses to the software control must be clearly visible on screen while the students are controlling the experiments. Finally, there must be an easy way for staff members to assist students with the experiments whilst being carried out remotely.

Being able to use software installed on the lab machines whilst using remote desktop applications allowed students from many different locations to participate in the lab. Whilst the lab described in the paper required the purchase of 20 boards, this choice was influenced by an additional desire to use the equipment in multiple labs in the future. If existing labs use real hardware that can be controlled by software on machines, the use of remote desktop applications and a webcam provides a relatively low-cost solution for transforming an in-person lab to an online one or to add dual-mode functionality to an in-person only lab.

One advantage gained from converting the lab to a remotely accessible one was that it was possible to reserve computers to access the equipment at times outside the timetabled lab session. Not only did this allow students to complete the lab in their own pace, it also allowed teachers on the module to demonstrate digital electronics concepts using hardware during the lectures, tutorials or when introducing the concepts to other members of staff.

5.1 Future work

Further research into the pedagogical effects of the change to remote access is necessary, the authors intend to make use of further, more detailed surveys and analyse assessment results between access methods. It is acknowledged that there are challenges in separating the effects of access mode change to those caused more generally by the COVID-19 pandemic.

A lab for introducing basic digital electronics theory has been developed for the application of digital logic but it is the authors' intentions to extend the same principles to other labs. The DSDB board used contains many peripherals that would be useful for more advanced study of applied digital electronics and reusing the same equipment for multiple subjects aligns with sustainable laboratory design.

Acknowledgements

The authors would like to thank the Wolfson School for its financial support and are grateful to the technical support teams within the University for their continued assistance in setting up these labs.

References

Anderton, R. S., Vitali, J., Blackmore, C. & Bakeberg, M. C., (2021). "Flexible Teaching and Learning Modalities in Undergraduate Science Amid the COVID-19 Pandemic", *Frontiers in Education*, Volume 5, p. 278.

Corter, J., Nickerson, J., Esche, S. & Chassapis, C., (2004). "Remote versus hands-on labs: a comparative study", Savannah, GA, USA, *34th Annual Frontiers in Education, 2004*. FIE 2004.

Croker, K. et al., (2015). "Enhancing the student experience of laboratory practicals through digital video guides", *Bioscience Education*, 16(1), pp. 1-13.

Graham, R., (2010). "UK Approaches to Engineering Project-Based Learning", s.l.: White Paper sponsored by the Bernard M. Gordon, MIT Engineering Leadership Program.

Krosnick, J. A., (1999). "Survey Research", *Annual Review of Psychology*, Volume 50, pp. 537-567.

Lindsay, E. D. & Good, M. C., (2005). "Effects of Laboratory Access Modes Upon Learning Outcomes", *IEEE Transactions on Education*, 48(4), pp. 619-631.

National Instruments, (2011). NI Educational Laboratory Virtual Instrumentation Suite II Series (NI ELVIS II Series) User Manual. [Online] Available at: https://www.ni.com/pdf/manuals/374629c.pdf [Accessed 27 May 2021].

National Instruments, (2017). Multisim 14.1 Education. [Software].

National Instruments, (2018). NI Digital System Development Board User Manual. [Online] Available at: https://www.ni.com/pdf/manuals/376627b.pdf [Accessed 27 May 2021].

Ogot, M., Elliott, G. & Glumac, N., (2003). "An Assessment of In-Person and Remotely Operated Laboratories", *Journal of Engineering Education*, 92(1), pp. 1069-4730.

Williams, S. et al., (2014). "The development of a remote laboratory for distance learning and its impact on student learning", *Journal of International Scientific Publications: Educational Alternatives*, Volume 12, pp. 366-373.

Reflecting on the Experience of Forced Transition to Distance Learning During the COVID-19 Pandemic

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DOI: 10.34190/EEL.21.052

Abstract: The emergency transfer of the educational process to a distance format in March 2020 was stressful for all universities without exception. The Ural Federal University, being the largest educational institution in the region, has done everything possible to provide conditions for the implementation of educational programs in the distance format as soon as possible. The understanding of the need for a radical restructuring of the educational process, on the one hand, united the efforts of the university administration, faculty and students, and on the other hand, caused uneasiness among the participants of the processes and stress for the entire educational system. During the first wave of the pandemic, it was important for the university to ensure the continuity of the educational process, to conduct exams and an admission campaign in an online format. Reflection the first experience of distance learning and the university's systematic approach to the introduction of digital technologies made it possible to overcome the identified problems and adjust the actions of participants to preserve the quality of education during the second wave of the pandemic. The aim of this paper is to study the attitude of the main participants of the educational process to the distance format. The article presents a comparative analysis of the results of surveys of faculty members and students of the Ural Federal University conducted at the beginning of the emergency transition to distance learning and a year later. The research allowed us to study the experience of switching to distance learning at the largest Russian university, as well as to trace changes in the assessments of participants in the educational process of the opportunities and limitations of e-learning and distance learning technologies. The results of the study can be used by other universities to improve the model of the educational process in a distance format.

Keywords: COVID-19, higher education, forced distance learning, UrFU, organization of the learning process

1. Problem statement

Urgent transfer of the educational process to a completely remote format has caused an increase in research related to the impact of the pandemic on the Russian education system in general. Thus, Radina & Balakina (2021), conducting a review of studies assessing the impact of the pandemic on education, note the complex nature of the challenges of the pandemic, affecting the economic, technical, social and methodological aspects of education. Grunt, Belyaeva & Lebedkina (2021) in their study note the large-scale reconstruction of educational practices of faculty members and students, which provoked enforced integration into a new system of digital interaction and interactive teaching methods.

Koksharov et al (2021) note the obvious difference in the ability of universities to adapt to new conditions. Thus, the leading universities maintained a high level of education during the pandemic, while some regional universities experienced a sharp shortage of resources, which further aggravated the differentiation between universities. On the other hand, many universities have expressed their readiness for mutual support by providing online courses for students of other universities free of charge, thereby reducing the consequences of this gap. Goncharova & Zaitseva (2020) support this opinion, dividing Russian universities into "advanced" ones that have preserved the synchronous form of the educational process, and "newcomers" of digital transformation who are forced to choose an asynchronous form.

According to Kondyukova, Shershneva & Zorina (2021), the enforced emergency transition of educational institutions to a distance format led to an understanding of the need for the development of online technologies. While conducting the study, the researchers noted the importance of a systematic approach to the digitalization of the educational process in order to create an optimal system that can withstand extreme loads, while remaining stable, and able to develop. Investigating the consequences of the enforced transition to a distance format, the authors noted the savings of personal time and material resources. Larionova et al (2021) disagree with this statement; they proved in their study the growth of the labor efforts of faculty members by 1.5 times and an increase in the costs of universities for providing distance learning, leveling partial savings on operating and utility costs.

Belyaeva & Grunt (2020), considering the problems and prospects for the development of distance learning caused by the pandemic, analyzed a number of theoretical and practical studies on distance education and identified a number of contradictions in the further implementation of distance education, including the contradiction between reducing the classroom load of faculty members and increasing their total labor efforts. Larionova et al (2020), studying the expectations and fears of students associated with the transition to distance learning, found out that the risks are mainly associated with a possible misunderstanding of the material, which is typical for junior students who do not assess their level of self-organization, are afraid of difficulties in communicating with faculty members and attend classes in order to acquire knowledge. Shalina, Stepanova & Novokreschenov (2021), studying the behavior of students in the conditions of distance learning, raised the problem of reducing the capacity of their educational activities and "mood", which entails a violation of the stability of the entire educational process.

According to Grunt, Belyaeva & Lisitsa (2020), the COVID-19 pandemic has become a catalyst for the processes that were actively developing in the previous period, including the processes of introducing online technologies and the network form of implementing educational programs by Russian universities. The researchers identified the problems of adaptation of students and faculty members to work in the network, the presence of a gap in the digital culture of the younger and older generation of faculty members, the changing role of the teacher in the educational process and, as a result, the risks of reducing the quality of education.

Panov et al (2020) in their study of the digital transformation of the educational process, showed the need to develop and implement psychological and pedagogical conditions and methods that ensure the effectiveness of learning in new conditions, focused on the cognitive and personal development of students. Kubina et al (2020) believe that the problem is not a decrease in the effectiveness of the educational process due to the indirect interaction of the teacher and the student, but the unwillingness to use all the possibilities of digital educational technologies on the part of both faculty members and students.

Nazarov, Zherdev & Averbukh (2021), investigating the perception of shock digitalization of participants in the educational process, noted the need for an immediate analysis of the reaction of participants in the educational process to the first period of total distance for making informed management decisions. Scientists have identified insufficient infrastructure development in the regions, technological and competence-based digital inequality, the lack of well-developed methods for using digital educational tools, the lack of high-quality content, and the lack of full-fledged integrated educational resources on the market. Goncharova, Daineko & Larionova (2021) in the study of the university's response to global changes, noted the need for a radical restructuring of the educational process. During the first wave of the pandemic, the priority task for universities was to urgently transfer the educational process to a remote format and ensure its continuity. The ongoing pandemic has led to the realization of the need for a systematic approach to the introduction of digital platforms and services in order to maintain the high quality of education. According to Abramov et al (2020) the discussion of the results of the emergency transition to distance learning and the readiness of the educational system for this transition will continue for quite a long time.

2. Methodology

This paper is a continuation of the 2020 study, in which the authors studied the attitude of faculty members and students to "distance learning" at the time of an emergency transition to this format (Daineko et al, 2020) and identified their concerns about the effectiveness of distance learning (Larionova et al, 2020). In this paper, the authors set the task to study how the opinion of students and faculty who participated in the "global experiment" to distance learning and the use of online technologies changed a year after the introduction of restrictions. For the analysis, the results of two sociological surveys conducted in March 2020 and in April 2021 at the same university with a similar set of questions were used. The methods of sociological research, descriptive analytics tools, analysis and synthesis, comparison and generalization were used in the study.

3. Results

As a starting point, the data of the 2020 sociological survey among students and faculty members of the Ural Federal University were used. To conduct a comparative analysis, in April 2021, the authors conducted a similar survey in which respondents were asked to answer 20 single and multiple choice questions using Google forms.

The request to take the survey was sent out on April 5, 2021 through notifications in personal accounts and in letters to corporate mail to 35 288 students and 3 898 faculty members of URFU. The sample of respondents who passed the survey was 1 944 students (5.51% of the general population) and 463 faculty (11.88%). The majority of respondents answered the questions within a week.

The analysis of the qualitative composition of the sample of students showed that 55% of the students who answered the questions were girls, 45% were boys. The age composition of the respondents included 49.8% of students aged 18 to 20 years, 38.8% aged 21-25 years, 11.1% over 25 years and 0,3% under 18 years. Approximately an equal number of students from the respondents to the survey are studying in the first (31.9%) and the second year (32.2%), the remaining part was distributed among third-year students - 19.8%, fourth-year students - 11.7% and fifth-year students - 4.5%. 27.5% of the surveyed students showed high academic performance (within 100-85 points), 45.6% had academic performance within 84-70 points, 21% of students had a satisfactory level of academic performance (69-60 points), 5.9% of respondents indicated low academic performance (59-40 points). In addition, 35.1% of students believed that their academic performance during distance learning had increased, 16.7% - noted that it had decreased and 48.2% said that their academic performance has not changed. For comparison, 6.3% of faculty members note that students ' academic performance had become significantly higher compared to the traditional training format, 16.7% - slightly higher, 21.5% - slightly lower, 15.4% - significantly lower and 40.1% did not notice any changes. The data is presented in Figure 1.

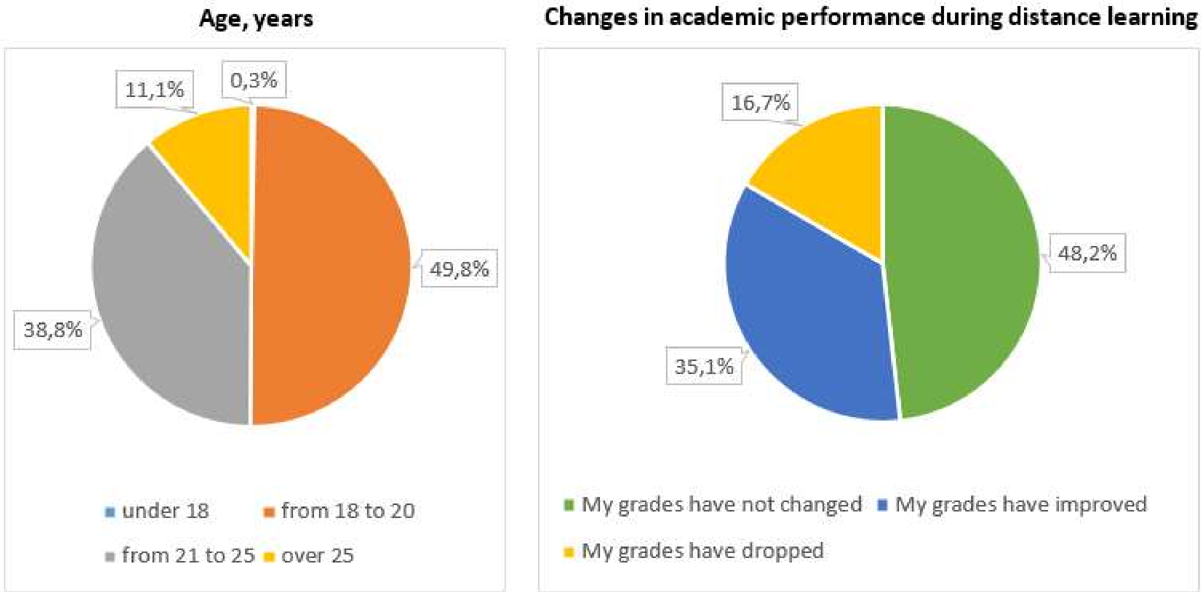


Figure 1: Age and academic performance changes of the students

Analyzing the qualitative composition of the sample of faculty, it can be stated that 53.4% of the interviewed faculty members are women, 46.6% are men. The majority of the surveyed faculty member are aged 31-40 years, which is 27.6%, 22.5% of respondents belong to the age category of 41-50 years, 15.1% are 61-70 years old, 13% are 51-60 years old, 12.7% are 26-30 years old, 6.3% are older than 71 years and 2.8% are 20-25 years old. 49.7% of the surveyed faculty members work as associate professors, 23.4% is senior lectures, 10.9% are professors, 10.5% are assistants, 5.5% are heads of departments (Figure 2).

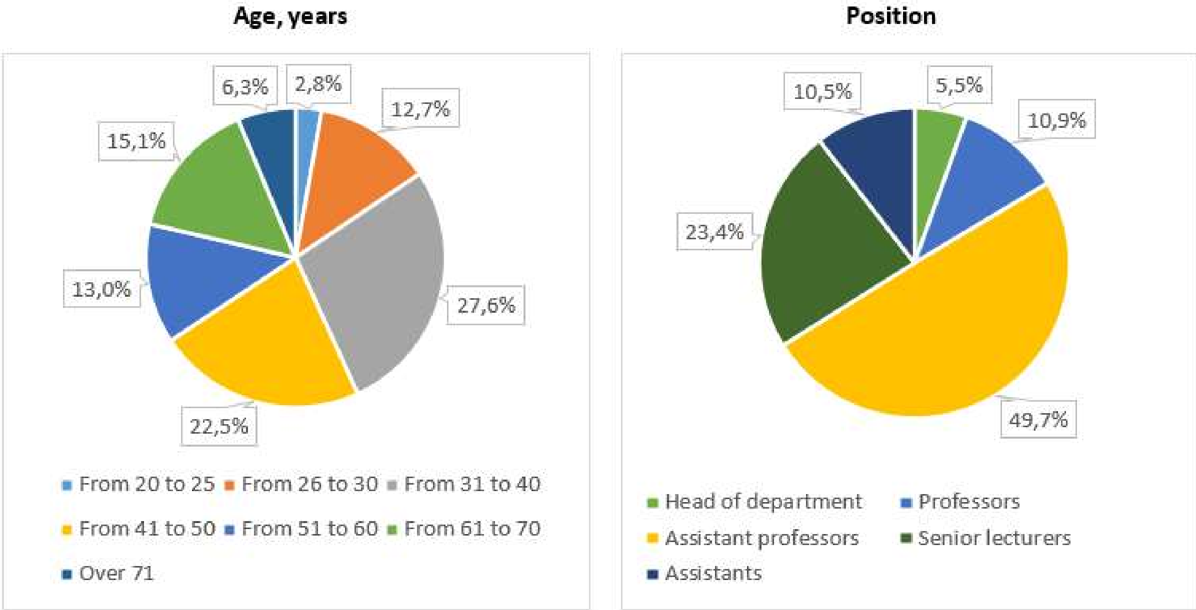


Figure 2: Age and positions of faculty members

The students were asked whether they felt comfortable in the process of distance learning. 41.6% said that everything was fine, 25.3% - mostly everything was fine, but there were small problems, 18% were able to overcome the difficulties encountered, 14% noted that they were uncomfortable because of a large number of problems and increased anxiety, and 1.1% found it difficult to answer (Figure 3).

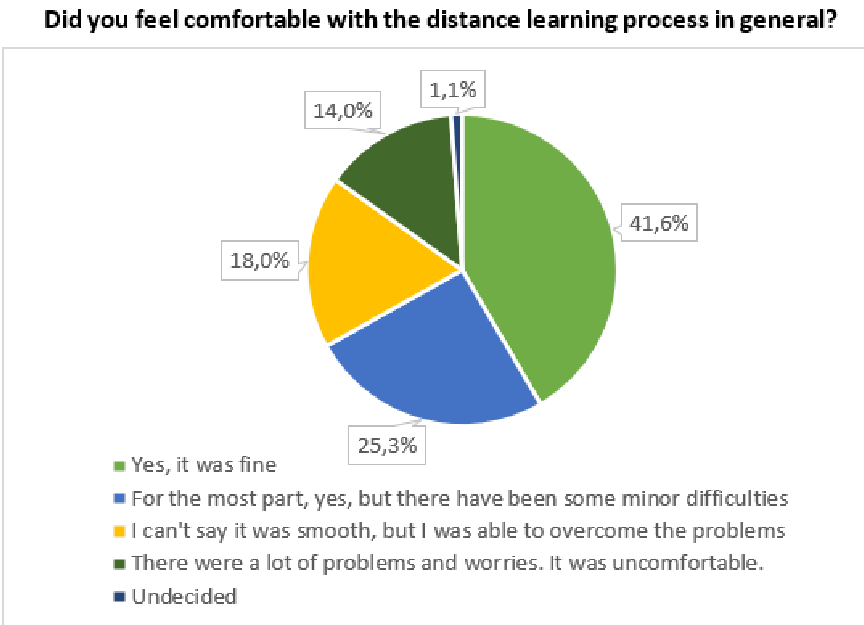


Figure 3: Students' perceptions of distance learning

Faculty members, for their part, noted low motivation of students (61.7%) and poor communication with students during distance learning (48.4%), as well as their own ignorance about the possibilities of services for organizing the educational process (21.4%). Students, in turn, pointed to poor communication with faculty (52.8%), a low level of their own motivation (37.8%), problems with mastering the material (36.4%), increased nervousness when passing exams with the proctoring system (31.8%) and insufficient knowledge or skills of using digital platforms and services (15.9%).

The majority of faculty and students did not experience problems with Internet access during distance learning (69.5% and 69.9%, respectively), as well as with equipment for participating in webinars (computer, web camera, microphone) - 56% of faculty members and 70.9% of students. At the same time, 30.9% of students noted that they experienced a lack of technical and organizational support from the university services during distance learning, 24.1% of faculty members also supported this point (Figure 4).

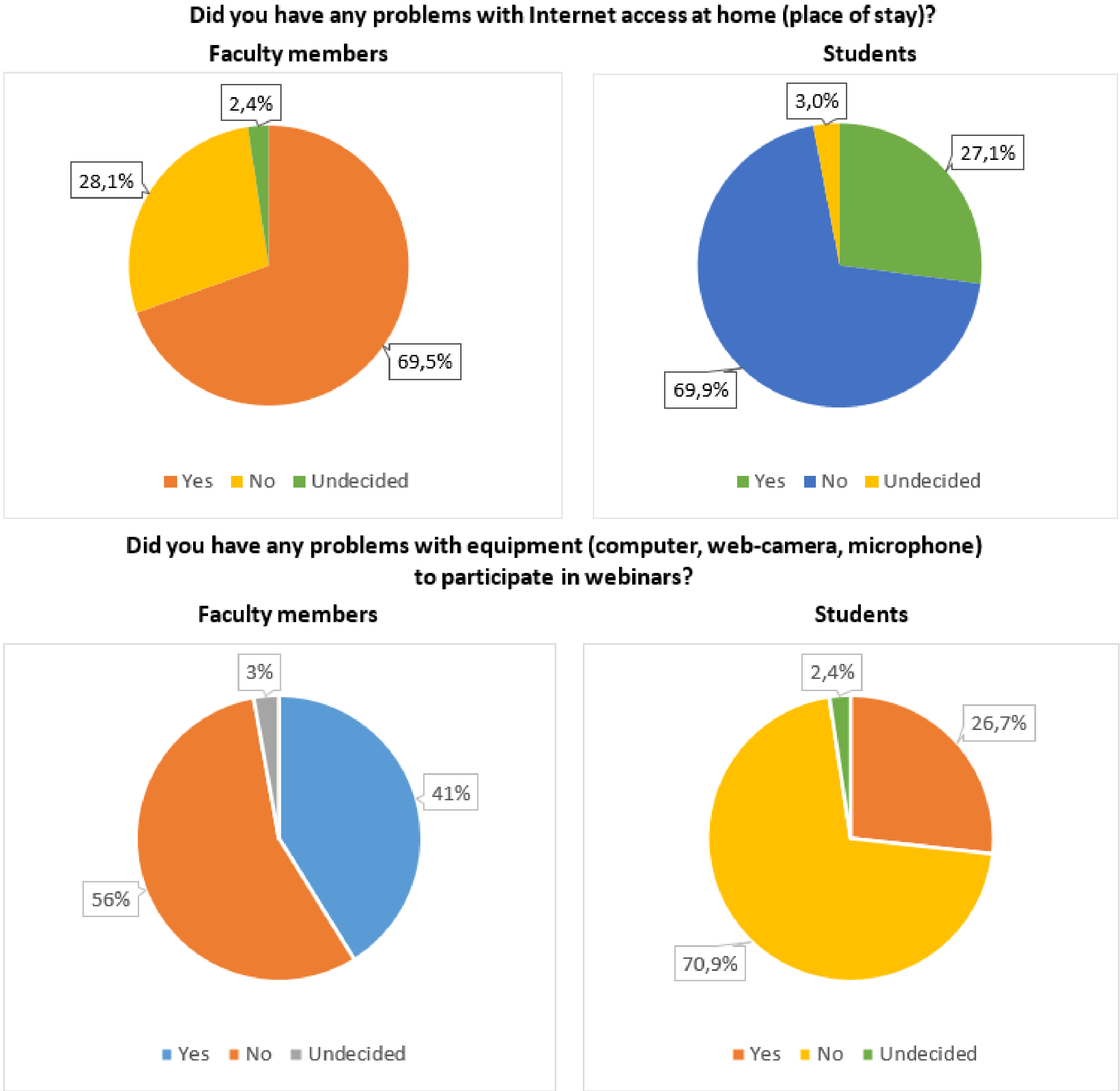
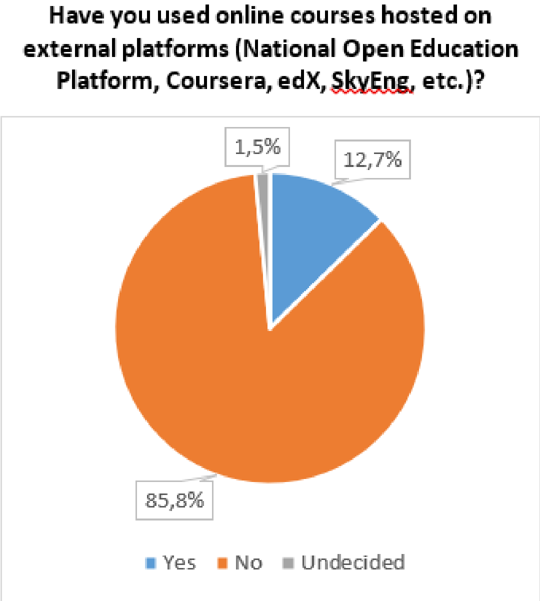


Figure 4: Problems with internet access and necessary equipment during distance learning

When asked about the use of corporate services, such as personal account, GRS, etc., the majority of students noted that they work with them several times a week (46%), 32.1% daily, 18.7% rarely, 1.3% never use them, and 1.9% found it difficult to answer. Slightly less than half (45.8%) of faculty members used the services of their personal account (sending notifications, class schedules, requests for technical support, etc.) to organize distance learning several times a month, 25.2% daily, 14.1% never used it, 6.1% during exams and 8.9% found it difficult to answer.

Only 12.7% of faculty answered that they used online courses hosted on external platforms (National Open Education Platform, Coursera, edX, SkyEng, etc.) to organize distance learning for students (Figure 5).

26.9% of students answered that they did not study any external resource during distance learning, 17.7% - mastered one course, 19.2% two courses, 14% - three courses, 7.8% - four courses, 4.9% - five, 8.7% passed from 5 to 10 external courses and 0.7% indicated that they mastered more than 10 online courses. At the same time, 30.8% of faculty members and 28.6% of students used the internal LMS systems of the university (Hypermethod, Moodle, etc.) daily. The answer "have never used LMS-systems" was given by 35.4% and 8.7% of faculty members and students, respectively. It is important to note that 75.4% of faculty members have never canceled classes, 23.3% did it occasionally, 38% of students confirmed the fact of canceling classes.



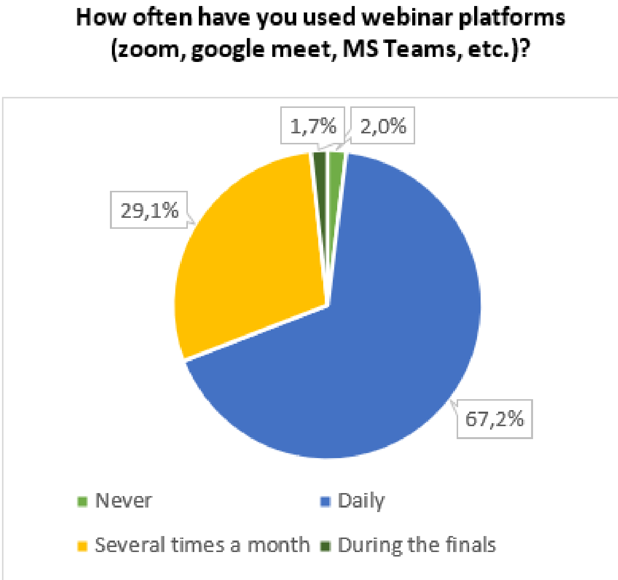


Figure 5: Faculty members' use of online services to organise distance learning lessons

Students were asked a question about assessing their ability to self-organize as a factor for the improvement of the effectiveness of distance learning, the majority (49.7%) rated the level of self-organization as average, 39% - as high, 10.1% - as low and 1.2% found it difficult to answer.

14.2% of faculty members estimated a significant increase in the level of computer proficiency and the tools of the electronic information and educational environment during the forced distance learning, 47.7% noticed minor changes, 37.7% did not notice any improvements and 0.4% found it difficult to answer.

The majority of students (59.2%) confirmed their expectations from distance learning, 22.2% answered that they were not confirmed and 18.6% found it difficult to answer. Expressing a free opinion about the distance format, 61.9% noted that it has its advantages, such as saving time on the road and the possibility of studying with a flexible schedule, 36% indicated that if desired, it was possible to study just as effectively, for 49.4% this format was even preferable to full-time training in some cases, for example, when studying non-core subjects, if there is a recording of classes for more detailed study, during the exam preparation, with a large amount of theoretical material.

38.6% of respondents discovered new opportunities for learning and self-learning during the pandemic, while 45.6% preferred a mixed learning format, pointing to the ineffectiveness of pure "distance learning", a large amount of materials for independent learning, difficulties in obtaining practical skills in specialized disciplines, a constant feeling of loneliness, high fatigue due to a lot of time at the computer, weak organization of classes in the spring semester of the 2019/2020 academic year, complete lack of motivation to study. It should be noted that there are special difficulties for the 1st-year students due to unfamiliar surroundings and new subjects.

Basically, faculty members note that distance learning has become an interesting experience, and the acquired skills will be useful in the future (33%). 29.6% of respondents note that they are not going to use the acquired skills in the future and perceive the distance format as an enforced measure. 18.7% of respondents indicated that such a format, combined with active teaching methods, can be even more effective than the traditional form. 12.6% of faculty members who had conflict situations related to the dissatisfaction of students and their parents with the distance format received a negative experience.

At the same time, the majority of faculty members (86.3%) believe that the university has coped with the organization of distance learning, 2% - disagree, and 11.7% found it difficult to answer.

A great response was received by the question on the assessment of labor efforts in distance learning compared to traditional formats. 65.2% of faculty members noted that they began to work significantly more (and this fact is confirmed by the studies of Larionova et al, 2021), 18.7% - a little more, 11.3% - about the same, but there were also those who noted a decrease in workload for preparing and conducting classes: 2.2% spent a little less time and 2.6% – much less (Figure 6).

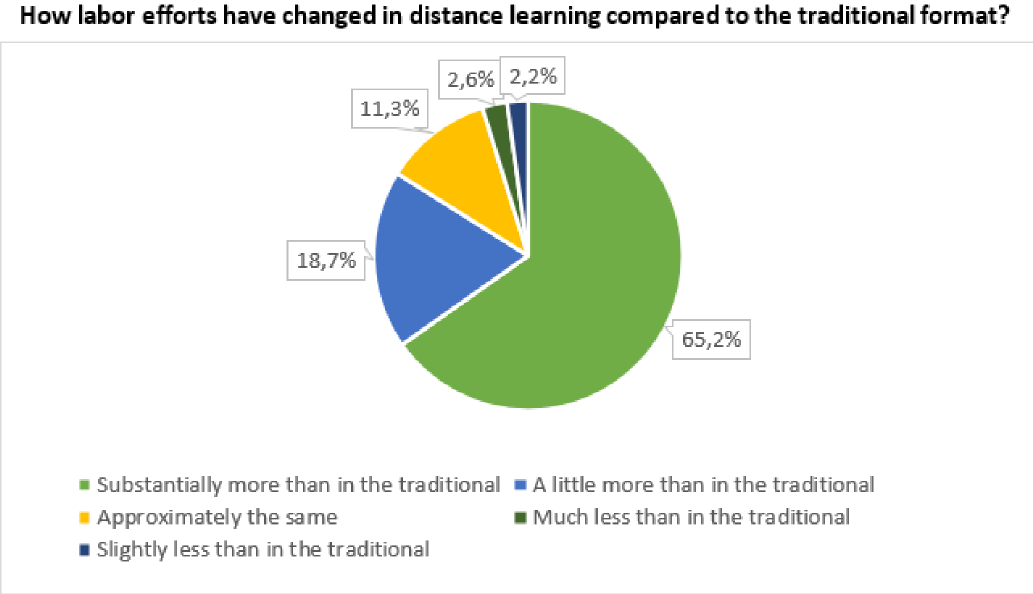


Figure 6: Faculty members' perceptions of how labor efforts of distance learning differ from the traditional format

Thus, the results of the second survey revealed a sufficient level of adaptation of faculty members and students to the new format of training. The majority of respondents did not experience difficulties with Internet access, using the necessary equipment and digital services. About 30% of faculty members and 14% of students remained sharp opponents of distance education technologies. At the same time, two negative points should be noted: the unwillingness of faculty members to use external educational resources, including online courses from leading universities in educational activities and the high workload of faculty members in organizing and supporting distance learning.

It should be noted that during the emergency transfer of the educational process to a completely remote mode, laboratory workshops caused special difficulties. For this reason, laboratory work, which can be performed at home or with the help of virtual laboratory installations, was organized remotely. For this purpose, the teachers prepared and posted 112432 pages of methodological guidelines for the implementation of laboratory workshops in the university's educational process management system (Larionova et al, 2021). Conducting laboratory workshops, the implementation of which is impossible in a remote format, was postponed to the next semester (autumn 2020/21 academic year).

During the second wave of the pandemic and as a consequence of the transfer of the educational process to a remote format (November 2020), laboratory workshops were organized in a short time (three weeks) in small groups in compliance with all anti-epidemic precautions.

4. Discussion

A comparative analysis of the survey results at the beginning of the pandemic and a year later is presented further. It should be noted that the sample size of the number of faculty members (552 respondents who participated in the survey in March 2020, and 463 respondents in early April 2021, which is 30.8% and 26.2% of the average number of faculty members of the university in 2020 and 2021, respectively) allows us to draw statistically significant conclusions from the conducted sociological research (with a confidence figure of 99%, the confidence interval was 4.19% and 4.72%, respectively). The survey of students involved 6 230 people in March 2020 and 1 944 people in April 2021, which amounted to 21% and 6.4% of the actual number of full-time students in 2020 and 2021. This gives an error of the research results of 1.45% and 2.84%, respectively, with a given confidence figure of 99%.

The analysis begins with a survey of faculty members. When asked about the experience of using remote technologies at the time of the outbreak of the pandemic, half of the faculty members surveyed (51%) replied that they had such experience. During the pandemic, their number has increased to 99%. This indicates that the emergency transition to distance learning has forced many faculty members to master new webinar platforms and digital services urgently. At the same time, 96.5% and 77.7% of faculty members respectively were provided with Internet access and equipment for participation in webinars, and a year later almost all faculty members (99.1%) had the opportunity to conduct lectures and practical classes online. 67.2% of faculty members used webinar platforms for conducting classes on a daily basis, and 29.1% of respondents used them several times a month, that is, 96.3% of faculty members regularly conducted synchronous classes with students in a remote format. Nevertheless, during the year, some faculty members experienced technical problems during classes: 28.8% of respondents had problems with Internet connection, and 41.1% of the surveyed faculty members faced problems with equipment.

To organize distance learning, 54.1% of faculty members planned to start using free online courses on external platforms (National Open Education Platform, Coursera, edX, SkyEng, etc.) in the educational process in March 2020, but only 12.7% said that they really used this opportunity. A large campaign was carried out at the university to connect faculty and students to the international open education platform Coursera. More than 5,000 courses were available to everyone free of charge. Despite this, no more than 3% of students were registered on the platform and no more than 1% of students successfully completed the courses. This indicates the lack of a systematic approach to the use of third-party online courses in educational activities, the unwillingness of the teaching staff to expand the educational opportunities of students and the low motivation of students to study.

Nevertheless, most of the faculty members created their e-courses on the internal LMS (learning management system) platforms of the university and used them in distance learning. According to the survey, 59.7% of faculty members actively used internal LMS platforms during the pandemic, while only 37.9% of respondents had such experience at the time of switching to distance learning. At the same time, the number of respondents who pointed out the daily use of their own resources on internal LMS platforms increased almost 2 times (from 15.8% to 30.8%).

When faculty members assessed the problems they faced when organizing distance learning, the following results were obtained: 61.7% of faculty members noted low motivation of students (for comparison, in 2020, 50.5% of faculty members expected such difficulties in distance learning), weak communication with students was recorded in 48.8% of responses (in 2020, 33.8% of faculty members pointed to these risks), technical problems (Internet, the operability of LMS systems, lack of equipment, 44.8% of faculty members were concerned (at the beginning of the pandemic, there were 66.7% of them) and 21.4% of faculty members indicated a lack of experience in using services for organizing distance learning (in 2020, 42.8%, respectively). Thus, most of the expected problems, such as lack of communication with students and their low motivation to study, were confirmed and even increased in the process of distance learning, while the uncertainty in the technical issues of the process of organizing distance learning among faculty members significantly decreased.

A survey of students revealed similar difficulties and achievements. Thus, 97.1% and 76.1% of students, respectively, were provided with Internet access and the necessary equipment to participate in webinars. Technical problems during distance learning were observed in 27.1% of respondents with the Internet and 26.7% with equipment for participating in online training events. That is, students were more provided with the necessary equipment, then faculty members. At the same time, students acquired important self-organization skills during distance learning: if in 2020 only a third of students (29.3%) rated their self-organization skills as "high", then in 2021 a high level of self-organization was noted by 39% of the surveyed students. About half of the students gave "average" assessment of their self-organization (56.2% in 2020 and 49.7% in 2021, respectively), and "low" assessment was recorded in about 10% of concerned students (12.7% in 2020 and 10.1% after the experience of distance learning in 2021).

Analyzing the difficulties encountered during distance learning, students arranged them in the following order: poor communication with faculty members - 52.8% (49.9% of respondents expected such difficulties when switching to the online format of classes), low level of their own motivation - 37.8% (more respondents were afraid of such problems 46.4%), misunderstanding of the material - 36.4% (58.5% of students predicted these risks, respectively). Thus, students adapted quite well to the new format of training and in most cases were able to overcome the difficulties that arose.

The expectations of students regarding the use of online courses in education were also met: 74.9% of students planned to study online courses during distance learning, and these expectations were met by 73.11%. However, it should be noted that there are some discrepancies related to the term "online course". Often, students classified electronic resources on internal LMS platforms as online learning, without distinguishing external online courses hosted on online learning platforms from internal electronic courses. Taking into account this remark, it should be noted that the number of students who often (daily, several times a week) used LMS systems internally (Hypermethod, Moodle, etc.) increased from 11% to 70.6%, and the number of those who never used these resources decreased from 47.3% to 8.7%.

In addition, students' motivation to attend full-time classes at the university has changed in the direction of increasing motivation and the need for communication with the teacher. "The desire to meet and to communicate with friends" was pointed by 53.5% of students (compared to 48.1% before the outbreak of the pandemic). However, the "desire to gain knowledge and to learn new things" decreased from 70% to 41.8%, which is explained by the higher amount of information that students had to master independently during distance learning. A "lively creative atmosphere" has become important for 41.5% of students (before distance learning, there were 23.9% of such students) and only 33.7% of respondents noted that attending classes is a "responsibility of a student" (before the pandemic, there were 65.3% of such students).

The obtained research results demonstrate the emergence of a new "normality" of university education, namely partial (or complete) transition of the educational process into a distance format (Pokhrel, Chhetri, 2021). The acceleration of the digital transformation of education caused by the pandemic is noted in many studies around the world (Kutnjak, 2021) and the inevitability of digital transformation of education is emphasized. At the same time, special attention of researchers from all over the world is focused on the problems of the quality of distance education (Assessment of the quality of education in the conditions of distance learning: the experience of the pandemic by the school education systems of the post-Soviet countries (2021) - M.: "Alex" (IP Polikanin A.A.), 390 p.). In particular, Lori Williams & Melanie Booth (2021) note that the quality of distance education and the protection of the interests of students as consumers of educational services should be ensured by the joint efforts of the university management, accreditation bodies and the government.

On the one hand, the emergency transition to distance learning during the pandemic, the one hand, exacerbated the problems associated with the unavailability of some universities to use digital technologies in the educational process, and on the other hand, it accelerated the processes of digital transformation of universities, which, in its turn, necessitated a radical restructuring of the educational process, the search for new approaches to pedagogical design, the introduction of external educational resources, digital platforms and services to preserve the quality of education. The "warming" relationships to online learning and distance learning technologies of both teachers and students revealed in the surveys confirms their readiness for the institutional implementation of new models of teaching and learning at universities.

It can be stated that many methodological and organizational and technical problems identified in the survey process have yet to be solved by universities, but the conclusions convince that the loyalty of participants in the educational process and their interest in changes have significantly increased.

5. Conclusions

Students and faculty members who faced an emergency transition of the entire educational process to a distance format in March 2020 were not fully prepared for this emergency situation. Doubts about the possibility of maintaining the quality of training during the transition to a distance format and the level of necessary digital competencies were natural, which is confirmed by the results of a survey conducted in March 2020. The 2021 survey revealed, on the one hand, some fatigue of faculty members from the online learning format (which was expressed, in particular, in a reduction in the number of respondents to online surveys), on the other hand, the growth of digital competence of faculty members and an increase in the number of faculty members actively using digital services and platforms for distance learning (from 47% to 99% of faculty members). It should be noted that the main concerns of faculty members in March 2020 were related to possible technical problems of organizing distance learning, and in fact, the issues of communication with students and their motivation turned out to be problematic. On the part of students, there was a fairly high level of adaptation to the new format of training, a decrease in fears for their success and an increase in the level of self-organization.

The global experiment on the emergency transition to a distance format revealed a large number of justified and refuted fears on the part of both faculty members and students. Understanding the experience of the Ural Federal University made it possible to identify a number of problems faced by both faculty members and students, which made it possible to analyze trends and learn lessons from the emergency transition to the "distance learning", as well as to "error correction". The next stage of transformation involves a deep understanding of the experience gained by the university during the pandemic, and further systematic improvement of the organization of the educational process, which could be observed already in the second wave of the pandemic (Goncharova, Daineko and Larionova, 2021).

The results of a sociological study and a comparative analysis of data at the beginning of the pandemic and a year later on the attitude of faculty members and students to the organization of the educational process in a distance format at the largest university in the region can serve as a basis for forming recommendations for Russian universities and the education system as a whole. Of course, the final conclusions can be made only after the lifting of the restrictions associated with the pandemic and the transition to the usual mode of operation. However, it is already becoming clear that the university has readily responded to the challenges of the global educational agenda, and faculty members and students who were seriously afraid of the difficulties of switching to distance learning have acquired new skills and practical experience of digital transformation of the educational process during the pandemic.

References

Abramov, A.V., Bagdasaryan, V.E., Byshok, S.O., Volodenkov, S.V., Evstaf'ev, D.G., Egorov, V.G., Komleva, N.A., Manojlo, A.V., Mihajlenok, O.M., Petrenko, A.I. and Prokof'ev, V.F. (2020) "Pandemiya COVID-19: konec privychnogo mira?" [Pandemia COVID-19: the end of the familiar world?], *Vestnik Moskovskogo gosudarstvennogo oblastnogo universiteta [Bulletin of Moscow State Regional University*], Vol 2, pp 3–83. [In Russ.]

"Assessment of the quality of education in the conditions of distance learning: the experience of the pandemic by the school education systems of the post-Soviet countries" (2021) - M.: "Alex" (IP Polikanin A.A.), 390 p. [In Russ.]

Belyaeva, E.A. and Grunt, E.V. (2020) "Sociologicheskaya refleksiya distancionnyh form obucheniya v vysshej shkole v usloviyah COVID-19: problemy i perspektivy dal'nejshego razvitiya" [Sociological reflection higher education distance learning in the context of COVID-19: Problems and prospects for further development], *Russian Economic Bulletin*, Vol 3, No. 4, pp 256–262. [In Russ.]

Goncharova N.V., Daineko L.V. and Larionova V.A. (2021) "Lessons of pandemic and digital development practices: URFU experience", *15th International Technology, Education and Development Conference Online Conference,* 8-9 March, 2021, pp 6715-6719.

Goncharova, N.V. and Zaitseva, E.V. (2020) "Responses of Russian universities to the challenges of Covid-19 pandemic", *Proceedings of the 19th European Conference on e-Learning*, *ECEL 2020,* pp. 221–228.

Grunt, E.V., Belyaeva, E.A. and Lebedkina, E.G. (2021) "Dekonstrukciya obrazovatel'nyh praktik prepodavatelej i studentov rossijskih vuzov v usloviyah vynuzhdennogo perekhoda na distancionnoe obrazovanie" [Deconstruction of Russian university staff's and students' educational practices in the context of the forced transition to distance education], *Sociologiya [Sociology],* Vol 1, pp 191–201. [In Russ.]

Grunt, E.V., Belyaeva, E.A. and Lissitsa, S. (2020) "Distancionnoe obrazovanie v usloviyah pandemii: novye vyzovy rossijskomu vysshemu obrazovaniyu" [Distance education during the pandemic: New challenges to Russian higher education], *Perspektivy Nauki i Obrazovania [Perspectives on science and education],* Vol 47, No. 5, pp 45–58. [In Russ.]

Daineko, L.V., Larionova, V.A., Yurasova, I.I., Davy, Y.M. and Karavaeva, N.M. (2020) "Educational process digiltalization in Ural Federal University", *Proceedings of the 19th European Conference on e-Learning, ECEL 2020,* pp 146–153.

Koksharov, V.A., Sandler, D. G., Kuznetsov, P.D., Klyagin, A.V. and Leshukov, O.V. (2021) "The Pandemic as a Challenge to the Development of University Networks in Russia: Differentiation or Collaboration?", *Voprosy obrazovaniya [Education issues],* Vol 1, pp 52-73.

Kondyukova, E.S., SHershneva, E.G. and Zorin, A.K. (2021) "Distancionnyj format obucheniya v universitetah: vyzovy i perspektivy" [Distance learning at universities: Challenges and prospects], *Modern Humanities Success,* Vol 1, pp 116–121. [In Russ.]

Kubina, E.A., Bareicheva, M.A., Stepanova, N.R. and Brown, K. (2020) "Problems and ways of forming the educational strategy of students in the process of remote learning", *Proceedings of the 19th European Conference on e-Learning, ECEL 2020,* pp 260–269.

Kutnjak, A. (2021). “Covid-19 Accelerates Digital Transformation in Industries: Challenges, Issues, Barriers and Problems in Transformation”. *IEEE Access,* pp 79373-79388.

Larionova, V., Semenova, T., Murzakhanova, E., & Daineko, L. (2021) “Economic Aspects of Emergency Transition to Distance Education, or The Price of Going Online in Higher Education”. *Mir Rossii*, *30*(1), pp 38-157.

Larionova, V.A., Semenova, T.V., Murzakhanova, E.M. and Daineko, L.V. (2021) “Ekonomicheskie aspekty vynuzhdennogo perekhoda na distancionnoe obuchenie, ili kakuyu cenu zaplatili vuzy za distant” [Economic aspects of emergency transition to distance education, or the price of going online in higher education], *Voprosy Obrazovaniya [Educational Issues],* Vol 1, pp 138–157. [In Russ.]

Larionova, V.A., Semenova, T.V., Shmeleva, E.D., Dajneko, L.V. and Yurasova, I.I. (2020) “Vynuzhdennyj perekhod na distancionnoe obuchenie: ozhidaniya i opaseniya studentov” [Forced transition to distance learning: students' expectations and concerns], *Universitetskoe upravlenie: praktika i analiz [University governance: practice and analysis],* Vol 24, No. 4, pp 22–29. [In Russ.]

Nazarov, V.L., Zherdev, D.V. and Averbukh, N.V. (2021) “Shokovaya cifrovizaciya obrazovaniya: vospriyatie uchastnikov obrazovatel'nogo processa” [Shock digitalisation of education: The perception of participants of the educational process], *Obrazovanie i Nauka [The Education and science journal],* Vol 23, No. 1, pp 156–201. [In Russ.]

Panov, V.I., Borisenko, N.A., Kapcov, A.V., Kolesnikova, E.I., Patrakov, E.V., Plaksina, I.V. and Sunnatova, R.I. (2020) “Nekotorye itogi cifrovizacii obrazovaniya na primere vynuzhdennogo udalennogo shkol'nogo obucheniya” [Some results of the digitalisation of education on the example of forced remote schooling], *Pedagogika [Pedagogy],* Vol 84, No. 9, pp 65–77. [In Russ.]

Pokhrel, S., Chhetri, R. (2021). “A literature review on impact of COVID-19 pandemic on teaching and learning”. *Higher Education for the Future*, 8(1), pp 133-141.

Radina, N.K. and Balakina, J.V. (2021) “Challenges for Education during the Pandemic: An Overview of Literature”, *Voprosy obrazovaniya [Education issues],* Vol 1, pp 178–194.

Shalina, D.S., Stepanova, N.R. and Novokreshchenov, S.A. (2021) “Aktivizaciya obrazovatel'noj deyatel'nosti studentov v usloviyah distancionnogo obucheniya” [Activation of students' educational activities in the context of distance learning]. *Sovremennye problemy nauki i obrazovaniya [Contemporary issues of science and education],* Vol 1. [In Russ.]

Williams, L., & Booth, M. (2020). “Quality Distance Education for Students is Within Reach”. *Change: The Magazine of Higher Learning*, 53(1), pp 55-59.

The Fourth Industrial Revolution and Higher Education in Africa: A Systematic Review and Implications

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DOI: 10.34190/EEL.008

Abstract: The fourth industrial revolution is upon us with several countries being in the preliminary stages. It is said to change the way we live and the way we work. The fourth industrial revolution is about digitalisation and automation of work and is viewed by many as the most important societal and economic trend in the world. This is a trend that will change the nature of work, societies, and businesses in the coming decades. The fourth industrial revolution has a significant impact on education systems around the world which is why Africa needs to continuously research how best they can incorporate the fourth industrial revolution into their current education systems. The Covid-19 pandemic has led to a massive impact on people in all industries and sectors around the world including the education sector. Furthermore, the Covid-19 pandemic is forcing most universities to use online distance learning and e-learning as this has increasingly become important in maintaining prominent levels of adaptation in the future. This is one of the reasons why the fourth industrial revolution has become an important subject. This paper looked at the fourth industrial revolution and what it means for higher education in Africa. The methodology includes reviewing of 42 scholarly journal articles. The main purpose of this study was to get an understanding of the emerging technologies in industries and education and the threats and opportunities that are posed by the fourth industrial revolution in Africa. The paper concluded by reviewing journal articles on how best African universities can create capacity for the fourth industrial revolution.

Keywords: fourth industrial revolution, emerging technologies, creating capacity, higher education, trends, coding

1. Introduction

The fourth industrial revolution is about digitalisation and automation of work and is viewed by many as the most important societal and economic trend in the world. This is a trend that will change the nature of work, societies, and businesses in the coming decades (Coberly-Holt, and Elufiede, 2019). The world has gone through several industrial revolutions over the past decades and every industrial revolution has come with implications on the education of society. Mkwanazi and Mbohwa, (2018) define an industrial revolution as an occurrence that is unpredictable which is a result of speedy rapid changes in designing solutions. Another definition of the fourth industrial revolution by Fomunyam (2019) is that it is transforming how humans function and results in disruptive technology trends which include the internet of things (IoT), virtual reality, Artificial Intelligence (IA) and robotics. According to Naudé (2017), the difference between the fourth industrial revolution and the previous revolutions is that the previous revolutions were about technology replacing higher-skilled workers and complementing low skilled workers whilst the fourth industrial revolution is the opposite where it replaces lower-skilled workers and complements higher-skilled workers. The fourth industrial revolution changes how education is understood as well as the future of education (Mkwanazi and Mbohwa, 2018). According to Wogu, et.al, (2018) using ICT is beneficial in enhancing educational efficiency and improves the effectiveness and efficiency within the administrative function. Furthermore, it leads to a promotion of learning and research which is individualised and improves the current teaching and research techniques. ICT is not there to replace current administrative and teaching and research techniques but to enhance them. The Coronavirus 2019 (Covid-19) pandemic is forcing most universities to use online distance learning and e-learning as it has increasingly become important in maintaining elevated levels of adaptation in the future (Hack, 2020).

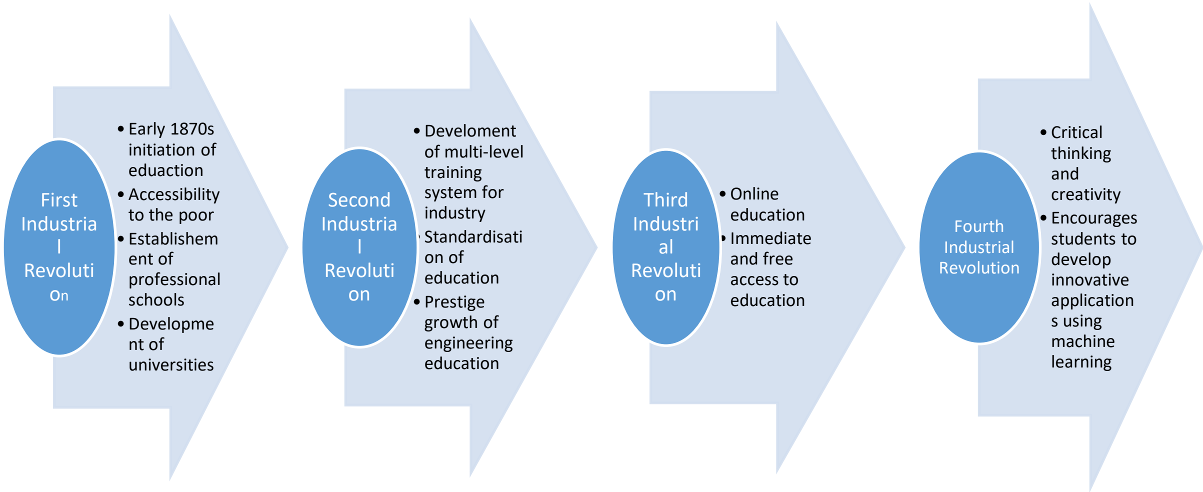
2. Emerging technologies in African education

The fourth industrial revolution has led to emerging technologies. These emerging technologies are drastically novel and fast-growing technologies that persist over time and which can have an enormous impact on socio-economic spheres. Herweijer et al., (2018) identified ten emerging fourth industrial revolution technologies as presented in the figure below:

Source: Herweijer et al., (2018)

Figure 1: Ten emerging fourth industrial revolution technologies

The works of creativity have led to emerging technologies in education and the stakeholders of education including the heads of education and lecturer have to be creative and inquisitive as they need to be re-trained so they can meet the modern trends in their professional fields (Wogu, et.al, 2018). There have been emerging technological breakthroughs especially in the field of the internet of things, autonomous vehicles, 3D printing, artificial intelligence, robotics, and quantum computing (Peters and Jandrić, 2019). Below is a figure that depicts how education has evolved from the first to the fourth industrial revolution.



Source: Fomunyam (2019)

Figure 2: Evolution of education from first to the fourth industrial revolution

Different scholars have written about the emerging e-learning technologies and the following e-learning technologies were identified:

2.1 Coding

Soykan and Kanbul (2018) indicated that coding in education was introduced in the early 1960s and it has been revived in recent years with visual programmes including Scratch, Alice, Kudo and code.org. Wilson (2019) highlighted the importance of teaching young students to code as it will help them be creative, use logic and be able to transfer their skills to other subject areas. Furthermore to teach computational thinking which is a skill that has for the 21st century learners been considered by some researchers as fundamental coding is one of the methods where computational thinking is defined as the use of strategies in conducting a detailed analysis of problems so that one can fully understand issues and be in a position to formulate solutions and identify patterns (Wilson, 2019). Schmidt-Crawford, Lindstrom and Thompson (2018) are in support of this notion as they indicated that the coding experience is providing experience in defining problems, creating and organise parts, problem solving, testing the problem, and using the information in coming up with a solution. Soykan and Kanbul (2018) added that several types of research have been conducted by scientists on the skills that are expected in the 21st century and these are problem solving, critical thinking, knowledge media, technology literacy, creativity, and communication. These skills need to be taught to students with Code.org being the most prominent organisation for teaching these skills. Code.org was established to promote computer sciences education as a non-profit organisation. According to Tamatea (2019), digital code endorses robotics, artificial intelligence, and autonomous stealth drones. Tamatea (2019) speaks about how the world is emblazoned by the digital and how the response of education has been on introducing compulsory coding in schools. Soykan and Kanbul (2018) indicated that in a technologically focused world if you want to be a productive country there is a need for individuals to be skilled in coding.

2.2 Seamless resource access

Marín et al., (2016) define seamless learning being when the learners make use of multiple technological devices to search for information, to collaborate and communicate with peers, friends, and family and to create knowledge with no restrictions of time or location. Yetik et al., (2020) support this view as they indicate that seamless learning is learning that is not restricted, it is technology-based learning which takes place regardless of social environments, time and place and it is a special kind of accessible and mobile learning which is continuously improved through technology. According to Kruse and Rapp (2019) as much as seamless materials are advised for improved learning there is however no evidence that if a continual flow of learning materials is provided it will result in learning that is effective and seamless on its own does not guarantee useful learning. Kali et al., (2018) did a study to try to identify a way in which to make seamless learning more effective. The study was based on making use of Supporting Outdoor Inquiry-Learning (SOIL) guidelines in support of designing seamless flows of activities where four dimensions were considered. These dimensions include scientific practices, outdoor learning, physical settings, and social activity structures. These dimensions are briefly discussed in the table below:

Table 1: SOIL dimensions

Dimensions	Outcome
Scientific practices	Providing students with scientific resources to be summarised and shared
Outdoor learning	Designing of preparation activities to further use resources from fieldwork
Physical settings	Multiple physical settings, with pre-activities designed to take place at home and follow ups to be done in class
Social activity structure	Moving back and forth between individual, small group and whole-class work.

Source: Kali et al., (2018)

2.3 Remote learning

Universities operate in a highly competitive environment and are affected by technological changes. This has led to the need for universities to introduce if they have not already or to improve their remote learning (da COSTA, Pelissari, and Gonzalez, 2018). Remote learning is also called distance learning and is learning that happens beyond the classroom. According to Traxler (2018) distance learning is learning that happens off campus. Furthermore, the delivery mechanisms for most distance learning include e-learning, digital learning, online learning, and virtual learning. These are synonymous which can be used interchangeably. There are several ways in which remote learning can be conducted and that is through mobile technologies and MOOC's. Mobile technologies are currently seen as being more than just a tool for communication. It has been recognised as a learning tool due to technological advancements such as wireless network development (Wai, Ng, Chiu, Ho, and Lo, 2018). One of the ways to transform education is through the use of Massive Open Online Courses (MOOCs) (Peters and Jandrić, 2019). MOOCs make it possible for students to learn in a way that will best suit their needs as they can pause, rewind and fast forward.

2.4 Gamification

According to Dicheva et al., (2015) using educational games in teaching and learning is a promising tool because it has the ability not only for the knowledge to be reinforced but also for important skills including communication, problem solving and collaboration to be gained. It can be exceedingly difficult for lectures to keep students motivated and to get them to engage, gamification approach is seen as an approach that can lead to an improvement to students' motivation and engagement. Majuri et al., (2018) define gamification as a design approach where there is utilisation of gameful design in several contexts for inducing familiar experiences from games so that different activities and behaviours can be supported. There is a study conducted by several authors to assess the impact which gamification has on students' performance (Legaki et al., 2019). The study's results revealed that the students learning performance had a positive impact when gamification applications as a complementary teaching tool were used. A number of authors believe that gamification has the potential to improve learning but that is when there is correct use and if it is professionally designed (Dicheva et al., 2015). Furthermore, the authors highlighted the obstacles for applying game elements to education and this obstacle is when there is a lack of technical support but one of them was to overcome this obstacle is to develop software tools that can efficiently support gamification and to conduct research on feasibility and efficacy of gamification in education.

2.5 Personalised LMS

O' Donnell et al., (2015) define personalised learning as personalising the learning activities to meet the needs of diverse students. Moreover, information and communication technology must ensure that there is facilitation of active learning which will be suited for student's requirements. According to Muruganandam and Srinivasan (2014), most e-learning systems ignore the various requirements of learners as these systems do not take into account the individual aspects which is why personalising e-learning systems is important as it is more suited at satisfying the requirements of different students. There is an e-learning learner management system that supports personalised learning and can be used by education institutions. This learner management system is referred to as Modular Object-Oriented Dynamic Learning Environment (MOODLE). MOODLE is an open-source learner management system that is free. With MOODLE the courses have been created with interactive features including video, animation, images, audio, and games which accommodate the diversity of students as it provides stimulations and simulations for engagement and students can learn at their own pace (Kumari, 2016). This shows that MOODLE offers personalised learning opportunities to meet the different students' needs.

3. Threats and opportunities posed by the fourth industrial revolution in Africa

The Covid-19 pandemic resulted in the lockdown in most countries around the world including African countries. Most of the Universities and schools did not have the tools needed to carry out online learning and they were not prepared to engage in e-learning. This is because of the African Continent challenges with the infrastructure, the high costs of data and broadband (Mhlanga and Moloi, 2020). Naudé (2017) highlights a threat to Africa where there is a lack of sufficiently skilled workers in Africa as the fourth industrial revolution is there to replace lower-skilled workers and complement higher skilled workers. The reason behind this is that Africa has lower completion rates in primary education as compared to other continents and the lowest rate of participation in tertiary education with the highest pupil-teacher rate. According to Fomunyam (2019), the fourth industrial revolution will disrupt labour markets leading to greater inequality as automation across the entire economy will replace labour. This leads to the most valuable resource being technology driven and not human resources. To overcome this talent should be monopolised.

The introduction of ICT has unlimited the boundaries and created opportunities that are boundless for education stakeholders such as students, researchers, and lecturers so they can be in a position to access, store and distribute materials in a cheaper way across disciplines (Wogu et al., 2018). As much as ICT has led to unlimited boundaries it is not necessarily always a good thing for universities. This could also pose a threat in that since students can access education anywhere without having to be physically present, what can stop them from doing online courses internationally. This means that the competition for universities has gone beyond just being competitive with local universities to an increase in international competition.

One of the concerns is that with the introduction of ICT some lecturers are frustrated because they lack adequate skills and knowledge of how to use the ICT systems'. A suggestion by Wogu, et.al., (2018) is the importance of having policies that will make gaining these skills and knowledge a prerequisite for employment and promotion in the education sector. According to Peters and Jandrić (2019), innovative technologies have turned many industries upside down. Furthermore, the advancement of technology through robotics, 3D printing, artificial intelligence and many other innovations have disrupted industries. The biggest concern with technological unemployment is that it will create greater inequalities and increase the gap between the returns to labour and capital. Fomunyam (2019) alluded that there is a view that with artificial intelligence more jobs will be replaced than jobs being created as half of the jobs available today will be automated. To overcome this the teaching and learning process needs to be adjusted in a way that reflects skills that are required to cope with innovative technologies. This will require that students are trained to be experts and institutions should have exceptionally talented members who are trained but this will need a lot of funding.

4. Creating capacity for the fourth industrial revolution

According to Wilson, et.al, (2017), there have been predictions which made by several authors which were based on a large-scale survey indicating opinions from machine-learning researchers. These opinions concluded that there is a possibility of technology outperforming humans in many activities in the next ten years with a 50% chance of artificial intelligence outperforming humans in tasks and automating the jobs of humans in the next 120 years. Wilson et al., (2017) highlighted the importance of considering the sustainability of the current educational systems because of two reasons which are; the risk that might be associated with higher education failure in reforming or reforming quickly enough and the risk of undertaking the reform uncritically or at a pace that is too great. One of the main things discussed by Wilson et al., (2017) is the importance of creativity in creating capacity in higher education. Coberly-Holt and Elufiede, (2019) support this notion as the authors mentioned that there is a demand for higher cognitive skills including critical thinking, creativity, complex information processing and decision making. Moreover, two of the four top ten skills have been identified as creativity and critical thinking which will be needed the most. Marr (2019) wrote about eight things that every school must do in preparation for the fourth industrial revolution. These things are:

4.1 Redefining the purpose of education

There are some concerns when it comes to the quality of education. According to Biesta (2019), there is a worry that schools are becoming part of the problem rather than the solution where students, teachers, politicians, the public at large and media are dissatisfied and want more and better results from schools. We have seen this by a number of riots in Africa where students are demanding better services from Universities. There is a need for education to be defined and redefined; this can be achieved by looking at legislation, financing and stakeholders should conduct monitoring (Muema and Lavery, 2018). Patrick et al., (2018) raised an especially important question which is: "How is it possible that our education system still graduates many students who lack basic reading and math skills when they hold a high school diploma?" This shows that there is a problem with the purpose of the education system, and it needs to be redefined. According to Patrick et al., (2018) redesigning education is of utmost importance so that it can be aligned to a more comprehensive definition of success.

4.2 Changing higher education

There has been a prolonged neglect of Higher Education is Africa. This has resulted in Africa having the lowest rank in the critical economy indicators including; the creation of knowledge, patents numbers, and number of qualified researchers (Molla and Cuthbert, 2018). There is a need for HEIs in Africa to change so they can improve the ranking in the critical economy indicators. The change in higher education is large because of the increase in pressure for universities to be able to demonstrate their effectiveness and to ensure effective teaching (Devlin, and Samarawickrema, 2010). One of how change can be brought about in higher education is by the integration of sustainable development through organisational change (Verhulst and Lambrechts, 2015). This can be achieved by concentrating on the factors including resistance, communication, empowerment and involvement, and organisational culture. Whenever there is a change in the organisation these factors are impacted, and the fourth industrial revolution will highly have an impact within the organisation as it will bring about change.

4.3 Improving STEM education

Peters and Jandrić (2019) suggested that there should be pursuance in STEM field careers (Science, Technology, Engineering, and Mathematics) for the improvement of people's chances in the global work market which is highly technological. Furthermore, Fomunyam (2019) indicated that to produce STEM graduates who possess 21st century skills, there should be a reorganisation of STEM where the STEM centers must be capacitated with professional experts and materials. According to Ismail (2018) STEM education is lacking in developing countries. Mnguni and Mokiwa (2020) emphased on the urgency of a need to have a dialogue globally to understand the best practices to enhance STEM education vial e-learning more specifically in developing countries.

4.4 Developing human potential

The potential of humans being able to think critically, to interact socially and to have physical skills needs to be developed by education institutions. According to Fedorova and Ponomareva (2017), it is important to discuss issues of how a favourable environment can be created so there can be an increase in the number of talented researchers and teachers who will make up the universities human and intellectual potential. Universities are known for being communities of thinking and promoters of wisdom but have been criticised for shifting focus to other agendas which impact their contribution towards what they are known for (Bina, 2017).

4.5 Adopting lifelong learning models

Lifelong learning is when new tasks are learnt based on previous experiences (Sun et al., 2018). In other words, the previous experiences that one has contributed to the ease of a new task being mastered. According to Baporikar (2016), there is a shift in education from teaching to learning where the teacher's role has shifted to facilitating the acquisition of knowledge. This leads to moving away from just concentrating on making sure that you cover the subject matter as a teacher but also ensuring that the students are in the position to develop their intellectual tools and learning strategies and this will ensure that there is an adoption of lifelong learning.

4.6 Altering educator training

Ansari et al., (2018) computational systems and artificial models are resemblances of the ability of human learning, and they reproduce human skills, and this process is referred to as machine learning. Digital transformation on industries impact will put numerous tasks and activities which were traditionally performed by human beings out of place (Ciolacu et al., 2017). It is for this reason that educators need to change the way they teach so it can be relevant for the fourth industrial revolution industries.

4.7 Making schools makerspaces

Failure is bound to happen, but this is one method of how students learn and improve. Hsu et al, (2017) mentioned that in the STEM field one of the ways to encourage growth is through the process of creating something and it incorporates activities that involve programming and physical computing. Stornaiuolo and Nichols (2018) added that doing it yourself, designing and remixing things using physical and digital tools is part of the maker movement and it has gained an increase in the attention of policymakers, practitioners, and researchers.

4.8 International mindfulness

African universities are not only competing amongst themselves in Africa or their African countries. The competition goes beyond the borders because of ICT. This means that the world is digitally interconnected which is why a global mindset is needed. Universities must adopt learning that takes into account perspectives of not just one country but the perspectives around the world. Chan et al., (2018) alluded that it is important to "think globally and act locally" as this will allow countries to get entry into foreign markets by incorporating local conditions in their global strategies. According to Lovelace et al., (2015) if students are to be able to function effectively in the global work environment there are certain skills that they need to possess and these include, attitudes, behavioural skills, and cognitive abilities essential for success in a global workforce.

5. Conclusion

The goal of the study was to do a literature review on the fourth industrial revolution and what it means for higher education in Africa. The study revealed that there are various emerging technologies in industries and education due to 4IR. Moreover, it touched on how education has evolved over the revolutions including the first to the fourth industrial revolution. It was interesting to note that several threats are posed by the 4IR but as much as there are threats there are some opportunities that African higher education universities can take advantage of. Some recommendations were given at the end which indicated how African higher education can create capacity in the 4IR era. If HEIs in Africa wants to keep up with the emerging technologies, there is a need for a paradigm shift. This means that the view on emerging technologies should not be negative but rather seen as opportunities to gain a competitive advantage over the HEIs that they are competing with. The failure to view the emerging technologies as opportunities will lead to African HEIs loosing students to international HEIs.

References

Ansari, F., Erol, S. and Sihn, W., 2018. Rethinking Human-Machine Learning in Industry 4.0: How Does the Paradigm Shift Treat the Role of Human Learning?. Procedia Manufacturing, 23, pp.117-122.

Baporikar, N., 2016. Lifelong Learning in Knowledge Society. In Impact of Economic Crisis on Education and the Next-Generation Workforce. IGI Global. pp. 263-284.

Biesta, G., 2019. What Kind of Society Does the School Need? Redefining the Democratic Work of Education in Impatient Times. Studies in Philosophy and Education, 38(6), pp.657-668.

Bina, O., 2017. Thinking about the Future of Universities.

Ciolacu, M., Tehrani, A.F., Beer, R. and Popp, H., 2017, October. Education 4.0—Fostering student's performance with machine learning methods. In 2017 IEEE 23rd International Symposium for Design and Technology in Electronic Packaging (SIITME). pp. 438-443. IEEE.

Chan, K.C., Fung, A., Fung, H.G. and Yau, J., 2018. A conceptual framework for instilling a global mindset in business students. Journal of Teaching in International Business, 29(1), pp.4-19.

Coberly-Holt, P. and Elufiede, K., 2019. Preparing for the Fourth Industrial Revolution with Creative and Critical Thinking. Adult Higher Education Alliance.

da COSTA, F.R., Pelissari, A.S. and Gonzalez, I.V., 2018. Corporate image of public higher education institutions: relevant factors to distance learning students. Turkish Online Journal of Distance Education, 19(1), pp.117-135.

Devlin, M. and Samarawickrema, G., 2010. The criteria of effective teaching in a changing higher education context. Higher Education Research & Development, 29(2), pp.111-124.

Dicheva, D., Dichev, C., Agre, G. and Angelova, G., 2015. Gamification in education: A systematic mapping study. Educational Technology & Society, 18(3), pp.75-88.

Fedorova, A. and Ponimareva, O., 2017, April. Developing university HR potential as the basis for its intellectual capital. In Proceedings of the European conference on Intellectual Capital. pp. 97-105.

Fomunyam, K.G., 2019. Education and the fourth industrial revolution: Challenges and possibilities for engineering education. International Journal of Mechanical Engineering and Technology (IJMET). 10(8), pp. 271-284.

Hack, K., 2020. "Learning in the time of Covid-19", [online], Advance HE, https://www.advance-he.ac.uk/news-and-views/learning-time-covid-19.

Herweijer, C., Combes, B., Johnson, L., McCargow, R., Bhardwaj, S., Jackson, B. and Ramchandani, P., 2018. Enabling a sustainable Fourth Industrial Revolution: how G20 countries can create the conditions for emerging technologies to benefit people and the planet (No. 2018-32). Economics Discussion Papers.

Hsu, Y.C., Baldwin, S. and Ching, Y.H., 2017. Learning through making and maker education. TechTrends, 61(6), pp.589-594.

Ismail, Z., 2018. Benefits of STEM education.

Kali, Y., Levy, K.S., Levin-Peled, R. and Tal, T., 2018. Supporting outdoor inquiry learning (SOIL): Teachers as designers of mobile-assisted seamless learning. British Journal of Educational Technology, 49(6), pp.1145-1161.

Kruse, O. and Rapp, C., 2019. Seamless Writing: How the Digitisation of Writing Transforms Thinking, Communication, and Student Learning. In Seamless Learning. Springer, Singapore. pp. 191-208.

Kumari, S., (2016). Personalised, flexible and blended learning features of moodle-LMS. Educational Quest, 7(1), p.53.

Legaki, N.Z., Xi, N., Hamari, J. and Assimakopoulos, V., 2019, January. Gamification of the future: an experiment on gamifying education of forecasting. In Proceedings of the 52nd Hawaii International Conference on System Sciences. pp. 1813-1822.

Lovelace, K.J., Parent, J.D. and Litvin, D.R., 2015. The Global Organizational Behavior (OB) Project: Using Comparison Learning to Enhance Students' Global Mindset. Journal of the Academy of Business Education, 16, p.73.

Majuri, J., Koivisto, J. and Hamari, J., 2018. Gamification of education and learning: A review of empirical literature. In Proceedings of the 2nd International GamiFIN Conference, GamiFIN 2018. CEUR-WS.

Marín, V.I., Jääskelä, P., Häkkinen, P., Juntunen, M., Rasku-Puttonen, H. and Vesisenaho, M., 2016. Seamless learning environments in higher education with mobile devices and examples. International Journal of Mobile and Blended Learning (IJMBL), 8(1), pp.51-68.

Marr. B., 2019. 8 Things Every School Must Do To Prepare For The 4th Industrial Revolution. [Online] Available: https://www.forbes.com/sites/bernardmarr/2019/05/22/8-things-every-school-must-do-to-prepare-for-the-4th-industrial-revolution/#2427eede670c. [Accessed 15 November 2019].

Mkwanazi, S. and Mbohwa, C., 2018. Implications of the 4th Industrial Revolution on Entrepreneurship Education. Proceedings of the International Conference on Industrial Engineering and operations Management Washington DC, USA. September 27-29. pp. 318-328.

Mhlanga, D. and Moloi, T., 2020. COVID-19 and the Digital Transformation of Education: What Are We Learning on 4IR in South Africa?. Education Sciences, 10(7), p.180.

Mnguni, L. and Mokiwa, H., 2020. THE INTEGRATION OF ONLINE TEACHING AND LEARNING IN STEM EDUCATION AS A RESPONSE TO THE COVID-19 PANDEMIC. Journal of Baltic Science Education, 19(6A).

Molla, T. and Cuthbert, D., 2018. Re-imagining Africa as a knowledge economy: Premises and promises of recent higher education development initiatives. Journal of Asian and African Studies, 53(2), pp.250-267.

Muema, E.M. and Lavery, M.R., 2018. Redefining Quality in Higher Education: The Concept of Juakalization. Sino-US English Teaching, 15(9), pp.415-428.

Muruganandam, S. and Srininvasan, N., 2017. Personalised e-learning system using learner profile ontology and sequential pattern mining-based recommendation. Proceedings of The National Conference on Man Machine Interaction. IJBIDM, 12(1), pp.78-93.

Naudé, W., 2017. Entrepreneurship, education and the fourth industrial revolution in Africa. ” Discussion Paper Series, IZA DP No. 10855. IZA Institute of Labor Economics.

O'Donnell, E., Lawless, S., Sharp, M. and Wade, V.P., 2015. A review of personalised e-learning: Towards supporting learner diversity. International Journal of Distance Education Technologies (IJDET), 13(1), pp.22-47.

Patrick, S., Worthen, M., Truong, N. and Frost, D., 2018. Fit for Purpose: Taking the Long View on Systems Change and Policy to Support Competency Education. CompetencyWorks Final Paper. iNACOL.

Peters, M.A. and Jandrić, P., 2019. Education and technological unemployment in the Fourth Industrial Revolution. In The Oxford Handbook of Higher Education Systems and University Management. Oxford University Press.

Schmidt-Crawford, D.A., Lindstrom, D. and Thompson, A.D., 2018. Coding for Teacher Education: A Recurring Theme that Requires Our Attention. Journal of digital learning in teacher education, 34(4), pp. 198-200.

Soykan, F. and Kanbul, S., 2018. Analysing K12 Students' Self-Efficacy Regarding Coding Education. TEM Journal, 7(1), p.182.

Stornaiuolo, A. and Nichols, T.P., 2018. Making publics: Mobilizing audiences in high school makerspaces. Teachers College Record, 120(8), pp.1-38.

Sun, G., Cong, Y. and Xu, X., 2018, April. Active Lifelong Learning With" Watchdog". In Thirty-Second AAAI Conference on Artificial Intelligence. pp. 4107-4114.

Tamatea, L., 2019. Compulsory coding in education: liberal-humanism, Baudrillard and the 'problem'of abstraction. Research and Practice in Technology Enhanced Learning, 14(1), pp.1-29.

Traxler, J., 2018. Distance learning—Predictions and possibilities. Education Sciences, 8(1), pp.35.

Wai, I.S.H., Ng, S.S.Y., Chiu, D.K., Ho, K.K. and Lo, P., (2018). Exploring undergraduate students' usage pattern of mobile apps for education. Journal of Librarianship and Information Science, 50(1), pp.34-47.

Wilson, L., 2019. Coding in K-8 Education. Technology and the Curriculum: Summer 2019.

Wilson, C., Lennox, P., Brown, M. and Hughes, G., 2017. How to develop creative capacity for the fourth industrial revolution: Creativity and employability in higher education. in Reisman, F. (Ed.), Creativity, Innovation and Wellbeing, KIE Conference Publications, London, pp. 241-273.

Verhulst, E. and Lambrechts, W., 2015. Fostering the incorporation of sustainable development in higher education. Lessons learned from a change management perspective. Journal of Cleaner Production, 106, pp.189-204.

Wogu, J.O., Ezenwaji, I.O., Agboti, I.C., Ololo, K.O. and Nwobi, U.A., 2018. Implications of Emerging Trends in Media Technology and Communication for Education Policy and Organizations in Nigeria: A Prognosis. International Journal of u-and e-Service, Science and Technology, 11(2), pp.1-12.

Yetik, E., Ozdamar, N. and Bozkurt, A., 2020. Seamless Learning Design Criteria in the Context of Open and Distance Learning. In Managing and Designing Online Courses in Ubiquitous Learning Environments (pp. 106-127). IGI Global.

Developing Training Materials for Entrepreneurial Skills: Identifying Processes, Principles and Core Skills Through Case Studies

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DOI: 10.34190/EEL.21.097

Abstract: The study reported in this paper aims to address the challenge of entrepreneurial skills shortage by sharing the experience and findings of developing entrepreneurial skills for women and young graduates in the agri-food and creative sectors through effective online training material development and implementation. To achieve this aim, this paper analyses four projects, and identifies common themes in terms of projects, processes, principles, and core skills for developing online training materials. All four projects provide online training materials combined with multiple complimentary support schemes. Using the projects as case studies, this paper examines in particular the projects' aim and training objectives, processes and the core skills covered in the training modules. The findings of this paper are used to propose a framework for projects, processes and design principles, with the aim of enabling the development of entrepreneurial skills through effective online training design and implementation.

Keywords: entrepreneurship, entrepreneurial skills, online training, case study

1. Introduction

Entrepreneurship is a critical factor for business success, innovation and creating jobs. Helping create entrepreneurs can therefore provide significant benefits to the economy and society. However, entrepreneurship often faces challenges due to the lack of necessary skills, particularly in the agri-food and creative sectors. Although these sectors are growing rapidly, women and young graduates in particular often have difficulties in transforming their innovative ideas into viable business enterprises.

The study reported in this paper aims to address this challenge by exploring how to develop entrepreneurial skills of women and graduates in the agri-food and creative sectors through effective online training material development and implementation. To achieve this aim, the paper analyses four recent projects, and identifies the common themes in terms of processes, principles, and core skills for the development of online training materials. One of the projects aims to create the awareness of the entrepreneurship concepts, challenges, and opportunities in the creative economy among Ukrainian and UK graduates. It is funded by British Council's Creative Spark Higher Education Enterprise Programme. Three other projects are funded by EU Erasmus+ strategic partnership programme and aim to develop entrepreneurial knowledge and skills in the agri-business sector, especially for women in agri-food sector and young people who are interested in entering the farming business through land mobility initiatives. All four projects use online training materials combined with multiple complimentary support schemes. Using the four projects as case studies, this paper analyses the common themes in terms of project aims, training objectives, project processes and core skills covered in the training modules, and shares the experience and lessons learned based on case studies. The findings are then used to propose a framework illustrating the projects, processes and principles enabling the development of entrepreneurial skills through effective online training materials development and implementation.

The paper first provides a short review of relevant literature. The research method section describes the four projects used as case studies for this research. Common themes are highlighted as findings. A framework is presented to illustrate the processes, principals, and core skills for developing entrepreneurial skills for young graduates, women, SMEs employees, or others who seek to start their own businesses in the agri-food and creative sectors.

2. Literature review

This section reviews key themes for the paper which covers the significance of entrepreneurship training, need for entrepreneurial skills development, and the design of entrepreneurship training programmes for young graduates, new entrepreneurism and women as a minority group.

2.1 Significance of entrepreneurship education

An 'entrepreneur' is defined as a person who takes the risk and opportunity to open a new business, typically has an independent mentality, and dares to start the business without being overly discouraged by fears or worries even in uncertain economic conditions (Kasmir, 2007; Krisnaresanti, 2020).

Many researchers (e.g., Davidsson et al, 2006) have highlighted the relevance of entrepreneurship to the development of economies. For example, entrepreneurship is regarded by the EU as being an important part of the solution to unemployment, and as a way of contributing to general welfare and economic growth (European Commission, 2013; Valerio et al., 2014).

It is recognised that education and training can play an important role in helping cultivate future entrepreneurs, and to enhance the abilities of existing entrepreneurs to grow their businesses to greater levels of success (Henry et al., 2003). It is also recognised that entrepreneurship education can produce graduates who are not only able to work within an institution, but also open new business opportunities by themselves becoming entrepreneurs (Krisnaresanti, et al. 2020).

The aim of entrepreneurship education and training should thus be to 'develop entrepreneurial capacities and mindsets' that benefit economies by fostering creativity, innovation and self-employment (European Commission (2008). The concept of an entrepreneurial Europe, which promotes the creation and development of innovative businesses, has led many of the EU member states to strengthen their policies on SME formation and support since academics, politicians, and policy-makers increasingly acknowledge the substantial contribution that entrepreneurship can make to the economy (Bruyat & Julien (2001).

2.2 Need for entrepreneurial skills and designing of training programmes

However, entrepreneurship education and training programmes have sometimes been criticised for various reasons, including in not sufficiently instilling essential entrepreneurial skills. For example, Henry, et al. (2003) say that entrepreneurship education programmes are often too focused on the functional aspects of business management, rather than helping develop the broader capabilities of entrepreneurs to be innovative, manage the changing business environment, and to be creative in developing and taking forward their businesses. While business students might learn theoretical concepts of entrepreneurship at education institutions, they may not have sufficiently mastered the broader range of entrepreneurial skills.

According to the UK's Department of Business Innovation and Skills (now Business, Energy and Industrial Strategy), entrepreneurship skills are linked with one's competence in identifying opportunities and the ability to capitalise on such opportunities to develop and implement business plans to ensure that the opportunities are realised; and pointed out the link between entrepreneurship skills and business success (BIS, 2015). Moreover, BIS (2015) noted that a significant number of SME managers in UK had relatively underdeveloped entrepreneurial skills.

Academic studies have shown evidence of the impact of entrepreneurship programmes on students' entrepreneurship skills (Ismail, et al., 2019). For example, the survey by Jain and Chaudhary (2017) indicated that entrepreneurship programmes have a positive impact on students entrepreneurship skills; and the study by Lyons and Zhang (2017) also showed a positive impact on minorities, especially females. But while some entrepreneurship skills can undoubtedly be taught by standard education approaches, evidence also shows that students tend to learn some of these less effectively from such traditional teaching approaches. As a result, a variety methods of entrepreneurship education and training are provided in many countries in order to produce new and more competent entrepreneurs. UK initiatives such as Goldman Sachs '10,000 project' and the UK's Growth Accelerator programme have supported target small businesses in developing their entrepreneurship skills by demonstrating best practices. However, it is not clear as to how truly effective and innovative overall entrepreneurship education has been in producing new entrepreneurs (Krisnaresanti, et al., 2020), and where

BIS suggested that it is more effective to learn entrepreneurship skills by using experiential learning that is task-oriented, with focus on real business problems (BIS, 2015). Given that the world is currently facing significant economic challenges, especially with the decreasing opportunities for graduate employment during the current health pandemic, developing new entrepreneurs and encouraging greater entrepreneurial activities have become a prominent goal for all countries.

3. Research method

3.1 Introduction

This study aims to explore how to develop entrepreneurial skills of young graduates, women and SME managers in agri-food and the creative sectors through effective e-learning design and implementation. To achieve this aim, the study adopts a qualitative case study method that "explores a research topic, or phenomenon within its context, or within a number of real life contexts" (Saunders, Lewis, & Thornhill, 2012). In our context, it involves a close examination of phenomena of multiple cases (four cases). According to Saunders et al. (2012), the rationale for using multiple cases focuses on whether findings can be replicated across cases. Based on the authors' experience working on the relevant funded projects on developing entrepreneurial skills among different target groups, four cases are selected in terms of their relevance and similarities. Table 1 provides a profile of the cases used in this study.

Table 1: Profile of the four chosen cases

Case Title	Funding Body	Project Length	Other project partner(s)	Status
Case 1: Create creative entrepreneurs (CCE)	British Council	60 months	Simon Kuznets Kharkiv National University of Economics (S. Kuznets KhNUE) (Ukraine); Ukrainian Engineering Pedagogics Academy (UEPA)	On-going
Case 2: Creating Entrepreneurs in Food (CEF)	EU Erasmus +	26 months	Galway-Mayo Institute of Technology (GMIT) (Ireland) The European Council of Young Farmers (CEJA) (Belgium) The Polish Beef Association (Poland)	Completed
Case 3: Land Mobility: Innovative and digital training materials to foster land mobility initiatives	EU Erasmus +	24 months	Macra na Feirme (Ireland); GMIT (Ireland) Polish Farm Advisory and Training Centre (PFATC) PROPEL Europe (Belgium); European Landowners Organization (Belgium)	On-going
Case 4: Advancing Women in Agri-Food Rural Environments (AWARE)	EU Erasmus +	30 months	GMIT (Ireland) Confederazione Italiana Agricoltori Toscana (Italy) PROPEL Europe (Belgium) PFATC (Poland); Macra na Feirme (Ireland).	On-going

3.2 Case study analysis process

The case study analysis mainly involves two important phases: The first phase is with case analysis and the second phase is cross case analysis. The within-case-analysis collects and analyses information concerning the project background, the rationale, aims and objectives, partners, target beneficiaries, key project activities and outcomes, stakeholder surveys, evaluation feedback, and initial results and impacts. These are all secondary data available to the authors. The findings of the within-case-analysis is provided in Section 3.3. The cross-case-analysis involves identifying the common themes in developing and implementing online training programmes for developing entrepreneurial skills among graduates, women, and SME managers. The authors' personal experience and observation are also used for case analysis and themes identification. The common themes are served as the main findings and presented in Section 4. Cross Case Analysis and Key Findings.

3.3 Within case analysis

Case 1 – Create Creative Entrepreneurs (CCE)

Creative industry is becoming an important sector to boost competitiveness, productivity, employment, and sustainable economic growth. However, people working in the sector face various challenges to develop innovative ideas and transform them into viable business enterprises. In Ukraine, the impact of creative industries is growing rapidly. However, support for entrepreneurial activities in these areas is rather poorly developed and requires comprehensive support from the state, business, and education.

This project aims to develop a new partnership between the Business School of the University of Bedfordshire's Business School (UBBS), Simon Kuznets Kharkiv National University of Economics (KhNUE) and Ukrainian Engineering Pedagogics Academy (UEPA) to establish a Centres of Creative Entrepreneurship Development (CCEDs) in KhNUE and UEPA. CCEDs will include three main types of activities: (1) Training programmes; (2) Business support and consulting services, (3) Annual roadshow of the best entrepreneur ideas and annual competition award for young creative entrepreneurs

The outputs of this project include:

- 1. Creation of a new innovative educational model for developing creative enterprises and entrepreneurial oriented curriculum
- 2. Design and creation of new training course for developing participants' essential entrepreneurial skills
- 3. A pilot support portal to provide relevant educational materials and resources, and to link students, graduates, and young entrepreneurs (SME managers) and other like-minded people to share their ideas and promote their businesses.

Through knowledge transfer, capacity building, pilot training and launching of CCEDs, the project should help raise the awareness of entrepreneurial skills among the target groups in both UK and Ukraine, develop their new skills and abilities, and enhance further collaboration and knowledge sharing.

It is observed that the project has started to create a positive impact on the creation of creative entrepreneurship and self-employment in the creative industry for the eastern region of Ukraine. In the long run, the work of CCEDs should help increase the number of start-ups of creative enterprises, generate new jobs, improve competitiveness of creative industry, and enable a sustainable ecosystem of youth entrepreneurship.

Case 2 – Creating Entrepreneurs in Food (CEF)

The CEF project, which was completed in 2020, aimed at building food innovation and entrepreneurship-focused rural communities and economies across Europe. This project addressed the flagship initiatives of the Europe 2020 strategy namely 'Innovation Union' and 'An Agenda for New Skills and Jobs'. The project's aim was to boost innovation and entrepreneurship in vocational education, and ultimately in business and in the broader socio-economic environment with the following objectives:

- 1. To jointly develop and implementing entrepreneurship training aimed at those in short food supply chains in participating programme countries
- 2. To create short food supply chain entrepreneurship mind-set that will empower food producers to gain control of their business models and move up the value chain
- 3. To cultivate transversal skill sets developed in cooperation with food entrepreneurs thus strengthening employability, creativity, and new professional paths
- 4. To provide a web platform that stimulates the flow and exchange of knowledge between education and enterprises, embedding entrepreneurship and innovation as core themes

The aim of the curriculum and web portal developed as part of this project is to develop entrepreneurial skill sets in the early stage of food entrepreneurs and to facilitate innovative thinking that will develop the potential for participants to recognise and critically analyse opportunities within the sector and in turn create employment in their local regions throughout Europe. The main target of the resultant vocational education and training package is local/regional food producers, the wider agricultural community, rural farmers, and food entrepreneurs across Europe.

The participating organisations of the three countries involved in the project should have benefited from various activities. They include:

- In Ireland: Teagasc, Department of Agriculture, Food and the Marine, Department of social Protection, Education and Training Boards (ETBs), VET colleges, Local Enterprise Offices, Industry leaders

- In the UK: Department for Environment, Food & Rural Affairs (DEFRA); FARMA (A not-for-profit association of the best real farm shops and genuine farmers markets from across the UK), Community Food Enterprise Limited, The farmers' network
- In Poland: Ministry of Agriculture and Development, Ministry of Environment, Ministry of Education, Wide network of Beef Farmers, Agricultural Market Agency, Educators, and training centres

There are three main outputs from the project:

- 1. Core teaching materials and guidelines for Level 4 curriculum 'Creating Entrepreneurs in Food'
- 2. Online learning course - 'Creating Entrepreneurs in Food'
- 3. A web portal as an all-in-one online support tool for food entrepreneurs. It is serving as a knowledge repository for food entrepreneurs to access information, forums, social media community, knowledge base, and training materials.

Case 3 – Land Mobility: Innovative and Digital Training Materials to Foster Land Mobility Initiatives

This project aims to develop training modules for the establishment of land mobility services for all partner countries, and to promote similar initiatives in EU Member States and internationally beyond the project lifetime. The main objectives are:

- 1. To promote initiatives and innovative concepts surrounding land mobility by developing training materials and guidelines for landowners, farmers, authorities, and advisors around land mobility services, land management partnerships and farm take-over brokerage
- 2. To promote agricultural land staying in the sector and a continuation of the EU family-like farming model
- 3. To ensure that land in Europe is kept as much as possible in sustainable ownership and is not subject to land abandonment so that land becomes a tool for empowerment and entrepreneurship for Europeans rather than an obstacle to it

The project will set out guidelines for how to establish land mobility services and develop an animated educational video to help raise the awareness of different concepts of land mobility and the enormity of the problem of access to land that faces European young farmers. This will be accompanied by open access training materials in the project website such as animated power point slides, training materials for the farmers (both successor and predecessor), and mobile training opportunities for land mobility brokers and advisors.

The project aims to bring a generation of young agricultural entrepreneurs one step closer to starting their own farming business by providing them with a solution to one of the main barriers which currently stand in their way: access to land.

The project will encourage the take-up of land mobility initiatives by training relevant target audiences and informing them about best-practices elsewhere in the EU which should be rolled out in other areas and regions. By matching young farmers with older farmers, the project will multiply the number of young farmers that are able to start their own entrepreneurial farming businesses, including promoting general take-up of digitization and modern technologies in the farming population across Europe.

The project's main outputs are: new training curricula with digital training materials training methodology, and open educational resources.

The project is expected to have far-reaching impacts and results on the European farming population, including:

- 1. Improved education and training for farmers, landowners, farming organisations, local authorities and other relevant regional actors in farm partnerships and land mobility.
- 2. Fostered new ideas and concepts in this field
- 3. Increased awareness of potential solutions to challenges relating to land access for young would-be agricultural entrepreneurs, not only through informing, explaining, and attempting to roll-out best practices but also through the creation of a promotional video about land mobility solutions
- 4. Raised awareness of land mobility and developed new thinking around the idea in relation to farming
- 5. Increased knowledge of these issues among farmers across the EU

Case 4 – Advancing Women in Agri-Food Rural Environments (AWARE)

This project aims to assess the needs of women living in rural areas, who are willing to start up farming and forest activities. The main objective of the project is to support the growth of women entrepreneurs in the Agri-Food sector across Europe. The project should contribute to achieving social inclusion and closing the gender gap in agri-food entrepreneurship. The project's objectives are in line with the recommendations of the Social Inclusion and development of rural economies - European Network for Rural Development (ENRD), Bruges Communiqué on enhanced European cooperation in Vocational Education and Training (VET) for 2011-2020, in particular, fostering innovation, creativity, and entrepreneurship, as well as the use of ICT. The key outputs as follows will be available as online resources to women entrepreneurs in the Agri-Food sector, VET educators, business mentors and the wider agricultural community:

- 1. Curriculum for an online training course "Start your own Food Business" designed specifically for women in the Agri-Food sector
- 2. Module contents for the training programme
- 3. Research report on the importance and benefits of engaging with a business mentor
- 4. Video of testimonials from Mentors/Mentees in Agri-Food businesses across partner countries
- 5. Infographic booklet of resources for supporting women entrepreneurs in Europe's Agri-Food sector

The main achievements of the project will include needs analysis review for the development of a detailed curriculum and module content, project website and social media platforms for supporting project dissemination activities and allowing for engagement with the target audiences and stakeholders as well as a database of women entrepreneurs, mentors, educators, and enterprises. The output of this project should equip women entrepreneurs in the Agri-Food sector with the knowledge, skills, and confidence to foster their business concepts right through to fruition by providing access to specific training and engagement with business mentors.

4. Across case analysis and key findings

The four project cases described above are cross-analysed and four common themes are identified. They are project, processes, principles, and core entrepreneurship skills. These are discussed in detail below.

4.1 Project

To develop entrepreneurial skills among the target groups including young graduates, woman, and SMEs managers, all the projects have secured financial support from public funding programmes (EU and British Council) and established a strategic partnership involving higher education institutes, sector associations, support agencies, and consultancies. The common features of the projects are involving key stakeholders in the project partnership, establishing effective collaboration, and identifying clear aim and training objectives.

Although these projects are funded by different programme funding bodies that have targeted at different project participants from different sectors, they do share common project objectives that are summarised as follows:

- 1. To develop entrepreneurial skillsets
- 2. To facilitate innovative thinking
- 3. To recognize and critically analyse opportunities within the sector and in turn create employment in the local regions
- 4. To provide young graduate, women or people who are keen to start their own business with the skills and the mind set required to become successful entrepreneurs.

Based on these objectives, all four projects focus on developing online training materials that should help participants with the following:

- 1. Increased awareness and understanding on the importance of entrepreneurship in the creative and agri-food industries
- 2. Development of knowledge and skills in business planning, marketing and branding
- 3. Enhanced personal and inter-personal communication skills

- 4. Creation of awareness of business sustainability
- 5. Development of digital business skills

4.2 Process

To achieve these project objectives, the processes that these projects have followed share the following common themes:

- 1. Identifying skills shortages, challenges, and training needs – Three of the four projects involve identifying the main areas and specific training needs at the start of the projects. This is achieved by using online survey questionnaire and interviews with the key stakeholders.
- 2. Designing programme modules to meet the training needs – Partners in all projects discuss and contribute to the development of training programme. The modules not only cover the core skills, but also specify the sector related skill needs and activities. For example, for Land Mobility project, in addition to the development of core modules, it also has specific modules covering topics such as "Farm hand over process" and "Farm management".
- 3. Developing effective training materials – The final training materials are created based on the skills identification exercise and agreed training needs.
- 4. Delivering training sessions via effective blended learning approaches – Project web portals, workshops, and training sessions (face to face and online), webinars, and so on.
- 5. Testing, evaluating, and improving.

4.3 Principles

Three principles identified for developing online training programmes are common to all the four projects:

- 1. Relevant and focused – The topic of entrepreneurship covers a wide range of areas. All projects understand the importance of providing the most relevant and well-focused materials for the target groups. It is critical that the training materials are relevant based on the input from key stakeholders. It must be well focused on the development of core skills. For example, in the creative sector, the training materials aim to develop knowledge and skills to help round entrepreneurs and graduates to turn big ideas to business success.
- 2. Interesting and interactive training materials – To effectively engage target groups in online and offline learning, all projects have developed the online training materials that are interesting and engaging. The online training materials include a range of activities which include multimedia presentation, online interactive workbooks, online quizzes, links to free online resources, workshops, virtual events, etc.
- 3. Supporting online learning with offline activities – Using various face to face activities to support online learning, e.g., mentoring scheme, gamified learning workshop using Lego, pitch competitions, multiplier events, guest speakers, etc.

4.4 Entrepreneurship skills

To provide the most relevant and focused e-learning materials, three of the four projects conducted surveys and interviews with target groups to understand and identify their training needs. Table 2 below shows the core training modules identified from the four case studies which should help develop the participants' entrepreneurship skills. Based on these core skills, all project have enriched and contextualised the training materials with supplementary materials using sector-specific examples, case studies and best practice.

Table 2: Core training modules

Training Modules	Main Topics
Module 1: Essential skills for entrepreneurs	Session 1 - Characteristics and Skills of Entrepreneurs Session 2 - Understand Team Theory and Teamworking Skills Session 3 - Design Thinking: Opportunity Recognition and Solution Generation Session 4 – Communications
Module 2:	Session 1 – Business Start Ups: Top Tips

Training Modules	Main Topics
Skills for building and running successful enterprises	Session 2 - Business Planning and Business Plan Session 3 - Financing your business
Module 3: Marketing and branding	Session 1 - Marketing concepts and principles Session 2 - Market testing techniques and evaluation methods Session 3 - Marketing strategy Session 4 - Concept of branding Session 5 - Brand strategy
Module 4: Digital and analytics skills for entrepreneurs	Session 1 - Introduction to emerging digital technologies Session 2 - Digital media and marketing Session 3 - Digital Analytics Session 4 - Tools of web analytics – Google Analytics

Figure 1 is a framework which summarises the key points identified for effective online training design and implementation through the collaborative work with our partners on the funded projects.

Figure 1: Framework for developing entrepreneurship skills

5. Conclusions

Entrepreneurial education and training are vital for the development of entrepreneurial attitudes and behaviours of business students and individuals who seek to meet the increasing needs for creativity and innovation in a labour market characterized by globalization, uncertainty, and dynamic change. Although there are many online training materials available for entrepreneurship development, there is still a significant gap in providing relevant and well-focused courses that meet the needs of specifically women and young people in the agriculture, food and creative sectors. This study aims to help address this entrepreneurial skills challenge by sharing the experience of projects on the development of effective online training materials and their implementation focussed on these areas. Using the four case studies based on the funded projects, the paper presents the key findings in terms of project, process, principles and core skills. From the common themes identified, we concluded the following key points:

- 1. Government and public support is likely to be a critical element in such provision, as all four studies were funded by public organisations, specifically the EU and British Council, and where the funding provided the financial resources to enable key stakeholders to work together to provide entrepreneurial skills in the agriculture, food, and creative sectors.
- 2. Effective collaboration of the key stakeholders helped set up feasible project aims and training objectives; and also ensured a clear understanding of beneficiaries' training needs for developing relevant and focused materials.
- 3. A set of common development process were identified, from training needs identification through to training programme design, evaluation and feedback to ensure that the projects were able to meet their aims and to address feedback for continuing improvement.

- 4. The core skills for the targeted groups included: essential skills for entrepreneurs; skills for building and running successful enterprises; marketing and branding; and digital and analytics skills for entrepreneurs. The projects also showed that when delivering training programmes, training materials should be contextualised, and supported with supplementary materials using sector-specific examples, case studies and best practice.
- 5. Finally, to effectively implement online training materials and courses, they should be supplemented by associated supporting schemes, both online and offline, including mentoring, gamified learning workshops, 'project-pitch' competitions, multiplier events, and external speakers.

References

Bruyat, C. & Julien, P.A. (2001). Defining the Field of Research in Entrepreneurship. *Journal of Business Venturing*, Vol 16, No 2, pp 165-80

Business Innovation & Skills/BIS (2015). *Entrepreneurship Skills: Literature and policy review - Report examining entrepreneurship skills and the policy options for promoting their development among small businesses*. BIS Research Paper No. 236. Accessible via the link: https://www.gov.uk/government/publications/entrepreneurship-skills-literature-and-policy-review. Accessed on 29 July 2021

Chell, E. (2013). Review of skill and the entrepreneurial process. *International Journal of Entrepreneurial Behaviour and Research,* 19(1): 6-31.

Cooney, T. (2012). Entrepreneurship Skills for Growth-Orientated Businesses, *Report for the Workshop on 'Skills Development for SMEs and Entrepreneurship'*, Copenhagen, 28 November 2012

Davidsson, P., Delmar,F. & Wiklund, J. (2006). Entrepreneurship as Growth: Growth as Entrepreneurship. In Davidsson, P, Delmar, F, & Wiklund, J (Eds.) '*Entrepreneurship and the Growth of Firms'*, Edward Elgar Publishing, United Kingdom, pp. 21-38.

European Commission (2008). *Entrepreneurship in Higher Education, Especially Within Non- Business Studies*, European Commission, Brussels.

European Commission (2013*). Entrepreneurship 2020 Action Plan. Reigniting the entrepreneurial spirit in Europe*. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52012DC0795&from=EN

Henry, C., Hill, F. & Leitch, C. (2003). *Entrepreneurship Education and Training*. Ashgate Aldershot.

Ismail, A., Adnan, W.N., Masek, A., Hassan, R. Hashim, S., & Isail, M.E. (2019). Effectiveness of Entrepreneurship Programmes in Developing Entrepreneurship Skills towards Quality TVET Graduates. *Journal of Technical Education and Training*. Vol. 11 No. 1 (2019) p. 81-86

Jain, S.K. & Chaudhary, H. (2017). Impact of Entrepreneurship Education on Entrepreneurial Intentions of Potential Entrepreneurs in India. *Entrepreneurship Education*, p. 289-303.

Kasmir. (2007). *Kewirausahaan.* Jakarta: PT Raja Grafindo.

Krisnaresanti, A., Julialevi, K.O., Naufalin, L.R. & Dinanti, A. (2020). Analysis of Entrepreneurship Education in Creating New Entrepreneurs. *International Journal of Entrepreneurial Knowledge*, 8(2), 67-76. doi: 10.37335/ijek.v8i2.112

Lyons, E. & Zhang, L. (2017). The Impact of Entrepreneurship Programmes on Minorities. *American Economic Review*, 107 (5). doi:10.1257/aer.p20171008

Saunders, M., Lewis, P., & Thornhill, A. (2012). *Research Methods for Business Students* (6th ed.). London: Financial Times/ Prentice Hall.

Valerio, A., Parton, B., & Robb, A. (2014). *Entrepreneurship Education and Training Programs Around the World: Dimensions for success*. The World Bank.

An Augmented Reality Mobile Learning Experience Based on Treasure Hunt Serious Game

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DOI: 10.34190/EEL.21.109

Abstract: One of the playful activities used in education is the treasure hunt, a serious game that allows students to work cooperatively. This activity stimulates different cognitive processes connected to accurately reading the clues and understanding them, and extremely effective to elaborate a collaborative strategy necessary to find the hidden objects. Augmented Reality is an innovative technology with a growing potential in promoting new scenarios to support teaching and learning processes. In this paper we present a learning activity based on a treasure hunt serious game developed with ARLectio®. ARLectio® is an augmented reality authoring tool aimed at supporting the creation of educational resources that leverage the AR technologies to improve students' engagement. ARLectio® is characterized by an intuitive user interface that supports educational content creation based on different media types, such as: text, images, video, and 3D model, that will be accessed through mobile AR applications. From the architectural perspective, ARLectio® consists of a web-based AR authoring tool addressed to teachers for the creation of educational contents, and a mobile App in which the content is consumed by students within AR based educational activities. In the scenario described in this paper, ARLectio® is used by teachers to design an educational treasure hunt activity that will be accessed by students through their mobile devices. The topic of the treasure hunt is "Climate change and environmental sustainability". In a pilot study presented in this paper, students were divided into small groups, and they collaboratively interacted to solve some treasure hunt enigmas. The clues and enigmas are related to the school curriculum. For example, clues include the solution of simple mathematic and linguistic problems as well as historical references and notions of geography. The results of the pilot demonstrated a positive effect of the use of AR technologies in the level of engagement of students in the learning activities.

Keywords: augmented reality, treasure hunt, mobile learning

1. Introduction

The increasing use of mobile technologies in school education offers new opportunities for students to improve motivation, engagement and learning. Mobile learning involves the use of handheld devices such as smartphones and tablets (Sharples et al., 2009), offering new opportunities to overcome classroom boundaries and supporting outdoor learning activities (Arrigo, Taibi and Fulantelli, 2014). Recent research indicates an increased acceptance of mobile technologies in teaching and learning (Nikolopoulou, 2018). Mobile learning in recent years is taking great advantage of the use of Augmented Reality (AR), a growing technology that provides innovative approaches and new tools to support teaching and learning processes in education. In (Azuma, 1997), AR is presented as a technology that enhances the user's perception and interaction with the real world. For example, the real world can be augmented with virtual objects, such as textual information, as well as images, or 3D objects that provide additional information that the user could not directly detect with their senses. Several studies show that students can increase their motivation and improve their learning since the technology makes studying more engaging, stimulating and dynamic (Tosto et al., 2020; Sayed, Zayed and Sharawy, 2011; Lukosch et al., 2015). In fact, AR allows to associate theoretical concepts with practical and experimental activities, making the learning process more playful and immediate and creating interactive learning scenarios to facilitate learning by doing (Sungkur, Panchoo and Bhoyroo, 2016). Moreover, it can stimulate creativity, collaboration skills and critical thinking. In the literature, there are many experiences of using AR technology in education. In mathematics education, for example, AR systems can be used to help students to understand solids of revolution and improve spatial visualisation skills (Salinas and González-Mendívil, 2017). In language learning, this technology can be used to support students' comprehension of literature and the permanence of learning (Godwin-Jones, 2016). Bursali and Yilmaz (2019) have demonstrated that using AR systems, students perform better than students reading with traditional methods. In history education, AR systems can support students and help teachers to make classroom activities more engaging through videos related to the historical lessons that are displayed on mobile devices when a target image is scanned (Raghaw, Paulose and Goswami, 2018). In anatomy, AR can allow the study of human organs in a simple way, through the printing of a 3D model of a scanned organ and a mobile device that displays all the information related to the composition of the organ under examination, simply by framing it with the camera (Argo et al., 2018). In physics, through the use of AR systems, it is possible to demonstrate various properties of kinematics by dynamically evaluating an object that changes its velocity and acceleration over time (Lee, 2012). When applied to behavioural education, which focuses for example on studying how the environment influences long-term changes in behaviour, this technology allows to show, for example, the correct behaviour to be assumed in specific situations. This may be the expected behaviour in a school environment, where Augmented Reality can be used to teach shared values such as respect for others and the environment (Chiazzese et al., 2021).

Mobile learning and augmented reality can greatly enhance learning in education. Serious games represent a further technological solution widely adopted for engaging students in educational paths. The term serious games (SGs) is used to describe games and video games applied to non-playing contexts, i.e. used to foster the achievement of an educational objective (Laamarti and El Saddik, 2014). SGs are used to enhance learning at different ages and in several branches of knowledge. They allow learning based on game levels, group activities and the achievement of objectives through scores and rewards. There are different types of serious games, from the simplest ones that only require paper and a pen, to the more complex ones that use technologies such as augmented reality and virtual reality to reproduce situations in which the player can learn by doing (Signa et al., 2019).

The treasure hunt is an example of a serious game that can be used for educational purposes.

1.1 Treasure hunt in education

In Treasure Hunt games, participants compete to reach different target locations by correctly interpreting the clues that are proposed to them. Participants usually have to execute specific tasks or solve specific problems to obtain the clues. Mobile technologies can support such activities since they allow to trace participants' locations in real time, to use different multimedia formats for the clues, to support the execution of interactive activities related to the locations, to effectively activate communication between participants and with the game's instructor. Moreover, data related to the participants activities can be collected and analysed through learning analytics techniques to monitor the learning experience and promptly intervene when participants are struggling at a certain step (Fulantelli et al., 2013).

In (Mobius et al., 2015) a Treasure Hunt experiment was conducted with 789 junior and senior students at a private US university. Treasure hunt is used as a tool to study social interactions between students. The dynamics of the conversational networks that arise in the context of Treasure Hunt activity have been also investigated. Authors used treasure hunt activities to study the social dimension of the learning process, by taking into account the models of aggregation and how to detect imperfect diffusion of information in the network of students.

The need for a general framework for the development of augmented reality-based treasure hunt games was emphasized in (Bálint et al., 2012), since the existing frameworks to design treasure hunt games have some limitations, such as the use of physical objects whose placement is often an expensive task, and the use of GPS technology to localize participants that cannot be used in indoor scenarios. Authors reported the relevance of using AR technology to overcome these limitations, but the framework they proposed is not specifically focused to support educational experiences.

The work presented in (Shakouri and Tian, 2019) is more focused on the educational aspects. Authors present a location-based treasure hunt AR app to improve users' engagement during the visit of the Avebury heritage site in England. However, the paper of Shakouri and Tian focuses on the App and on the users' experience, and there is no reference to an authoring environment for teachers.

An interesting work aimed at providing teachers with a dedicated environment for designing location games conducted via mobile phones is presented in (Kohen-Vacs at al. 2021). However, AR technologies is not used in their environment.

In this paper we present an Augmented Reality mobile learning experience in which the framework ARLectio® (Farella et. 2020) has been used to support the authoring of treasure hunt activities in different places. After describing the framework ARLectio® (section 2), we illustrate how teachers used the framework to create the AR mobile learning experience. Finally, some conclusions are drawn.

2. ARLectio®

The ARLectio® framework was developed with the aim of facilitating teachers' task in creating AR educational resources and their visualization through the use of markers. The system consists of an authoring toolkit and a mobile application with a simple user interface to facilitate human interaction with the mobile system. The authoring toolkit consists of a web application designed for teachers to create educational content implemented by AR technology and is designed to be easy to use and to manage content easily. The teacher will be able to visualise their resources (Figure 1) as well as create, edit, delete and organise resources (Figure 2). To create a resource, the teacher has to select the category into which they want to place it, which corresponds to the topic or subject name, and enter a title and description for the resource. Since the system is based on a type of AR that uses markers to add the additional information to the real world, the teacher will have to select a marker that will work as an activator. In fact, the mobile application, by pointing the device's camera on the specified marker (an image or a QRCode), is able to recover the stored information in order to display the augmented object accurately. After selecting the marker, the teacher can choose the type of augmented content to be added (text, video, image or 3D model) and its position in relation to the marker (top left, top centre, top right, middle left, middle right, bottom left, bottom centre, bottom right). In fact, the marker is considered as a 3x3 matrix, and each box of the matrix corresponds to a position (Figure 3). Once saved, the resource is stored on a server and can be used through the mobile application. This application is for students or users of AR content created through the authoring toolkit. In fact, the user can access the category related to the AR resource, and by pointing the camera of his device on the marker will be able to access the augmented content. It has a simple and easy-to-use interface and can be used on most possible devices that are not necessarily the latest generation.

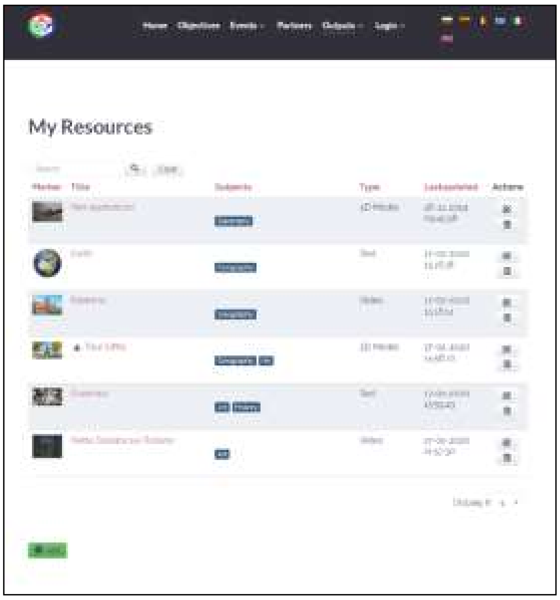

Figure 1: Educational resource list

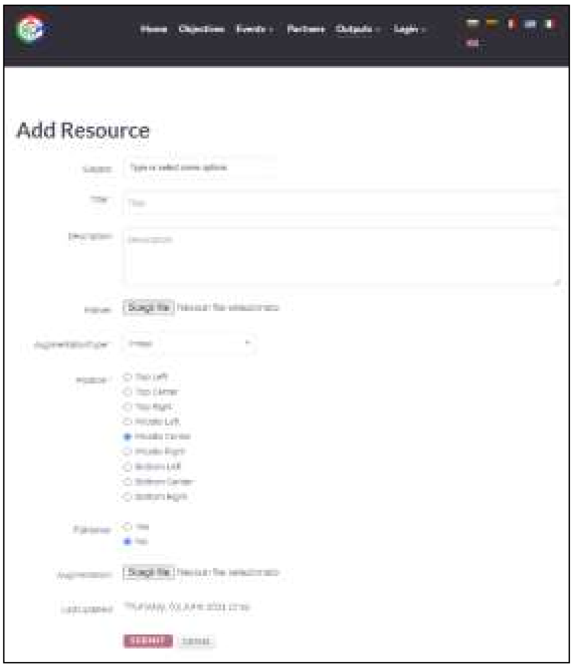

Figure 2: Create an AR educational resource

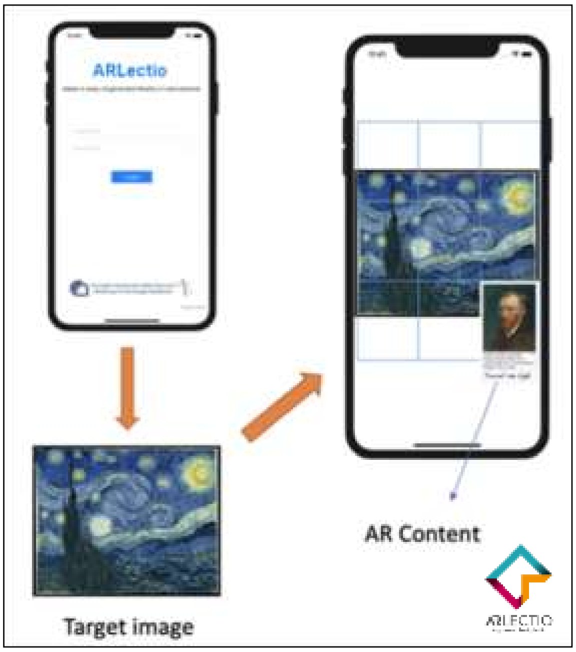

Figure 3: ARLectio® mobile application

3. Use case: Treasure hunt (we respect our earth)

The enigmas of the treasure hunt implemented were based on the theme "Climate change and environmental sustainability". Various problems were placed in a room, and each problem was activated by the device by framing an image (marker) and superimposing or replacing the image of the marker framed by the camera with the corresponding problem. The augmented content (displayed by framing the marker) could be a media of one of the following types: text, image or video.

In particular, 9 enigmas were produced, all of them relevant to the educational theme of the event (Climate change and environmental sustainability). Each enigma provides a clue for the next treasure hunt step. The nine elaborate enigmas re divided into seven types.

Dolly the whale

This enigma proposes to the students a reflection both on geographical aspects (testing them on notions of orientation linked to the cardinal points) and, above all, on the pollution of the seas that afflicts our planet. Some AR contents are presented in order to guide students in their search for the correct solution.

Animal extinction

Many animals and plants are becoming increasingly rare and at risk of extinction for various reasons. These include the destruction of their natural habitat, climate change, hunting and pollution. In this stage the student is challenged to find endangered animal species around the world. By framing the planisphere with a mobile device, different animals distributed over the various continents will be displayed in AR mode. Using their own knowledge, students will have to identify which of the animals displayed are at risk of extinction.

Differentiated

This test combines mathematical concepts with the issue of recycling materials. The student is given 6 cards with a QR code. Each card corresponds to an object, which the student must place in the correct container. The object represented on each card will be displayed in AR mode by framing the QR code. The containers in which to place the objects are related to "glass", "plastic", "paper" and "organic" and are also displayed through augmented reality so as to differentiate the possible combinations for each user. The test is passed by solving a mathematical formula such as:

8 x Plastic - 7 x Glass + Paper = ???

which will give the exact value if the classification has been made correctly.

Unplugged coding

The fourth task brings the student's unplugged coding skills into play. Set in a polluted pond, the student is asked to drive a bulldozer to remove harmful debris using right-left-forward commands given to the bulldozer. The location of the debris and all the elements in the environment are displayed in AR mode on a poster depicting a pond. The student is given a series of differently colored cards/cards depending on whether they give an instruction turn right left or go forward. The test is passed if the correct sequence of tiles is given.

Climate change/Pollution/Water contamination

Three of the stages of the treasure hunt are proposed by means of in-depth video clips that are activated in AR mode. When students are near a specific poster that highlights one of the themes proposed in the stage, they are led to reflect on the main causes and solutions for limiting climate change or water pollution or contamination. The in-depth video content will be used to answer the questions of a questionnaire that will be proposed to pass the test.

Interwoven words crossword clue

In this stage of the treasure hunt, the student will have to focus on foreign language (for the Italian students was English) terms related to the issues of climate change and environmental sustainability. By means of a crossword puzzle displayed in AR mode, she/he will have to identify some terms hidden between the letters presented. The test is passed if all the hidden words are identified.

A bit of physics

The ninth stage of the treasure hunt is linked to the problem of pollution from factories to the groundwater. The students are then asked to solve a small physics problem using an AR chart, so that they can work out how many years it takes to restore environmental contamination caused by the spillage of harmful substances.

Moreover, the above enigmas were administrated in random order as well as with different education contents in order to differentiate the treasure hunt path among students.

The pilot conducted in this study was carried out during the scientific event Esperienza inSegna 2020, a wide-ranging scientific event, built around annual themes and organized by the association PALERMOSCIENZA (https://www.esperienzainsegna.it/). Three classes of about 30 students aged 11-14 years participated in the trial, and the treasure hunt was repeated for each of the participating classes. The students were divided into small groups of 3-4 persons who were given a tablet with the AR application to use. The groups solved the puzzles with a notebook and pen for calculations or notes, independently, without the support of the app. Once they had found the solution to each quiz and checked that it was correct, they were given two objects:

- a piece of a jigsaw puzzle, useful for the composition of the final marker to get the solution to find the treasure.
- a clue to find the next image, the marker.

The winner team had a symbolic award, and all the participants had a certificate for participating to the experience.

4. Discussion and conclusion

In this paper we introduced an Augmented Reality mobile learning experience based on treasure hunt serious game. This experience leverages the potentiality of the ARLectio® framework to support teachers in authoring learning experiences based upon Augmented Reality technologies.

A qualitative analysis of the students' experience, conducted through semi-structured interviews, has highlighted the increased level of engagement of the students participating to the treasure hunt pilot when they used the AR technologies. In particular, students reported a positive attitude towards the immersive experience that they had with the AR technology. They also liked the possibility to use their own mobile device that usually is not allowed in the classroom during traditional learning activities. Finally, even though the group consist of students that use their mobile phone intensively, they were not too much familiar with the AR technology and the possibility to interact with virtual 3D object was highly appreciated.

Further study based also on quantitative analysis will be conducted to prove the effectiveness of the AR technology in these learning scenarios.

To this end, the ARLectio® framework will benefit of Learning Analytics techniques to collect data and provide evidence about the learning processes that are supported by the AR technology. In fact, further developments are going to be carried out to integrate Learning Analytics approaches in Augmented Reality learning experiences through the xAPI standard (Farella et al., 2021). The xAPI standard will be introduced into the ARLectio® framework to trace the interactions of the students and providing teaches with monitoring tools helping them to promptly intervene when students struggle during their learning experiences. Moreover, the use of the xAPIs could improve the user experience by keeping track of the enigmas solved, the time spent solving them as well as by keeping track of the user's interaction with the system and virtual objects.

Finally, it should be observed that the type of AR based learning activities that can implemented through the ARLectio® framework are not limited to treasure hunts, thus supporting the investigation of new scenarios not limited to treasure hunt based on AR technology.

Acknowledgements

This work has been developed in the framework of the Erasmus+ Key action Cooperation for innovation and the exchange of good practices, Strategic Partnerships for school education, project: "FabLab SchoolNet: STEAM education and learning by Robotics, 3D and Mobile technologies", reference number No 2018-1-LT01-KA201-047064.

We would also like to show our gratitude to the team of the Institute for Educational Technology of Palermo of the National Research Council of Italy for helping and supporting us in producing the learning material used during the pilot carried out during the "Esperienza inSegna 2020" event.

References

Argo, A., Arrigo, M., Bucchieri, F., Cappello, F., Di Paola, F., Farella, M., Fucarino, A., Lo Bosco, G., Saguto, D., Sannasardo F. and Lanzarone, A. (2018). Augmented Reality Gamification for Human Anatomy, GALA 2018: Games and Learning Alliance, Springer, 11385, 409-413.

Arrigo, M., Taibi,D. and Fulantelli G. (2014) Mobile Learning with Linked Open Data. International Journal Of Education And Information Technologies, Vol. 8, 2014, pp. 211-218, ISSN: 2074-1316

Azuma, R. T. (1997). A survey of augmented reality. Presence: Teleoperators & Virtual Environments, 6(4), 355-385.

Bálint Z., Kiss B., Magyari B. and Simon K. (2012) Augmented reality and image recognition based framework for treasure hunt games, 2012 IEEE 10th Jubilee International Symposium on Intelligent Systems and Informatics, 2012, pp. 147-152, doi: 10.1109/SISY.2012.6339504.

Bursali, H. and Yilmaz, R. M. (2019). Effect of augmented reality applications on secondary school students' reading comprehension and learning permanency. Computers in Human Behavior, 95, 126-135.

Chiazzese, G., Goei, S.L., Pronk, J., Tosto, C., Seta, L., Arrigo, M., Taibi, D., Farella, M. and Mangina, E. (2021). Teaching Behavioural Routines using Augmented Reality in the ARETE Project. Fifth edition of the International Science Fiction Prototyping conference - SCIFI-IT 2021, 15-16 April, online and in-presence, Ghent, Belgium.

Farella, M., Arrigo, M., Taibi, D., Todaro, G., Chiazzese, G. and Fulantelli, G. (2020). ARLectio: An Augmented Reality Platform to Support Teachers in Producing Educational Resources. In CSEDU (2) (pp. 469-475).

Farella M., Arrigo A., Chiazzese G., Tosto C., Seta L. and Taibi D. (2021). Integrating xAPI in AR applications for Positive Behaviour Intervention and Support. In proceedings of the 21st IEEE International Conference on Advanced Learning Technologies ICALT2021.

Fulantelli G., Taibi D., and Arrigo M. (2013). A semantic approach to mobile learning analytics. In Proceedings of the First International Conference on Technological Ecosystem for Enhancing Multiculturality (TEEM '13). Association for Computing Machinery, New York, NY, USA, 287–292. DOI: https://doi.org/10.1145/2536536.2536579

Godwin-Jones, R. (2016). Augmented reality and language learning: From annotated vocabulary to place-based mobile games. Language Learning & Technology 20(3), 9–19.

Kohen-Vacs, D., Ronen, M. and Cohen, S. (2012). Mobile treasure hunt games for outdoor learning. *Bulletin of the IEEE Technical Committee on Learning Technology*, *14*(4), 24-26.

Laamarti, F., Eid, M. and El Saddik, A. (2014). An overview of serious games. International Journal of Computer Games Technology, 2014.

Lee, K. (2012). Augmented Reality in Education andTraining. K. Techtrends, vol. 56.

Lukosch, S., Billinghurst, M., Alem, L. and Kiyokawa, K. (2015). Collaboration in augmented reality. Computer Supported Cooperative Work (CSCW), 24(6), 515-525.

Mobius, M., Phan, T. and Szeidl, A. (2015). *Treasure hunt: Social learning in the field* (No. w21014). National Bureau of Economic Research.

Nikolopoulou, K. (2018). Mobile learning usage and acceptance: perceptions of secondary school students. J. Comput. Educ. 5, 499–519. https://doi.org/10.1007/s40692-018-0127-8

Raghaw, M., Paulose, J., Goswami, B. (2018). Augmented reality for history education. International Journal of Engineering and Technology (UAE). 7. 121-125.

Salinas, P. and González-Mendívil, E. (2017). Augmented reality and solids of revolution. International Journal on Interactive Design and Manufacturing (IJIDeM), 11, 829-837

Sayed, N. A. M. E., Zayed, H. H. and Sharawy, M. I. (2011). ARSC: Augmented reality student card. Computers & Education, 56, 1045-1061.

Sharples M., Arnedillo-Sánchez I., Milrad M. and Vavoula G. (2009) Mobile Learning. In: Balacheff N., Ludvigsen S., de Jong T., Lazonder A., Barnes S. (eds) Technology-Enhanced Learning. Springer, Dordrecht. https://doi.org/10.1007/978-1-4020-9827-7_14

Shakouri F. and Tian F. (2019) Avebury Portal – A Location-Based Augmented Reality Treasure Hunt for Archaeological Sites. In: El Rhalibi A., Pan Z., Jin H., Ding D., Navarro-Newball A., Wang Y. (eds) E-Learning and Games. Edutainment 2018. Lecture Notes in Computer Science, vol 11462. Springer, Cham. https://doi.org/10.1007/978-3-030-23712-7_7

Signa, A., Perna, S., La Rocca, M., Allegra, M., Città, G., Dal Grande, V., Gentile, M., La Guardia, D. and Ottaviano, S. (2019) GROUNDING L2 LEARNING IN SOCIAL PRACTICE THEORY: THE VIRGIL2 SERIOUS GAME, EDULEARN19 Proceedings, pp. 5096-5100.

Sungkur, R.K., Panchoo, A. and Bhoyroo, N.K. (2016), "Augmented reality, the future of contextual mobile learning", Interactive Technology and Smart Education, Vol. 13 No. 2, pp. 123-146. https://doi.org/10.1108/ITSE-07-2015-0017

Tosto, C., Hasegawa, T., Mangina, E., Chifari, A., Treacy, R., Merlo, G. and Chiazzese, G. (2020). Exploring the effect of an augmented reality literacy programme for reading and spelling difficulties for children diagnosed with ADHD. Virtual Reality, 1-16.

Distance Higher Education Learning and Professional Pedagogy: Training the Trainers

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DOI: 10.34190/EEL.21.061

Abstract: The global disruption of all physical educational activities due the covid-19 pandemic impacted among others also professional development (PD) activities of higher educational faculty members and staff. Teaching and learning had to be organized exclusively online. This transition is not straightforward as it often requires a different way of facing new challenges, or even a cultural change in all involved stakeholders. Hence, instructional designers, but also instructors and researchers need to consider multiple factors related to online education instructional design. In this empirical study, we present in detail the views and needs of twenty-three higher education faculty members, on their preferable pedagogy for distance training that had to replace a face-to-face one, in the frame of a multinational capacity building project. The core research question was "what are higher education instructors' views and educational needs toward meaningful and effective pedagogy of PD teaching and learning activities both in a face to face and an online training process". A mixed research method was employed in the form of a 22-item questionnaire (pilot survey) combining qualitative and quantitative data in the form of open and closed questions, respectively as well as observation. The examined research indicators were the preferable training form, methodology, assessment, and feedback. Findings suggest that in online PD, a flipped learning approach can accommodate the needs of academics where online meetings can be dedicated mainly to critical discussions and practical applications based on prior asynchronous individual study of theoretical material. Based on polarizing perceptions regarding assessment and grading, participants' PD work was evaluated qualitatively for positive motivation though critical reflection and feedback towards excellence. This knowledge can be useful and support continuous professional development initiatives in the design and implementation of effective e-learning strategies.

Keywords: distance training, higher education, professional development, capacity building, instructional design

1. Introduction

The global disruption of all physical educational activities due the covid-19 pandemic disrupted education in all levels. Teaching and learning had to be organized exclusively online (Bawa, 2020). Emergency remote teaching became a necessity that faced challenges from multiple angles associated with all stakeholders, e.g. policy makers, administrators, teachers and learners (Bozkurt and Sharma, 2020). In higher education institutes, managers and administrators had to deploy rapidly digital technical solutions and systems to replace all previous face-to-face interactions, communications, administrative and critical academic processes such as remote assessment without physical presence (Li *et al.*, 2021). Learners had to adapt to a different day-to-day routine and replace commuting to university campuses with social distancing and home study. Instead of participating in classes and studying in libraries, their new reality was dominated by e-lectures and self-directed learning with digital resources. Academic educators without prior experience with e-learning platforms had to re-discover under time pressure novel methods to design instruction, teach and organize student learning (Mahmood, 2020). This transition is not straightforward as it requires a different way of addressing challenges, or even a cultural change in academic practice (Hanson, 2009). Even hesitant or reluctant educators who previously dismissed distance education had to embrace digital media to bridge the physical transactional distance (Hills and Keegan, 1994; Giossos *et al.*, 2009). To facilitate such transformations various faculty professional development initiatives were undertaken to rethink and redefine teaching (Leigh *et al.*, 2020). The success of academic professional development depends heavily on faculty members' views, in fact they can be considered as an integral variable in professional development interventions (Gast, Schildkamp and van der Veen, 2017). A systematic review on online professional development marks the research gap on online professional development instructional design elements and activities (Bragg, Walsh and Heyeres, 2021). This empirical study aims to explore the views and needs of higher education faculty members regarding the preferable pedagogy for online, distance professional development in the frame of a multinational capacity building project.

2. Background

Professional development activities of higher educational faculty members and academic staff has been facilitated effectively by the use of Information Communication Technologies and e-learning systems with the implementation of appropriate pedagogical approaches (MacKenzie and Staley, 2001; Stefani and Elton, 2002; Mostert and Quinn, 2009). Online professional development can be used for academic staff to improve their technological pedagogical content knowledge "TPACK" in various contexts (Mishra and Koehler, 2006; Fragkaki *et al.*, 2020; Fragkaki, Mystakidis and Filippousis, 2020). According to the learning model of andragogy, adults learn best when they assume an active role in the learning and are prompted to make conscious choices about their learning method and content (Arghode, Brieger and McLean, 2017). The perceived quality of online life-long learning depends heavily on the modeled instructional methods (Mystakidis, Kostopoulos and Amanatides, 2017). When teacher training is supported via multiple actors and methods throughout the whole process it has the potential to facilitate transformative, meaningful learning (Philipsen *et al.*, 2019).

Instructional designers, but also instructors and researchers need to consider multiple factors related to effective online teacher training instructional design. Open and distance education has a long participant-centered instructional design tradition orbiting around the learning material. Thoughtfully designed educational material is developed by interdisciplinary teams and offered for flexible self-study accompanied by appropriate learning activities (Lionarakis, Panagiotakopoulos and Xenos, 2005). Online professional development interventions can take many forms, synchronous and asynchronous. Utilizing both asynchronous and synchronous learning modes for distant support and peer learning is a critical success factor (Xydopoulos *et al.*, 2015; Mystakidis, Berki and Valtanen, 2019).

Academic staff professional development in an individual, team and institutional level is an integral component of international capacity building projects in higher education (Mallinson and Krull, 2013). Effective professional development caters to participants' cognitive, procedural, and affective competence needs. Effective online learning can be described as a dance among teachers and learners without multiple stages and altering roles such as communicator, expert, facilitator, mentor, instigator, leader (Frazer *et al.*, 2017). Teachers' engagement and rising interest encourages and enables them to venture cognitively out of their comfort habits and engage safely in the zone of proximal development with collaborative and cooperative social activities (Lambropoulos *et al.*, 2012; De Marsico, Sterbini and Temperini, 2013). Experiential training/learning methodologies for adult learners include team-based learning, project-based learning, inquiry-based learning, flipped learning, game-based learning (Wurdinger and Allison, 2017). For the successful outcome of academic professional development associated with a shift towards online teaching, cultural changes in the professional identity need to be considered (Philipsen *et al.*, 2019). This should be reflected in the assessment of online professional development. Assessment can be formative or summative and can take many formal and informal feedback shapes (MacKenzie and Staley, 2001).In addition, even almost all academics know how meaningful is to use state of the art pedagogies in eLearning, when they are teaching, the question is how easily and willingly they are ready to embrace them and be the trainees and not the trainers using the same pedagogies? During the in-service professional development training, does academics "personal theories" about teaching and learning "others" aligned with the same learning theories and practices that they must work on them "by themselves" during their professional development (Fragkaki and Lionarakis, 2009; Fragkaki, Mystakidis and Filippousis, 2020)? In this empirical study, we present in detail the views and needs of higher education faculty members, on their preferable pedagogy for distance professional development intervention that had to replace a face-to-face one.

3. Methodological framework

This research was conducted between January and March 2021 in the framework of the international capacity building Erasmus Plus project "Boosting Innovation in Education and Research of Precision Agriculture in Palestine" (BENEFIT). The acquisition of knowledge and skills in the creation of distance learning courses and open educational resources to promote innovation, and research in the scientific subject of Precision Agriculture are key pillars of the project. The used methodology concerns an empirical case study, a study of an instance in action (Adelman, Jenkins and Kemmis, 1976). Effects in a real context are observed, recognizing that context is a powerful determinant of both causes and effects (Cohen, Manion and Morrison, 2007). In this paper the complex dynamic and unfolding interactions of the training event, and factors/categories, concerning professional development desired training pedagogy are explored. The core research question was "what are higher education instructors' views and educational needs toward meaningful and effective pedagogy of professional development teaching and learning activities both in a face to face and an online training process". Specifically, the examined research indicators were the preferable training form, methodology, working type, assessment, and feedback.

Twenty-three higher education faculty members participated in this study. A convenience sample among participating universities was adopted to facilitate the needs of the specific project. The study implementation included three instruments and data sources. The primary data were faculty members' answers in the 22-item pilot survey, designed by the first author that combined qualitative and quantitative data in the form of open and closed questions, respectively. The closed questions were structured using a deliberate 4-level Likert scale with 1 being "strongly disagree", 2 being "disagree", 3 being "agree" and 4 being "strongly agree", in order for the participants to express themselves by selecting an option and avoiding a safe, neutral opinion. The secondary data collection method was the online training observation and the third one their synchronous and asynchronous completed assignments. So, researchers had the opportunity to check data, triangulating them, make correlations, and see possible contradictions. The validity of the questionnaire was safeguarded from the viewpoints of the respondents who did it accurately, honestly and correctly (Belson, 1986). The follow-up group synchronous discussions on preferable and used training pedagogies followed the peer examination of the findings and was addressed respondents' validation. The triangulation of the data, with the use of three methods of data collection (questionnaires, assignments, observation) was addressed through the honesty, depth, richness, and scope of the data achieved, the participants approached, the extent of triangulation and the disinterestedness or objectivity of the researchers (Winter, 2000).

4. Results and discussion

Findings are presented according to the following research indicators: (i) preferable training form, (ii) training methodology, (iii) assessment, grading, and feedback.

4.1 Form of training

In relation to the preferable pedagogy applied in *distance* and *face-to-face* professional development workshops 69% of academics prefer a structured strict form of training to be sure they will "understand project's objectives and tasks" and being able afterwards to perform their duties to the project's specifications. In relation to the fulfilment of their learning needs, the overwhelming majority (83% and 91%) prefers a flexible form of learning during online and face-to-face workshops respectively (Figure 2).

It is obvious both from the survey's answers as well as from the observation during the online training, that participants/faculty members/learners preferred a formal and structured form of OPD organization. Apparently they are aligned with Bloom's Taxonomy, where understanding comes from the construction of meaning from a traditional, well-structured and closed form of training (Anderson *et al.*, 2000). This form of training, as it was observed, accompanied with oral messages/lectures, written and graphic presentations. Verb types like interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining aligned with their preferences.

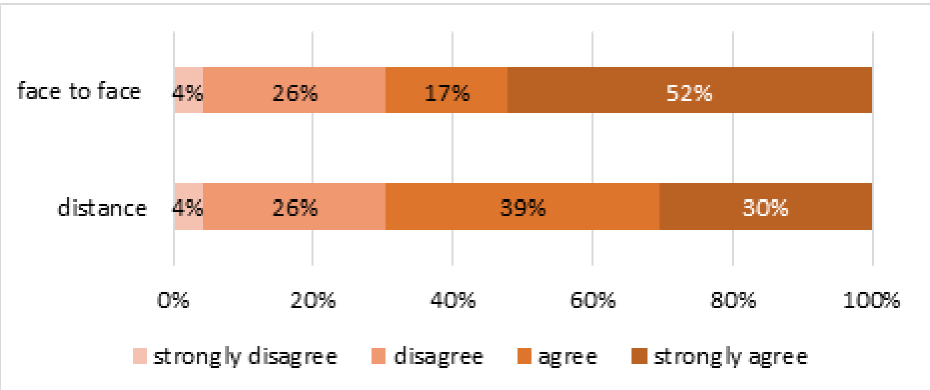

Figure 1: Faculty attitudes towards a strict, structured training form (distance; face-to-face)

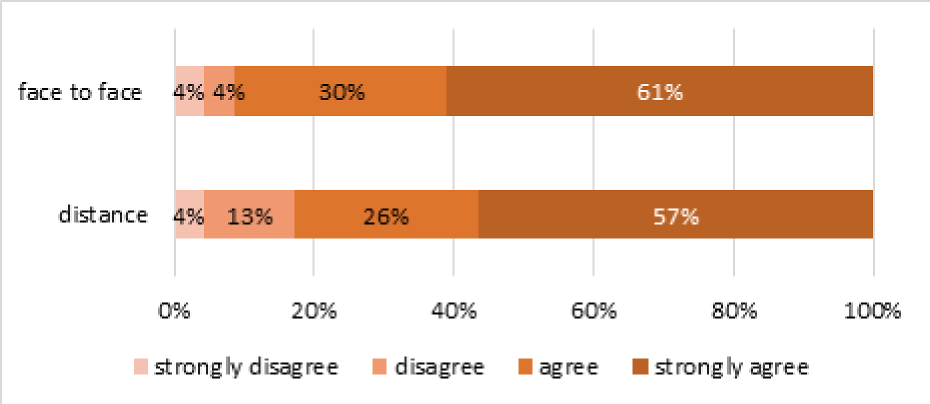

Figure 2: Faculty attitudes towards a flexible learning form (distance; face-to-face)

An interesting piece of information is that, on the other hand, they preferred *"a flexible form of learning"* to fulfil their personal and educational needs, in both modes (online/distance and face to face). Flexibility is deeply rooted in the needs of learners, with the main objective being to provide them with the most flexibility about the learning content, schedule, deadlines, access, and learning styles as much as possible (Caladine, 2008). It was observed that faculty members preferred to choose by themselves, per institution, "how", "what", "when" and "where" they learn. For example, some of them preferred flipped-classroom activities, while others wanted to listen to video-lectures the day of the training and then ask questions if they had misunderstood something. Flexible learning has also driven the faculty members to plan their workshop's activities according to their interest and enthusiasm. It also kept them in a pleasant state of mind without external fears or anxiety. In their assignments, it was observed that they preferred flexibility. Some of them preferred to work collaboratively through shared applications like Padlet, while others preferred at the same time to use Google Drive / Docs and some of them complete assignments individually. Thus, flexible learning permitted faculty members to customize one's pace, place, and mode of learning. In conclusion we can say that flexible models of learning allowed participants to regulate their study; it met the access needs of a wide range of faculty members from different regions and universities; built their confidence and independence and definitely responded to faculty members different learning styles (Heard, 2021).

4.2 Training methodologies

In relation to the preferable pedagogy during online professional development (OPD) workshops (featuring both synchronous and asynchronous learning) the vast majority (87%) of the participants approved *learning by experiment* through assignments related to project's tasks so to be effective in their future online training tasks. 91% of academic staff share the same opinion for face-to-face training (Figure 3).

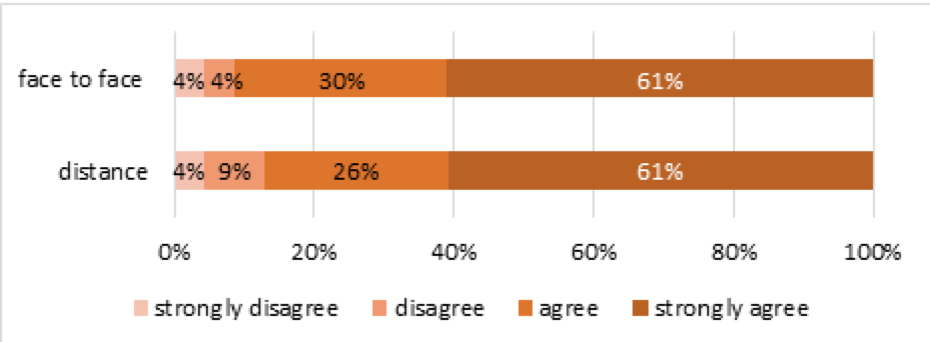

Figure 3: Faculty attitudes towards learning by experiment (distance; face-to-face)

In addition, 87% accepted widely playful training methodologies through *game-based learning* during both online and face to face workshops, so as to be both active and enjoy OPD (Figure 4).

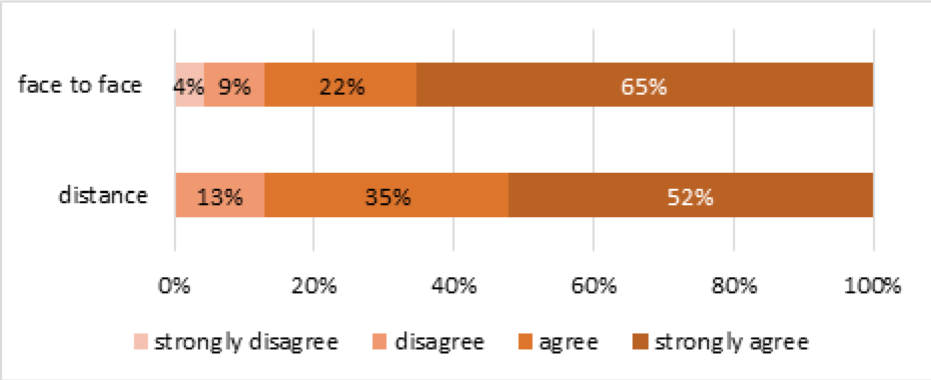

Figure 4: Faculty attitudes towards game-based learning (distance; face-to-face)

An equally great majority of 83% preferred inquiry as training methodology so as to be both active and critical on project's tasks, while all of them preferred the same method during face-to-face PD (Figure 5).

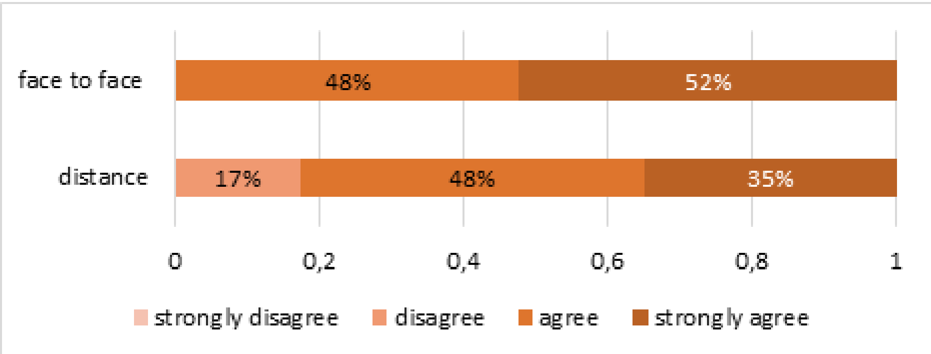

Figure 5: Faculty attitudes towards inquiry-based learning (distance; face-to-face)

83% expected information to be transmitted to them through "tutor's explanation through presentations", both during face-to-face and OPD so to be sure they comprehend project's tasks effectively (Figure 6).

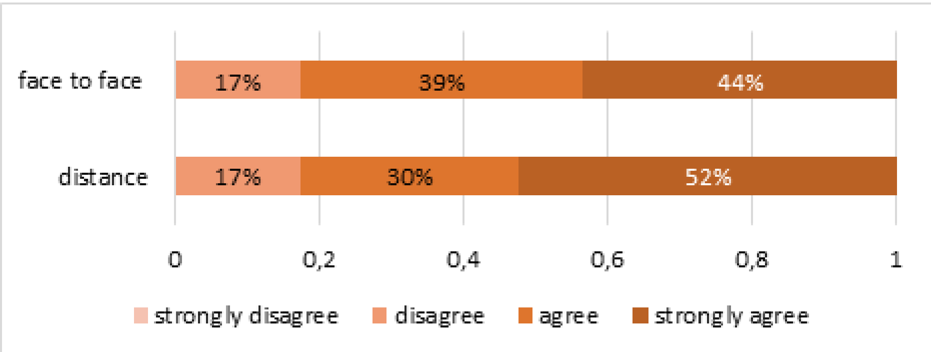

Figure 6: Faculty attitudes towards explanation through presentation (distance; face-to-face)

In addition, 78% of the trainees preferred as methodology "*short lectures"* from the trainer in OPD, while 87% preferred short lectures during face-to-face workshops to understand better the taught concepts and processes (Figure 7).

Another interesting finding was that almost all (86% and 95%) faculty members expressed their fondness of flipped learning, both for online and face-to-face PD respectively. In flipped classrooms trainers to send study material ahead of time so that students can prepare for the synchronous meeting in the physical or online class to engage in critical discourse (Figure 8).

There was also a positive consensus towards working in teams during online (92%) and attendance-based PD (100%) to achieve project's learning objectives (Figure 9).

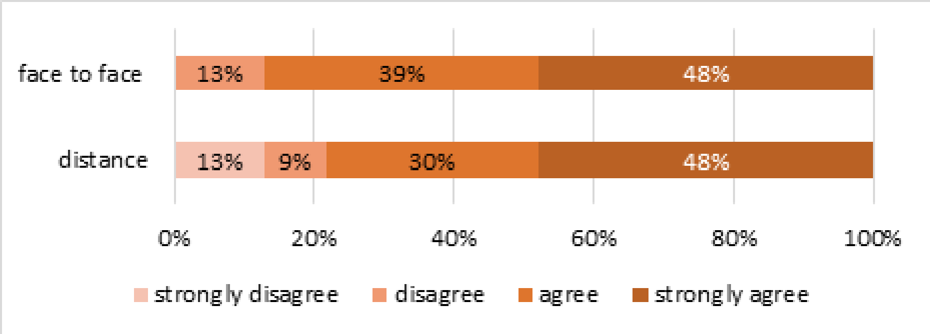

Figure 7: Faculty attitudes towards short lectures (distance; face-to-face)

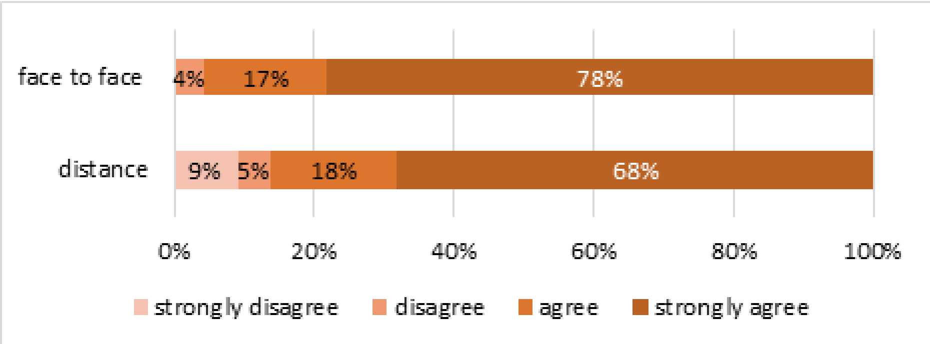

Figure 8: Faculty attitudes towards the flipped-classroom method (distance; face-to-face)

Concerning the preferable online training methodologies, most of the participants expressed their preference towards active methods as inquiry-based learning, experiential learning, and gamification. That was also obvious from the research observation. For example, they enjoyed very much to learn project's basics, by playing all together synchronously cognitive games in gamified platforms. However, they needed afterwards "strict", well-organized and visualized information to understand better the gained knowledge from the game. So, the self-reported survey views were well-aligned with OPD observations. From the assignments that participants had to submit individually after each online session, it was obvious that only few of the participants corresponded effectively and meaningfully to the assignments' targets. They needed more explanations, and to adjust them to their own pace. This finding created the impression on the researchers that although they were active and used in practice the desired methodologies during the training, they were not so active and effective in carrying out their work, which had to be carried out collaboratively from their side.

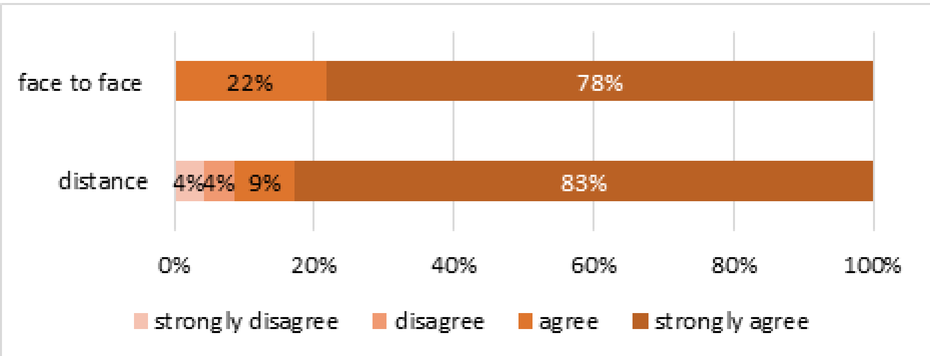

Figure 9: Faculty attitudes towards teamwork (distance; face-to-face)

In concluding, we could argue that, even they enjoyed playing, experimenting on case-studies, or exploring information during the synchronous online training, neither understand exactly their assignments tasks (e.g., instructional design, syllabus, accreditation process) or dedicated to them. So, even though they preferred flexibility to fulfil their personal and educational needs, it seems that either due to their culture of learning, or their tacit knowledge they were accustomed to be trained in a more traditional and strict way. Moreover, it was observed that almost all faculty members preferred short lectures, presentations, and explanations. However, interestingly even though a strong consensus was recorded in favor of flexible online professional development training, a layout featuring collaborative work, gamification, and inquiry-based learning, a more traditional, structured approach was preferred for face-to-face training.

Findings from the triangulation of the research tools suggest that in online PD, a flipped learning approach can accommodate the needs of academics with online meetings for critical discussions and practical applications based on prior asynchronous individual study of theoretical material. In addition, almost all participants love to work collaboratively in small teams, even online or face-to-face, and particularly to work in groups within their universities. Nevertheless, the assignments showed that there was a difficulty in the inter-group and cross-institutional cooperation. Although trainers recommended at a certain point inter-group communication and feedback, it did not appear to have happened in all the circumstances.

4.3 Assessment, grading and feedback

In relation to the preferable assessment, grading and feedback method, a slight majority of academics (56%) consented to being assessed formally by grading and feedback during OPD workshops to ensure they have achieved excellence in the project's objectives, while a strong minority of 44% were resistant to this practice preferring a more informal approach (Figure 10). Similar polarizing results (61% agreed or agreed fully, 39% disagreed or disagreed fully) were recorded for face-to-face training workshops.

On this finding, it can be noted that assessment and grading was always and remains a controversial issue in the educational field and beyond. In the OPD observation it became clear that even though all participants loved feedback through critical reflection, they detested assessment through grading when their initial submissions had considerable weaknesses. This sentiment was shared privately. In contrast, no complaints were recorded in cases of exemplary performance. To reach a middle ground, a practical solution was proposed to recognize excellence and simultaneously motivate and facilitate gradual improvement. Participant's work was not to be assessed in a quantitative scale. Instead, it could be evaluated in a qualitative scale to enhance positive motivation and promote excellence. The scale included three levels: excellent, satisfactory, and not yet satisfactory. Moreover, faculty members that did not achieve the best possible outcome could still improve their work and resubmit improved versions, a practice in the fashion of academic peer review. This solution has been implemented widely in OPD courses (Mystakidis *et al.*, 2018). An interesting point is that the "grade-less" argument was supported not only by some trainees (academics) but also by some trainers (academics) and was expressed as a philosophical/cultural issue in terms of evaluation. This finding underlines the importance of detecting and discussing openly eventual sensitive, personally important issues prior to the implementation of OPD programs in higher education to serve faculty members needs for rigorous learning in an empathetic way.

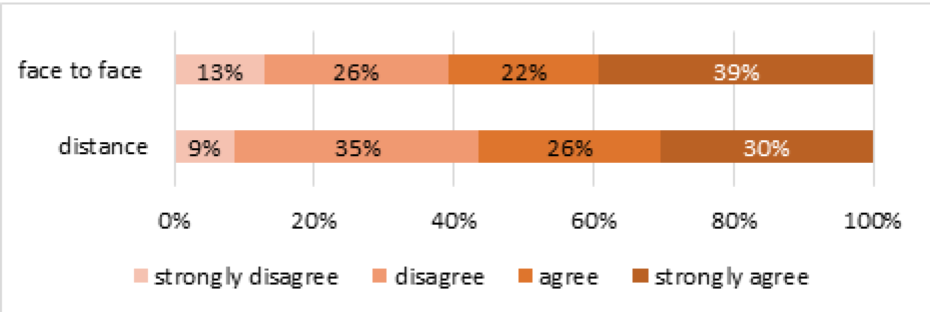

Figure 10: Faculty attitudes towards graded assessment (distance; face-to-face)

5. Epilogue

The analysis of data from various sources and their alternative explanations, as well as researchers' and participants' constructivist dialogue and arguments lead to the previously described, overall picture and conclusions. Due to the limited sample size results cannot be considered universally generalizable, and that was not researchers aim, as they preferred to focus on participants' content analysis and the qualitative part of the research that does not support generalizations. However, owing to the data triangulation, findings maintain their situational validity and reliability. Furthermore, they provide indications for wider usability especially in the context of voluntary online higher education professional development of short duration (e.g. 1-4 weeks). In these cases, flexible flipped learning can accommodate participants' needs and busy schedules under the condition that sufficient study time is foreseen between meeting days. Also, reinforcing motivation with active learning methods (e.g. collaborative problem-solving activities, authentic case studies, critical thinking debates) and constructive yet academically sound feedback and alternative assessment approaches can reconcile the temporary paradox of university professors taking the student's seat. Nonetheless, future cross-cultural studies for other online professional development arrangements are necessary to affirm the applicability of findings in other settings. The extracted knowledge can be useful and support online professional development training entities and initiatives in Higher Education. Moreover, it can be considered of essential importance, since a growing number of academic faculty members is expected to participate frequently as a learner in in-service professional development training workshops, thus seizing the opportunity to reflect critically on their practice as educators.

References

Adelman, C., Jenkins, D. and Kemmis, S. (1976) 'Re-thinking case study: notes from the second Cambridge Conference', *Cambridge Journal of Education*. Routledge, 6(3), pp. 139–150. doi: 10.1080/0305764760060306.

Anderson, L. W. *et al.* (2000) *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives, Abridged Edition*, *Theory Into Practice*. Pearson. doi: 10.1207/s15430421tip4104_2.

Arghode, V., Brieger, E. W. and McLean, G. N. (2017) 'Adult learning theories: implications for online instruction', *European Journal of Training and Development*. Emerald Publishing Limited, 41(7).

Bawa, P. (2020) 'Learning in the age of SARS-COV-2: A quantitative study of learners' performance in the age of emergency remote teaching', *Computers and Education Open*, 1, p. 100016. doi: 10.1016/j.caeo.2020.100016.

Belson, W. A. (1986) *Validity in Survey Research: With Special Reference to the Techniques of Intensive Interviewing and Progressive Modification for Testing and Constructing Difficult Or Sensitive Measures for Use in Survey Research : a Report*. Gower.

Bozkurt, A. and Sharma, R. C. (2020) 'Emergency remote teaching in a time of global crisis due to CoronaVirus pandemic', *Asian Journal of Distance Education*, 15(1), pp. 1–6.

Bragg, L., Walsh, C. and Heyeres, M. (2021) 'Successful design and delivery of online professional development for teachers: A systematic review of the literature', *Computers & Education*, p. 104158. doi: 10.1016/j.compedu.2021.104158.

Caladine, R. (2008) *Enhancing E-Learning with Media-Rich Content and Interactions*. IGI Global. doi: 10.4018/978-1-59904-732-4.

Cohen, L., Manion, L. and Morrison, K. (2007) *Research Methods in Education*. 6th edn. New York: Routledge.

Fragkaki, M. *et al.* (2020) 'TPACK Instructional Design Model in Virtual Reality for Deeper Learning in Science and Higher Education: From "Apathy" to "Empathy"', in *12th Annual International Conference on Education and New Learning Technologies (EDULEARN20)*, pp. 3286–3292. doi: 10.21125/edulearn.2020.0943.

Fragkaki, M. and Lionarakis, A. (2009) 'Critical-reflective Models for Professional Development and Further Training in Distance Education', in *Proceedings of the 5th International Conference on Open and Distance Education for International Collaborations and Educational Development*. Athens, Greece. doi: http://dx.doi.org/10.12681/icodl.468.

Fragkaki, M., Mystakidis, S. and Filippousis, G. (2020) 'Work-in-Progress—Design and Evaluation of an Augmented and Virtual Reality Flipped-Learning Course for K-12 Educators', in *2020 6th International Conference of the Immersive Learning Research Network (iLRN)*. IEEE, pp. 275–278. doi: 10.23919/iLRN47897.2020.9155200.

Frazer, C. *et al.* (2017) 'Faculty Perceptions of Online Teaching Effectiveness and Indicators of Quality', *Nursing Research and Practice*. Edited by C. Newman. Hindawi, 2017, pp. 1–6. doi: 10.1155/2017/9374189.

Gast, I., Schildkamp, K. and van der Veen, J. T. (2017) 'Team-Based Professional Development Interventions in Higher Education: A Systematic Review', *Review of Educational Research*, 87(4), pp. 736–767. doi: 10.3102/0034654317704306.

Giossos, Y. *et al.* (2009) 'Reconsidering Moore's Transactional Distance Theory', *European Journal of Open, Distance and E-learning*. ERIC.

Hanson, J. (2009) 'Displaced but not replaced: the impact of e-learning on academic identities in higher education', *Teaching in Higher Education*, 14(5), pp. 553–564. doi: 10.1080/13562510903186774.

Heard, I. R. (2021) 'Converting Traditional Learning to Online Environments', in *Research Anthology on Developing Effective Online Learning Courses*. IGI Global, pp. 1339–1352. doi: 10.4018/978-1-7998-8047-9.ch066.

Hills, P. and Keegan, Desmond (1994) 'Theoretical Principles of Distance Education', *British Journal of Educational Studies*. Edited by D. Keegan. London, UK: Routledge, 42(4), p. 411. doi: 10.2307/3121685.

Lambropoulos, N. *et al.* (2012) 'Immersive Worlds for Learning eXperience+: Engaging users in the zone of proximal flow in Second Life', in *EADTU 25th Anniversary Conference*. Paphos, 27-28 September, 2012, pp. 130–138. Available at: https://conference.eadtu.eu/download2425.

Leigh, J. *et al.* (2020) 'Redefining undergraduate nurse teaching during the coronavirus pandemic: use of digital technologies', *British Journal of Nursing*. MA Healthcare London, 29(10), pp. 566–569. doi: 10.12968/bjon.2020.29.10.566.

Li, M. *et al.* (2021) 'Optimized collusion prevention for online exams during social distancing', *npj Science of Learning*, 6(1), p. 5. doi: 10.1038/s41539-020-00083-3.

Lionarakis, A., Panagiotakopoulos, C. and Xenos, M. (2005) 'Open and Distance Learning: tools of information and communication technologies for effective learning', in *Open and Distance Learning, Pedagogical and Technological Application*. Hellenic Open University.

MacKenzie, N. and Staley, A. (2001) 'Online Professional Development for Academic Staff: Putting the Curriculum First', *Innovations in Education and Teaching International*. Taylor & Francis, 38(1), pp. 42–53. doi: 10.1080/147032901300002846.

Mahmood, S. (2020) 'Instructional Strategies for Online Teaching in COVID-19 Pandemic', *Human Behavior and Emerging Technologies*, pp. 1–5. doi: 10.1002/hbe2.218.

Mallinson, B. and Krull, G. (2013) 'Building academic staff capacity to support online learning in developing countries', *Journal of Asynchronous Learning Networks*. ERIC, 17(2), pp. 63–72.

De Marsico, M., Sterbini, A. and Temperini, M. (2013) 'A Strategy to Join Adaptive and Reputation-Based Social-Collaborative E-Learning, Through the Zone of Proximal Development', *International Journal of Distance Education Technologies*. IGI Global, 11(3), pp. 12–31. doi: 10.4018/jdet.2013070102.

Mishra, P. and Koehler, M. J. (2006) 'Technological pedagogical content knowledge: A framework for teacher knowledge', *Teachers College Record*. Teachers College, Columbia University, pp. 1017–1054. doi: 10.1111/j.1467-9620.2006.00684.x.

Mostert, M. and Quinn, L. (2009) 'Using ICTs in teaching and learning: Reflections on professional development of academic staff', *International Journal of Education and Development using ICT*. Open Campus, The University of the West Indies, West Indies, 5(5), pp. 72–84.

Mystakidis, S. *et al.* (2018) 'Towards a Blended Strategy for Quality Distance Education Life-Long Learning Courses – The Patras Model', in *17th European Conference on e-Learning (ECEL)*. Athens, Greece, pp. 408–416. Available at: https://search.proquest.com/openview/993f73d32d7189e82a0429d1ebdfe651/1.

Mystakidis, S., Berki, E. and Valtanen, J.-P. (2019) 'The Patras Blended Strategy Model for Deep and Meaningful Learning in Quality Life-Long Distance Education', *Electronic Journal of e-Learning*, 17(2), pp. 66–78. doi: 10.34190/JEL.17.2.01.

Mystakidis, S., Kostopoulos, K. P. and Amanatides, E. (2017) 'Preconditions for Quality Distance Vocational Training: The case of the Patras University Center for Vocational Education and Training', *9th International Conference in Open and Distance Learning*. Athens, Greece, 9(6B). Available at: https://eproceedings.epublishing.ekt.gr/index.php/openedu/article/download/1125/1250.

Philipsen, B. *et al.* (2019) 'Improving teacher professional development for online and blended learning: a systematic meta-aggregative review', *Educational Technology Research and Development*, 67(5), pp. 1145–1174. doi: 10.1007/s11423-019-09645-8.

Stefani, L. and Elton, L. (2002) 'Continuing Professional Development of Academic Teachers through Self-initiated Learning', *Assessment & Evaluation in Higher Education*, 27(2), pp. 117–129. doi: 10.1080/02602930220128706.

Winter, G. (2000) 'A Comparative Discussion of the Notion of "Validity" in Qualitative and Quantitative Research', *The Qualitative Report*, 4(3), pp. 1–14. doi: 10.46743/2160-3715/2000.2078.

Wurdinger, S. and Allison, P. (2017) 'Faculty perceptions and use of experiential learning in higher education', *Journal of e-learning and Knowledge Society*. Italian e-Learning Association, 13(1).

Xydopoulos, G. *et al.* (2015) 'Learning Assessment and Sustainable Business Models for Open Education Resources Initiatives', in *Proceedings of the European Distance and E Learning Network (EDEN) Open Classroom Conference, OpenDiscovery Space: Transforming schools into innovative learning organisations*. Athens, 19-21 September 2015.

Onboarding Challenges in Online and Blended Courses: Reviewing Virtual Cross-Country Collaboration of Student Teams in Higher Education

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DOI: 10.34190/EEL.21.065

Abstract: The proliferation of international online collaboration in higher education as part of the curriculum raises questions of how to successfully start these online courses and prepare student teams to effectively work on a project over the course of the semester in a virtual environment. Our paper aims to analyse the possibilities of onboarding student teams to an intercultural virtual course and what teachers need to be aware of when designing such learning environments. sing a literature review (Tranfield, 2003) as a basis for our research, the results show the importance of the following aspects, when designing the onboarding process of intercultural student teams in virtual courses: meaningful use of technology, precise and communicable course objectives, group formation process, focus on socializing activities and community building as well as common collaboration rules, and general aspects like a clear definition of the teacher's role and intercultural training. The results suggest links for teachers, developers and researchers of onboarding possibilities for intercultural virtual teams.

Keywords: virtual collaboration, onboarding tools, intercultural teams, higher education

1. Research focus and method

Ten years of expertise in virtual cross-country collaboration learning settings between Austria and Germany and a quantitative study with over 1.000 participating students have led to the significant development of our blended learning scenario (Herzog et al, 2018). This research is conducted around the TRAC (Teaching Research Across Cultures) project funded by the German Academic Exchange Service (DAAD) and the German Federal Ministry of Education and Research (BMBF), in which 70 students will be working in 18-20 intercultural groups in an online inquiry-based learning scenario.

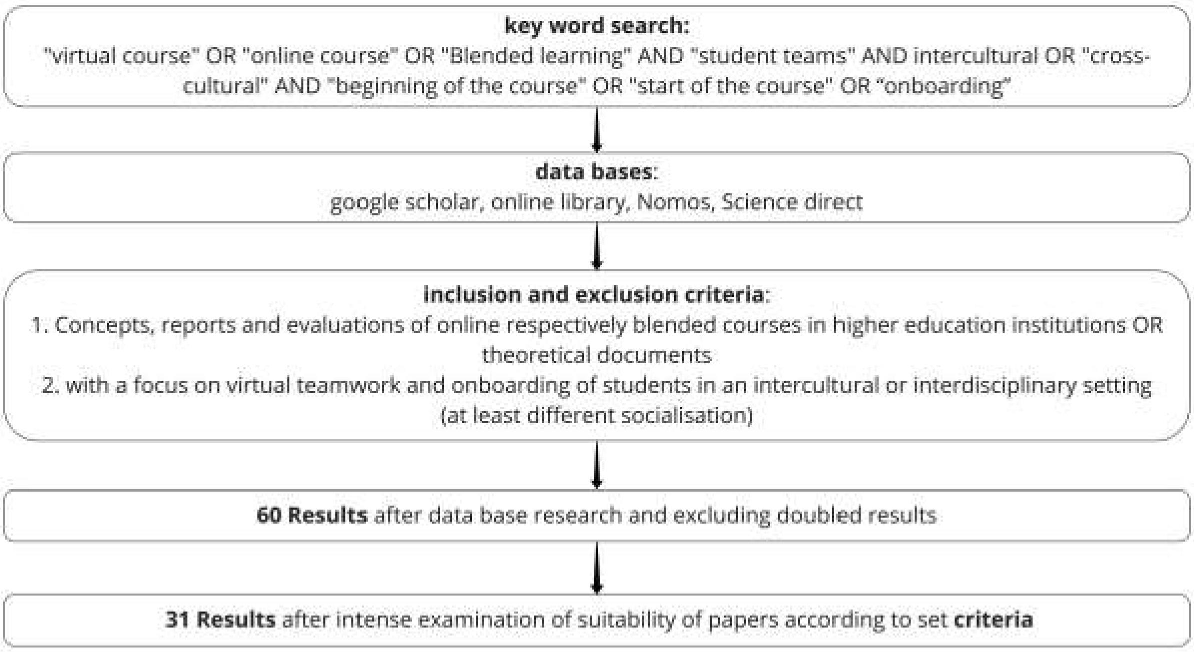

Figure 1: Methodological approach

Emphasis is put on improving the collaboration between the students working together in intercultural teams in the onboarding phase. Onboarding in this case is the process of supporting the students to successfully integrate in the learning setting and the community of learners. The successful start of online courses and how to prepare the teams to effectively work on their project over the course of the semester in a virtual environment is of importance to this paper. The various challenges that need to be overcome while working together with a new team language, culture, group dynamics and personal dispositions but also aspects of virtual barriers and challenges of virtual collaboration tools. One factor that is often overlooked by students but highly rated in the literature is the socialization process in virtual teams (Heebøll, 2017). Hence, we will analyse how teachers can facilitate the group socialization from the beginning of the course, which tools they can use and include in the onboarding phase.

To analyse our research question, we conducted a Systematic Literature Review according to Tranfield (2003) to provide solid results and eventually create an evidence-based onboarding experience. Figure 1 provides an overview of our methodological approach. First, it clarifies the key words used to find literature in the databases. The search identified 60 results. In the next step, figure 1 explains the inclusion and exclusion criteria we applied to filter relevant literature for our research question resulting in 31 papers. From the literature, we created five categories which will be elaborated in section 2. Furthermore, in a small-scale research, we suggest tools supporting the proposed activities in the five categories. In a discussion in section 3, we summarized the results and revealed research gaps. Finally, we conclude this paper in section 4 with future research directions.

2. Literature review

The literature review filtered 31 publications which revealed five categories that contribute to a better learning experience for students in intercultural collaborative virtual courses in higher education (see figure 2).

	Bohemia et al, 2009	Collins et al, 2014	DeLong & Vander Schee, 2020	DiGiano et al, 2008	Ehoff et al, 2002	Eisenberg et al, 2008	Flammia et al, 2010	Gersch et al, 2011	Grosse, 2002	Guenther et al, n.d.	Hayes, 2014	Heebøll, 2017	Johnson et al, 2002	Jones et al, 2013	Kavanagh et al, 2012	Kummer, 2013	Michaelsen & Sweet, 2011	Murphy et al, 2007	Painter-Morlad et al, 2003	Popov et al, 2012	Ragan, 2007	Reeves & Gomm, 2015	Rohrweck, 2017	Sadykova et al, 2009	Smith et al, 2018	Starke-Meyerring & Andrews, 2006	Stepanyan et al, 2014	Tawileh, 2016	Tervaskanto-Mäentausta, 2018	Weber et al, 2014	Wong & Schoech, 2007
technological aspects	■	■				■		■	■	■	■	■	■	■	■	■		■	■		■		■	■	■	■				■	■
general facilitation	■	■		■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■		■	■
group formation	■	■	■		■		■	■	■	■		■	■	■	■	■	■	■	■	■	■			■	■				■	■	
course objective	■	■		■				■			■	■		■	■	■		■	■	■	■		■	■				■			
team building	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■

Figure 1: Results of the systematic literature review

2.1 Technological aspects

Twenty-one of the analysed papers see potential discontinuities at the beginning of online seminars through technological challenges. Especially access problems in locations with proper bandwidth can be frustrating and decrease the onboarding experience (Murphy, Gazi and Cifuentes, 2007; Eisenberg and Scheffer, 2008; Ragan, 2007; Heebøll, 2017; Bohemia, Harman and Lauche, 2009). Moreover, differences in technical equipment at the various sites need to be considered (Murphy, Gazi and Cifuentes, 2007; Ragan, 2007). User-friendly tool interfaces are also an essential factor to stay motivated for the learning experience right from the beginning of the course (Murphy, Gazi and Cifuentes, 2007; DiGiano, Goldman and Chorost, 2008; Eisenberg and Scheffer, 2008; Hayes, 2014; Sadykova and Dautermann, 2009; Wong and Schoech, 2007).

Furthermore, to be able to delve into the technical infrastructure as well as to compensate for a different level of media competency, it is necessary to provide training on the software being used at the beginning of the course and explain why certain tools are being utilized for collaboration (Murphy, Gazi and Cifuentes, 2007; Painter-Morland et al, 2003; Gersch, Lehr and Weber, 2011; Kummer, 2013; Weber, Lehr and Gersch, 2014; Collins, Weber and Zambrano, 2014; Bohemia, Harman and Lauche, 2009). An audit of the students' and educators' e-readiness before involving in the course can be helpful to adjust the online learning environment (Kavanagh et al, 2012; Wong and Schoech, 2007). Naturally, the tools' functionality in terms of communication and collaboration should be reflected within the course's content and learning outcomes (Gersch, Lehr and Weber, 2011). Students will also need time to adjust to new tools in order to use them purposefully (Hayes, 2014) and understand their advantages and limitations for conducting their work (Grosse, 2002). Therefore, it is recommendable to draw on tools and methods that the students are already used to (Reeves and Gomm, 2015).

The majority of literature suggests using one central platform, a joint digital space or respectively channel for communication, course outline, and material. Some authors propose to leave the choice of other tools for collaboration to the students themselves as they know best which of them are easy to use which of them they trust (Kavanagh et al, 2012; Heebøll, 2017; Weber, Lehr and Gersch, 2014; Sadykova and Dautermann, 2009; Johnson et al, 2001). Allowing for control of their own webspace, e.g., wiki pages or WordPress sites, is also a great option to provide a safe environment in which they can collaborate (Starke-Meyerring and Andrews, 2006; Hayes, 2014; Guenther, White and Stechemesser, no date; Weber, Lehr and Gersch, 2014).

2.2 General facilitation

A strategy for the general facilitation of online courses needs to provide a particular structure and learning environment which is mostly provided through learning management systems (LMS). The LMS course itself gives an overview of what to expect from the course (see also 2.4) and provides an orientation for the upcoming semester, the deadlines, assignments and workload (Ragan, 2007; Stepanyan, Mather and Dalrymple, 2014; Popov et al, 2012; Collins, Weber and Zambrano, 2014; Rohrweck 2017). Reflecting on the teacher's role, most of the analysed literature suggests instead of dominating groupwork, it is necessary to support the students as consultants who guide them effectively through their teamwork, monitor and give feedback on their progress (Stepanyan, Mather, and Dalrymple, 2014; Gersch, Lehr and Weber, 2011; Hayes, 2014, Kummer, 2013; Ehoff, Helmi and Duangploy, 2002; Collins, Weber and Zambrano, 2014; Wong and Schoech, 2007; Johnson et al, 2001). Explaining and defining this role to the students must be done at the beginning of the course (Gersch, Lehr and Weber, 2011). At the same time teachers should not wait to be approached but rather join the groups proactively. (Heebøll, 2017). Monitoring the team can also prevent freeriding of individuals (Popov et al, 2012).

Murphy, Gazi and Cifuentes (2007) state that maximizing the structure would support the students in the beginning of the course. After a few weeks teachers should gradually allow for more learner control. Hayes (2014) claims that students at the beginning need systematic guidance to determine their goals and develop strategies to enhance their team process. She proposes establishing leadership through dedicated students within the team who focus on the knowledge production and group regulative processes (see also 2.5).

Stepanyan, Mather and Dalrymple (2014) suggest that teachers are an equal partner in the learning community, serve as mentors and hierarchies could be a big obstacle for interaction. Therefore, multicultural online learning environments should be designed in a way that "facilitators are not the primary point of contact" (p. 690).

Setting ground rules for communication or so-called "netiquette guidelines" from the beginning proved fruitful to establish a mutual understanding of engagement expectations and for social interaction (Ragan, 2007; Murphy, Gazi and Cifuentes, 2007; Kummer, 2013). Hence, teachers can facilitate special exercises that include assumptions about modes of interaction during the group meetings, e.g. openers or polite wording for disagreement (Murphy, Gazi and Cifuentes, 2007).

Assisting students in the intercultural appropriation process is also vital as students work most likely from assumptions and expectations shaped by their local contexts. Therefore, the teacher has to raise awareness for the different cultural contexts and behavioural motives to prevent misunderstandings and conflicts (Starke-Meyerring and Andrews, 2006; Popov et al, 2012; Weber, Lehr and Gersch, 2014). In intercultural communication training, students can learn what to expect from their counterparts during their collaboration (Popov et al, 2012). At the same time, teachers should create a learning atmosphere in which students and teachers can level up their different knowledge and experiences (Gersch, Lehr and Weber, 2011). In all cases we analysed, the shared working language was is English. However, many authors note that not all students might have the level of English proficiency that is needed (Murphy, Gazi and Cifuentes, 2007; Eisenberg and Scheffer, 2008; Gersch, Lehr and Weber, 2011; Collins, Weber and Zambrano, 2014; Wong and Schoech, 2007). This barrier is not easy to overcome if the intercultural experience should be open for a broad student body. Wong and Schoech (2007) tried chat-based communication, which gave non-native English speakers more time to think and the opportunity to precisely formulate their posts. Popov et al (2012, p. 312) suggests that teachers and students should encourage all group members to listen to one another actively and "promote the idea that a lack of English proficiency does not indicate a lack of competence in a subject matter". Promoting inclusive communication avoids team members' inactivity (Starke-Meyerring and Andrews, 2006).

When designing collaborative online environments, one also needs to think of motivational aspects for student participation (DiGiano, Goldman and Chorost, 2008; Tawileh, 2016). Students could be joining the course to engage in new connections and make new friends (Heebøll, 2017) and might also be interested in intercultural exchange and new perspectives (Painter-Morland et al, 2003; Eisenberg and Scheffer, 2008). They could be curious to join the course because of its digital novelty and more variety than conventional courses (Painter-Morland et al, 2003; Eisenberg and Scheffer, 2008). Another reason could be competing with other students, especially in courses where the students join from various study stages (Weber, Lehr and Gersch, 2014; Wong and Schoech, 2007). Teachers should keep these different motivations in mind while developing course assignments and hence set intrinsic incentives (Kummer, 2013).

2.3 Group formation

Approximately half of the analysed literature mentions the group formation process at the beginning of the online course. There is currently disagreement within the community about whether the forming of groups should be driven by instructors, the students, or through an automated system. The formation could be based on the students:

- profiles of their strength and weaknesses (Gersch, Lehr and Weber, 2011; Weber, Lehr and Gersch, 2014),
- level of expertise or interest in a specific topic or field of study (Murphy, Gazi and Cifuentes, 2007; Smith, Teschner and Bullock, 2018),
- command of English (Murphy, Gazi and Cifuentes, 2007),
- gender, geographic location, timely availability and time zone (Heebøll, 2017; Flammia, Cleary and Slattery, 2010; Johnson et al, 2001).

Kavanagh et al (2012) tried the modus of self-selected groups. After two weeks they used an electronic allocation process based on demographics for the students who could not find a team. However, they rated the late group formation as a rather hindering factor in the semester-long team process. Another option is to use a random team generator (Ragan, 2007; Heebøll, 2017; DeLong and Vander Schee, 2020). Gersch, Lehr and Weber (2011) appointed group leaders, based on their individual profiles, who then recruited their teammates.

Still, to avoid culture homophily teachers should distribute the students from different countries throughout the teams (Gersch, Lehr and Weber, 2011) as participants sharing the same culture tend to interact among themselves (Stepanyan, Mather and Dalrymple, 2014). Sadykova and Dautermann (2009) mention that "various cultures have different processes for making a decision in a group". An overrepresentation of one culture in a team will most likely impede collaboration (Gersch, Lehr and Weber, 2011; Sadykova and Dautermann, 2009), if for example the majority of the group speaks only their language and one person cannot understand them (Popov et al, 2012). Students need to understand how and why they were divided (Kavanagh et al, 2012).

2.4 Course objective

In order to fully commit to this kind of international collaborative learning environment students have to understand the rationale of the course. Apart from a description of the final examination and course goals, the purpose of intercultural virtual learning has to be made transparent through learning outcomes (Starke-Meyerring and Andrews, 2006; Ragan, 2007; Gersch, Lehr and Weber, 2011; Kavanagh et al, 2012; Hayes, 2014; Heebøll, 2017; Collins, Weber and Zambrano, 2014; Sadykova and Dautermann, 2009; Bohemia, Harman and Lauche, 2009) to prevent any confusion, uncertainty or even anxiety (Tawileh, 2016; Bohemia, Harman and Lauche, 2009). First of all, students must understand the interdependences to collaborate (Murphy, Gazi and Cifuentes, 2007). Second, it is also important to explicitly declare intercultural learning a learning objective (Painter-Morland et al, 2003; Murphy, Gazi and Cifuentes, 2007). An explanation of the courses' purpose and learning outcomes could be elucidated in brief readings, videos, mini lectures (Hayes, 2014; Rohrweck, 2017), a pre-course quiz (Rohrweck, 2017) or if possible in offline meetings (Tawileh, 2016). Meaningful activities like self-portraits can support this to minimize cultural and geographic distance (Murphy, Gazi and Cifuentes, 2007; Collins, Weber and Zambrano, 2014; Bohemia, Harman and Lauche, 2009). Third, the students have to work towards a common goal respectively on a final product which can only be developed through the contribution of all group members. Working on a shared objective will help them advance collective knowledge and skills (Heebøll, 2017). DiGiano, Goldman and Chorost (2008) call it the "joint problem space".

2.5 Team and community building

Bonding and socializing are crucial factors in the success of virtual intercultural teams (Heebøll, 2017; Collins, Weber and Zambrano, 2014). In order to realize team and community building, teachers need to foster exchange and induce a first reflection phase from the very beginning of the course (DiGiano, Goldman and Chorost, 2008; Stepanyan, Mather and Dalrymple, 2014; Tervaskanto-Mäentausta, 2018; Guenther, White and Stechemesser, no date; Collins, Weber and Zambrano, 2014; Rohrweck, 2017). A prerequisite for group cohesion is a fundament of trust (ibid.; Flammia, Cleary and Slattery, 2010; Kummer, 2013; Sadykova and Dautermann, 2009; Collins, Weber and Zambrano, 2014). Therefore, many of the authors suggest, after a personal introduction, which can be supported by tools mentioned in 2.6, to develop group agreements or contract as part of the course assignment (Starke-Meyerring and Andrews, 2006; Heebøll, 2017; Hayes, 2014; Guenther, White and Stechemesser, no date; Johnson et al, 2001; Jones et al, 2013) which will also give them more responsibility for their learning process. These policies could include communication rules, the technology choices, task division, timing, and deadlines. They can help document the shared group expectations and be prepared in case of conflict (Kavanagh et al, 2012; Collins, Weber and Zambrano, 2014).

Teachers can support the development of the group policies by handing out theory-oriented frameworks on teamwork, e.g., Caspersz, Skene and Wu, 2006; Belbin, 1981 or/and Tuckmann, 1965 (Kavanagh et al, 2012). To establish a shared team culture, it might be useful to create a team name that ideally reflects the teams' mission (Starke-Meyerring and Andrews, 2006; Bohemia, Harman and Lauche, 2009). DiGiano, Goldman and Chorost (2008) suggest that including external actors (e.g. project partners) into the group meetings will strengthen the team spirit as the students have to position themselves as team x. Including an initial reflection on the teams heterogeneity in terms of culture, but also individual strength and weaknesses, learning styles (Grosse, 2002; Ragan, 2007; Eisenberg and Scheffer, 2008; Stepanyan, Mather and Dalrymple, 2014; Jones et al, 2013) can help to reduce the rigidity and definition of gender roles and power distance of intercultural settings (Murphy, Gazi and Cifuentes, 2007). Moreover, a discussion of the students' expectations can, if adequately moderated, contrast worldviews (ibid.). Ideally, the students already had the chance to reflect on their personal traits and experience with teamwork in a pre-course and can built upon their knowledge at the beginning of the actual teamwork (Kavanagh et al, 2012).

Another option is to engage students in reflection through individual or group journals right after the team formation (DiGiano, Goldman and Chorost, 2008; Bohemia, Harman and Lauche, 2009; Sadykova and Dautermann, 2009). Consequentially, the team can negotiate and distribute the different team roles (e.g. project manager, editor, researcher) (Grosse, 2002; Gersch, Lehr and Weber, 2011; Kummer, 2013; Guenther, White and Stechemesser, no date; Weber, Lehr and Gersch, 2014; Collins, Weber and Zambrano, 2014; DeLong and Vander Schee, 2020) as some students might struggle to find their own role in the team (Tervaskanto-Mäentausta, 2018). Groups using their strength to fully extend and divide the tasks accordingly tend to be more satisfied with the whole learning experience (Flammia, Cleary and Slattery, 2010; DeLong and Vander Schee, 2020). Dividing tasks and focusing on each team member's strengths can also avoid social loathing (Heebøll, 2017). At the same time, it might also be an option to select a team leader to build the initial lines of communication but change the position over time so that everybody can practice leadership (Flammia, Cleary and Slattery, 2010; Johnson et al, 2001).

For structured interactions teachers can outline task interdependence around the assignments, so that all group members build on each other's work (Starke-Meyerring and Andrews, 2006; Kummer, 2013). This way collaboration instead of competition will be encouraged, and a shared experience is created (Murphy, Gazi and Cifuentes, 2007; Reeves and Gomm, 2015).

At the same time teachers have to allow the virtual teams the time to develop social connections in the early stages of collaboration (Flammia, Cleary and Slattery, 2010; Kummer, 2013) even formulate mandatory bonding assignments, e.g., by using team quizzes or ice breaker questions (Heebøll, 2017). Flammia, Cleary and Slattery

(2010) found that the most successful teams established socioemotional communication early on in their project. Teams also benefit from face-to-face meetings, at the beginning, to build relationships and get to know each other better (Grosse, 2002).

Furthermore, group learning can be supported by continuous external feedback through the teacher or student tutors who discuss the group's working process and challenges (Gersch, Lehr and Weber, 2011; Smith, Teschner and Bullock, 2018; Sadykova and Dautermann, 2009). Additionally, teachers can provide checklists or tools of regulative practices to stir reflection (Hayes, 2014).

2.6 Tools

In a preliminary investigation of appropriate online tools for the onboarding of students in intercultural collaborative learning settings, we found two software options that provide a possible alternative to face-to-face meetings. *wonder.me*, a tool created for online conferences and other virtual meetings for bigger groups, creates a social space in a virtual environment and an atmosphere where people can spontaneously meet and chat. By combining videoconferencing and gamification, *gather.town* recreates real-world interaction in rooms (like pubs, offices, etc.). Both tools provide avatars with which users can move around to and from other people. However, additional effort is needed to set up the rooms in both tools. As most online courses use LMS, teachers can combine the LMS course with the usual videoconferencing software and add other tools onboarding for students. Suitable tools we identified are:

- tscheck.in or checkin.daresay.io with questions for getting to know each other
- name-generator.org.uk/team a name generator for teams
- Kahoot.com or genial.ly for team contests and quizzes
- skribbl.io, a multiplayer drawing and guessing game
- a variety of whiteboards like creately.com, miro.com, mural.co, groupmap.com, ideaboardz.com, linoit.com, jamboard.google.com and padlet.com that can be used to support icebreaking activities

3. Discussion

The analysis has revealed the complexity of intercultural collaborative virtual learning environments. Existing literature shows which factors support the introduction of such learning settings to the students.

Besides typical technological problems like bandwidth, equipment, and interface, it is essential to facilitate training on the technological setup and clarify the benefits of using specific tools or use environments that the students are already familiar with. Providing a secure space in which they can easily work together will further support collaboration. Few studies evaluated the effect certain tools had on the onboarding process.

A virtual platform with background information on the course will provide an orientation for the students. In addition, the teacher should provide structured guidance at the beginning of the course and clarify intercultural, team, and virtual learning outcomes. Rather than dominating student collaboration, teachers should guide the students through their teamwork and act as consultants in their learning process. At the same time, teachers need to facilitate intercultural learning, raise awareness on language barriers and find solutions for team conversations on equal terms.

Focus must be laid on the group formation process, which should be made transparent to the students. A good mixture of different cultures and personal skills, abilities, and attitudes towards work and collaboration are crucial. The group's composition should quickly be reflected after its formation to determine team roles. Most of all, it is important to build up trust and confidence within the team. The literature recommends a student-driven development of group agreements and communication guidelines. Successful teamwork is guaranteed when bonding activities have taken place and social connections have been established. If no personal contact is possible during the course, the teachers should generate meeting places that preferably recreate an authentic environment where social connections can grow. A tool like gather.town might be useful in this context.

Concrete examples for onboarding strategies and didactical concepts and the use and combination of certain tools could not be found in the reviewed literature. Also there is no mentioning of creating fun factors for the students as a possible motivation for the collaborative course. Moreover, there is little evidence on how to establish self-driven teambuilding through e-learning tools and automated systems.

In general, we noticed that nine of the 31 results are older than 2010. We included them nevertheless, as many of the didactical aspects like the general facilitation and especially teambuilding and the socialization process are still relevant nowadays (e.g. DiGiano, Goldman and Chorost, 2008).

4. Conclusion

Our literature review summed up the most important aspects of designing and conducting an onboarding experience for international collaborative online courses between higher education institutions. Therefore, it provides possible starting points for teachers, developers, and researchers.

Based on the results, teachers can conceptualise and test new onboarding strategies for students. Through teaching evaluation, they could validate the outcomes of the study.

Learning technology designers and developers must understand the importance of team building and social activities in collaborative learning environments. They need to bear in mind that motivational aspects, especially at the beginning of the course, will foster enthusiasm for the whole course. Therefore, including elements that create fun is beneficial to collaborative learning settings. The results could be used to create a concept for onboarding intercultural teams in an inquiry-based learning course that includes suggestions and improvements for technical learning environments such as gamification and interaction options in 3D space or adopted profile matching supported by artificial intelligence.

For researchers, we provide a basis for further inquiries through the testing and evaluation of onboarding tools. We also suggest future studies to explore both quantitative and qualitative perspectives on student onboarding. Investigating a more detailed view on the students' experiences of certain onboarding strategies and tools could be conducted through in-depth group interviews. Additionally, it would be interesting to interview teachers and include their didactical and practical expertise. Quantitative surveys could throw more light on how onboarding impacts the team's experience and the final result of their teamwork.

References

Bohemia, E., Harman, K. and Lauche, K. (2009) *The Global Studio: linking research and teaching*. Amsterdam: IOS Press.

Collins, D., Weber, J. and Zambrano, R. (2014) "Teaching business ethics online: Perspectives on course design, delivery, student engagement, and assessment", *Journal of Business Ethics*, 125(3), pp. 513-529.

DeLong, D. F. and Vander Schee, B.A. (2020) "Team Role clarification: Improving student group performance in principles of marketing" in Hochradel, R. and Stovall, T. (ed.) *2020 MMA Conference: A Virtual Experience Proceedings*, pp. 51-52.

DiGiano, C., Goldman, S., and Chorost, M. (Eds.) (2008) *Educating learning technology designers: guiding and inspiring creators of innovative educational tools*. New York: Routledge.

Ehoff, C., Helmi, D. G. and Duangploy, O. (2002) "Four Platforms For Teaching Online Discussed: NOVA Southeastern University, University Of Maryland University College, Strayer University, And The University Of Phoenix", *International Business and Economics Research Journal (IBER)*, 1(3), pp. 15-24.

Eisenberg, M., and Scheffer, C. (2008) *Sustainable Economy for the Amazon Rainforest by Internet-based Engineering Education on Sustainability in Global Engineering Teams*. Available at: https://www.researchgate.net/profile/Marco_Eisenberg/publication/229020044_Sustainable_Economy_for_the_Amazon_Rainforest_by_Internet-based_Engineering_Education_on_Sustainability_in_Global_Engineering_Teams/links/00b7d521dff88bfbc9000000.pdf (Accessed: 22 May 2021)

Flammia, M., Cleary, Y., and Slattery, D. M. (2010) "Leadership roles, socioemotional communication strategies, and technology use of Irish and US students in virtual teams." *IEEE Transactions on Professional Communication*, 53(2), pp. 89-101.

Gersch, M., Lehr, C., and Weber, P. (2011) "Virtual Collaborative Learning in International Settings–The Virtual Seminar 'Net Economy'", in *5th International Technology, Education and Development Conference, INTED2011 Proceedings*, pp. 5078-5085.

Grosse, C.U. (2002) "Managing communication within virtual intercultural teams", *Business Communication Quarterly*, *65*(4), pp. 22-38.

Guenther, E., White, M. and Stechemesser, K. (no date) *Investing in a sustainable future*, TU Dresden, Available at: https://tu-dresden.de/bu/wirtschaft/bwl/bu/ressourcen/dateien/forschung/download/dateien/investing_in_a_sustainable_future.pdf?lang=de (Accessed: 24 May 2021)

Hayes, S. (2014) *A Mixed methods study of shared epistemic agency in team projects in an online baccalaureate nursing course*. State University of New York at Albany. Available at: https://www.academia.edu/download/37665877/Hayes_Final_Dec_9.pdf, (Accessed 23 May 2021)

Heebøll, J. (2017) *A Completely Digital University Course*, Report on design and findings from an experimental digital course at Technical University of Denmark, Available at: https://www.deic.dk/sites/default/files/uploads/PDF/A_Completely_Digital_University_Course.pdf (Accessed: 21 May 2021)

Herzog, M.A., Franz, L., Katzlinger, E., and Stabauer, M. (2018) "CROSSTEACHING: Interuniversity Research-Based Learning in Virtual Teams", in Remenyi, D. (ed.) *4th E-Learning Excellence Awards 2018: an anthology of case histories*, Reading: Academic Conferences and publishing limited.

Johnson, S.D., Berrett, J.V., Suriya, Ch., Yoon, S.W., and La Fleur, J. (2001) "Team Development and Group Processes of Virtual Learning Teams" in *Academy of Human Resource Development (AHRD) Conference Proceedings* (Tulsa, Oklahoma), pp. 11-18.

Jones, B.D., Epler, C.M., Mokri, P., Bryant, L.H., and Paretti, M.C. (2013) "The effects of a collaborative problem-based learning experience on students' motivation in engineering capstone courses", *Interdisciplinary Journal of Problem-Based Learning,* 7(2), Available at: https://doi.org/10.7771/1541-5015.1344 (Accessed: 24 May 2021)

Kavanagh, M., Sargent, L., Caspersz, D., and Levak, N. (2012) *Business education in the 21st century: Examining the antecedents and consequences of student team virtuality. Final Report 2012*, Available at: https://ltr.edu.au/resources/CG8_702_Kavanagh_Report_2012.pdf (Accessed: 15 May 2021)

Kummer, C. (2013) *Factors Influencing Wiki Collaboration in Higher Education*, Available at: http://dx.doi.org/10.2139/ssrn.2208522 (Accessed: 16 May 2021)

Murphy, K.L., Gazi, Y., and Cifuentes, L. (2007) "Intercultural collaborative project-based learning in online environments", in Khan, B. H. (ed.) *Flexible learning in an information society*, IGI Global, pp. 50-63.

Painter-Morland, M., Fontrodona, J., Hoffman, W. M., and Rowe, M. (2003) "Conversations across continents: Teaching business ethics online", *Journal of Business Ethics*, *48*(1), pp. 75-88.

Popov, V., Brinkman, D., Biemans, H. J., Mulder, M., Kuznetsov, A., and Noroozi, O. (2012) "Multicultural student group work in higher education: An explorative case study on challenges as perceived by students", *International Journal of Intercultural Relations*, 36(2), pp. 302-317.

Ragan, L. (2007) *Best practices in online teaching*, Available at: https://dspace.plu.edu/xmlui/bitstream/handle/10989/18/col10453.pdf?sequence=1 (Accessed: 16 May 2021)

Reeves, T. and Gomm, P. (2015) "Community and contribution: Factors motivating students to participate in an extra-curricular online activity and implications for learning", *E-Learning and Digital Media*, 12(3-4), pp. 391-409.

Rohrweck, J. (2017) "Guiding web-based self-study in accounting basics: Case: Lahti University of Applied Sciences", Available at: https://www.theseus.fi/bitstream/handle/10024/123398/Rohrweck_Johanna.pdf?sequence=1andisAllowed=y (Accessed: 14 May 2021)

Sadykova, G., and Dautermann, J. (2009) "Crossing cultures and borders in international online distance higher education", *Journal of Asynchronous Learning Networks*, 13(2), pp. 89-114.

Smith, N.M., Teschner, B. A., and Bullock, R. (2018) "Bringing sustainable development challenges into the engineering classroom: Applying human centered design protocols to artisanal and small-scale mining", *Proceedings of the ASEE Annual Conference and Exposition*, Available at: https://peer.asee.org/30159.pdf (Accessed: 15 May 2021)

Starke-Meyerring, D. and Andrews, D. (2006) "Building a shared virtual learning culture: An international classroom partnership", *Business Communication Quarterly*, 69(1), pp. 25-49.

Stepanyan, K., Mather, R. and Dalrymple, R. (2014) "Culture, role and group work: A social network analysis perspective on an online collaborative course", *British Journal of Educational Technology*, 4(45, pp 676-693.

Tawileh, W. (2016) "Virtual International Learning Experience in Formal Higher Education–A Case Study from Jordan", *Knowledge Communities in Online Education and (Visual) Knowledge Management*, 105-116.

Tervaskanto-Mäentausta, T. (2018) *Education during undergraduate medical and health care studies*, Available at: http://jultika.oulu.fi/files/isbn9789526218571.pdf (Accessed: 18 May 2021)

Tranfield, D., Denyer, D. and Smart, P. (2003) "Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review", *British Journal of Management*, 14(3), pp. 207-222.

Weber, P., Lehr, C. and Gersch, M. (2014) "Improving Virtual Collaborative Learning through Canonical Action Research", *Electronic Journal of e-Learning* 12(4), pp. 326-338.

Wong, Y.C. and Schoech, D. (2007) "Lessons Learned in Chat Room Teaching Internationally", *Journal of Technology in Human Services*, 25(1-2), pp. 59-83.

Conceptual Recommendations for Collaborative and Experience-Based Learning in Virtual Environments

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DOI: 10.34190/EEL.21.063

Abstract: This paper presents conceptual reflexions and technological recommendations for the development of virtual environments (VE) in the context of collaborative and experience-based learning. During the COVID-19 pandemic, the need for remote collaborative virtual reality environments (VRE) in the educational sector significantly raised, therefore the ongoing research and development efforts increased especially on VRE for student learning groups. Hence, we reflect on social presence as a key factor for the design of virtual laboratories to support experience-based learning in groups. The concept of social presence is an important factor for trust in remote teams as a basis for meaningful experiences in learning labs. In this context, we develop conceptual structure to design a VR-Lab by following three steps. First, discussing theoretical and empirical findings on social presence with respect to learning processes and group work. Concerning these findings, we explore the relevance of design components for social presence in VRE. Second, we derive an analysis grid of components and their dimensions of design concepts for social presence in VRE. Additionally, we rate their potential to support collaborative and experience-based learning. Third, based on the evolved analytical framework we discuss existing technological concepts, prototypes and use cases to implement collaborative VRE with regards to their effect on social presence within learning processes. Summarizing all these findings leads to a set of conceptual recommendations for the design and realization of a VR-Lab for learning groups with a focus on social presence.

Keywords: collaborative learning environments, social presence, virtual environments, technological modalities of virtual environments, avatar, interactivity

1. Introduction

After more than one year of rather improvised distance learning forced by the COVID-19 pandemic, German universities realise the urgent need to catch up for a systematic integration of digital learning systems from a technological as well as pedagogical perspective. Within the huge field of discussing e-learning systems in higher education, we focus on virtual laboratories, as we regard experience based collaborative development and exploration as a core aspect of teaching and learning in applied sciences.

In the following discussion we want to integrate existing findings with concern to the question which concepts of human-computer-human and human-computer interaction in VEs sustain collaborative learning on the one hand and which technological modalities do correlate with these concepts on the other hand.

The aim is to develop a first version of a conceptual framework, by prioritising different conceptual aspects and related technological possibilities, in order to support decisions for one technological approach versus another. In analogy to the framework presented by Elliott, Gardner and Alrashidi (2012), we try to merge media, scientific and technological findings with less focus on different pedagogical perspectives, as provided in their suggestion. Further it is necessary to refer to the critical reflections by Hamilton et al. (2021). They show that methodological foundation with regard to pedagogical concepts behind VEs as well as for the evaluation of learning outcomes in order to support conceptual and technological decision is so far rather weak (Hamilton et al., 2021).

2. Collaborative learning in VE

In our understanding of collaborative learning in VEs there are two main directions to follow. The aspect of social interaction on one side and experience-based learning on the other side.

There is a broad consensus in scientific literature about the enhancing capacities of immersive virtual learning environments that go beyond the extrinsic needs for remote learning systems (see Hamilton et al. (2021)). Different pedagogical concepts such as constructivist or situationist learning approaches afford learning environments allowing to provide authentic tasks (see Dede, Jacobson and Richards (2017)). This situational and experiential learning type requires realistic settings. Whereby the specification of possible manifestations of realism depends on the learning issues and the particular design approaches, for example: simulation, constructivist activities, embodied cognition, directed immersive narrative, learning simpler material (Dede, Jacobson and Richards, 2017).

As Dede et al. (2017) outline, a further aspect of experience-based learning is that the social aspect of learning gets more important with regard to the less structured learning paths and more individual processes of meaning construction (see also Elliott and Gardner (2014)). The authors distinguish four types of immersion in learning contexts: actional, symbolic/narrative, sensory and social immersion (Dede, Jacobson and Richards, 2017). Immersive media environments can enhance both the actional, experiential aspect of learning and the social aspect of learning in a collaborative experience. Krämer (2017) goes one step further claiming that learning is inherently a social process and consequently cognitive activities should always be embedded in social structures (with reference to Vygotsky´s theory of learning and Bandura´s concept of the social cognitive background of learning processes (Bandura and McClelland, 1977; Brame and Biel, 2015)). Therefore, the question which media characteristics of VR-technologies can foster social presence as an essential quality of social interactions in VRE is a necessary precondition for effective learning design concepts.

2.1 Social presence as determinant of collaborative learning in VE

2.1.1 Clarifying the concept of social presence in immersive collaborative learning environments

Immersion and presence are closely related concepts. Hence, the concept of presence is and has been one of the essential aspects in research on immersive VEs for a long time (e.g. Ryan (1994)). Whereas immersion refers to an objectively measurable quality of a mediated environment, presence refers to the experience of being there (Slater, 2003; Oh, Bailenson and Welch, 2018). An early approach to examine the various factors influencing presence in mediated environments was the propinquity theory developed by Korzenny (1978). His theory postulates the relevance of characteristics of the communication medium, the communicated information as well as situative factors and personal capacities (Korzenny, 1978; Walther and Bazarova, 2008; Kluck, Stoyanova and Krämer, 2021). Additionally, Lee (2004) distinguishes physical, social and self-related experiences on the user´s side and mediated experiences in VE which are either with or without reference to extramedial phenomena, which can be relevant for discussing aspects of experienced realism vs. inherent consistency of a VE (Lee, 2004).

As our aim is to develop an evaluation of existing technological possibilities and related design concepts, we will focus on the medium-centric view on presence (see Oh et al, 2008). Presence then can be differentiated in telepresence or spatial presence, self-presence and social presence (Lee, 2004; Oh, Bailenson and Welch, 2018). Social presence is often equated with co-presence, but we would follow suggestions to see social presence as the more complex construct than co-presence (Bente et al., 2008; Poeschl and Doering, 2015). According to Poeschl and Doering (2015) social presence occurs in a VE, when the users experience an access to the “intelligence, intentions and sensory impressions of another” (Poeschl and Doering, 2015). Therefore, it includes aspects of co-presence (being there with another person as sensory perception), psychological involvement and behavioural engagement (Poeschl and Doering, 2015).

Besides this theoretical perspective on the social aspects of learning processes, different empirical findings emphasise social interdependence as a positive factor of cooperation on one side and immersiveness in VEs on the other side (e.g. Wienrich et al. (2018)). Bente et al. (2008) focussed on social presence as antecedent for trust in remote teams and showed the importance of nonverbal behaviours (see also below). Considering the complexity of the given interconnected features, assumingly social presence will be closely related to other concepts of presence as well, which will be discussed partly in the sections below.

2.1.2 Categories and determinants for social presence in VE

In order to examine the influence of design concepts and technological features on social presence on a more concrete basis, we have to break down the concept in different aspects of social interaction and collaboration within VEs. Bente et al. (2008) distinguished seven different aspects in order to measure social presence in relation to different media channels used in remote collaboration. While Oh et al. (2018) defined in their metastudy on social presence in VEs five categories:

- Depth cues / Spatial Presence
- Audio Quality / Sound
- Haptic Feedback
- Virtual Representation of Actors
- Interactivity

We will follow these categories and supplement them by matching additional findings on social presence within the different aspects of VEs.

2.1.3 Depth cues / spatial presence

As discussed, social presence is closely related to the concept of co-presence. Co-presence is understood here as situated communication in shared spaces and through shared objects (see Bente et al. (2008)). Therefore, the experience of spatial relations or spatial presence as components of shared environments should be considered. Bente et al. (2008) state that avatar based interactions in VEs enable the inclusion of spatial dimensions (Bente et al., 2008). They show that shared information on space and objects allow participants to make inferences about possible perceptions, interests, mental construction of possible activities and motoric actions (Bente et al., 2008). The coordination of locomotive actions or object handling is supported by nonverbal cues, such as deictic gestures, gaze and body orientation (Bente et al., 2008; Gill, 2008). Hence, it can be assumed that an inclusion of these aspects with three dimensional characteristics of movement, bodies and motoric activities in VEs would be an important aspect. However, there were no explicit empiric results towards the importance of spatial dimensions of bodily or object-driven interactions in the conducted study of Bente et al. (2008).

Research on correlations between spatial presence and information processing indicate that high levels of experienced spatial presence increase persuasive effects of the presented content (Breves, 2021) and therefore can be evaluated as enhancive for learning processes in VE. Hofer et al. (2020) conducted an experimental research based on the assumption that plausibility might interfere with spatial presence. However, their study could not underpin their theoretical assumption. On the contrary, they highlighted the strong effect of spatial perception in 3D-environments, which seems to cover up perceived implausibility (Hofer et al., 2020). This would also point towards the relevance of 3D-perceptions as a factor for spatial presence, which then might foster nonverbal communication aspects as an important part of social presence as well as the involvement in learning experiences based on the strongness of the spatial perception.

2.1.4 Virtual representation of actors

Regarding the representation of actors, the most important factors are firstly the presence of a visual representation and secondly the behavioural realism (Oh, Bailenson and Welch, 2018). Bente et al. (2008) noted that social presence relates on nonverbal cues and relational information. Also Oh et al. (2018) report the high significance of a realistic nonverbal behaviour for social presence (e.g. mimic gestures as nodding, or involuntary reactions as blushing) (Oh, Bailenson and Welch, 2018). Further, they imply that the importance of behavioural realism may indicate why there are no positive results for avatar-based VR-systems in relation to social presence so far (Oh, Bailenson and Welch, 2018). Bente et al. (2008) present an in-depth analysis of communication behaviour (e.g. head movement, gaze directions) within different modes of communication channels and representation (text, audio, video and avatar). Idrus et al. (2010) examine social awareness in relation to communication elements of digital environments. They distinguished eight awareness types: presence, turn-taking, identity, contextual, conversational, state and role and examined different application with regard to the used communication channels (text, audio-video, 2D graphic, 3D graphic) and showed that text is still the dominant channel for communication (Idrus et al., 2010).

These results indicate that there are no clear differences between a video-based and an avatar-driven representation of the participants, as both seem to foster nonverbal behaviour (Bente et al., 2008). Nonverbal activity and visual attention were in both modalities more or less similarly high. Bente et al. (2008) discuss the possibility that participants unconsciously comply with social rules to make use of gaze and mimic or gestural behaviour, when assumed that they can be seen from the involved communicators. According to Gill (2008) regarding embodied cognition, it can be assumed that body movements and bodily gestures do have an important impact on the cognitive and emotional processes of the addressing communicators, as well as they are essential for mutual coordination and synchronization in collaborative activities.

While the discussed concepts focus on realistic representations, Krämer (2017) emphasizes the possibilities to improve social presence by means of computer-mediated environments which go beyond natural perception. Social presence can be fostered by: alteration or enhancement of nonverbal behaviour (e.g. an intensified smile of an avatar); by the impact of a direct gaze (e.g. of a presenter on its audience, which can be simultaneously addressed to every participant individually); and by the proteus effect, the positive effect on engagement or trust when participants perceive each other more similar to themselves by altered avatars (Krämer, 2017);

2.1.5 Audio quality / sound

The level of audio quality and the auditive presence of social agents increases social presence in VE (Oh, Bailenson and Welch, 2018). Grassini and Laumann (2020) report that results of a study from Lee, Bruder and Welch (2017) indicate a positive influence of sound for presence in general in relation to a mute condition. The condition of combined vibration and sound however achieved a higher rating of social presence, than the sound condition (Lee, Bruder and Welch, 2017). Kern and Ellermeier (2020) conducted an experimental study to exploit the effect of sound on presence in VE. In their theoretical discussion they refer to the work of Ramsdell, who structures hearing in three levels: social level, signal level and primitive level (Kern and Ellermeier, 2020). Their study focuses on the primitive level, but for further research on concepts of sound as for collaborative learning in VE it seems promising to pursue this structure, in order to discuss relevant findings on sound effects. Their research approach distinguishes between a general sound atmosphere and impulse-driven sound events, as triggered by steps or other activities (Kern and Ellermeier, 2020). Due to technical effects of imperfect sound synchronicity regarding the impulse-driven sound, the results might not be fully reliable. However, their findings indicate that a general sound atmosphere leads to higher effects on presence than impulse-driven sound effects especially with respect to involvement and immersiveness as subscale of presence (Kern and Ellermeier, 2020).

2.1.6 Interactivity

Interactivity can be related to interactional processes with the VE (space, objects, interface etc.) or to the mediated interactions with other participants. Therefore, social interactions rely on mediated features. In their metastudy Oh et al. (2018) summarize, that interactivity increases social presence in the field of low and medium level interactivity, but is plateaued for medium and high levels of interactivity. Analysing social presence and learning satisfaction three dimensions of social presence were found to be important by Oyarzun et al. (2018): social context, online communication and interactivity. They showed also that there is no clear evidence which strategies for collaborative VE will be best to enhance social presence (Oyarzun et al., 2018). And Further Bente et al. (2008) and Poeschl and Doering (2015) outline that specific characteristics and degrees of interactivity affect the feeling of social connectedness with other persons in VEs. Poeschl and Doering (2015) report the importance of perceived reactions of virtual agents as an important factor and even the impression of interaction possibilities as relevant components. A result of the study by Bente et al. (2008) is that real-time channels positively affect the experience of social closeness and co-presence, and surprisingly with no significant differences according to the media format (audio, video or avatar).

Social interdependence is reported as a significant factor for social presence in collaborative VEs, as it facilitates team cooperation and “mutual importance” or shared concerns, which in consequence increase achievement and retention in learning contexts (Johnson and Johnson, 1989; Wienrich et al., 2018). Wienrich et al. (2018) conducted a study on social presence within a collaborative scenario in a large-scale multi-user VRE. A result of their study is that symmetric systems in which the team members perform highly interdependent tasks increase the feeling of social presence, foster team cooperation and lead to more enjoyment than non-interdependent and asynchronous interactions (Wienrich et al., 2018). The synchronicity increases affective responses which in turn increase the feeling of presence (Wienrich et al., 2018). These findings can be related to investigations on engagement in live media. Haimson and Tang (2017) outlined that the feeling of presence in live media streams is closely related to the perception of other participants as an inherent part of the process (Haimson and Tang, 2017). Therefore, sociality and interactivity were stated as key aspects for engagement in live environments (Haimson and Tang, 2017).

2.1.7 Haptic feedback

There is solid empirical evidence that haptic feedback fosters social presence in collaborative environments[1]. Grassini and Laumann (2020) stated that vibration is positively correlated to social presence and seems to have more influence than sound. Haptic feedback is seen as an essential quality for an authentic experience when interacting with objects in VE (Hite et al., 2019). It will increase the perception of presence and allow more realism and fidelity by involving body interactions (Hite et al., 2019). Gill and Borchers (2008) identified the importance of haptic sensations combined with social gestures for cognitive processes of the individuals, as well as interpersonal understanding in collaborative processes and activities (Gill and Borchers, 2008).

[1] It is necessary to note, that this conclusion might contain a potential bias in the evaluated studies, because all of them relied on experiments with manual tasks.

Hamza-Lup and Stanescu (2010) discuss a framework for learning in VEs focusing on haptic technologies and their impact on learning processes. Their approach discusses the concept of cognitive presence in addition to social presence as an important aspect of learning in remote settings. Cognitive presence refers to the ability to create meaning through a reflective process, following four stages (triggering event, exploration, integration, achievement of resolution) (Hamza-Lup and Stanescu, 2010). Haptic experience can be divided in tactile feedback (as vibration) and force feedback (motions). They argue that haptic feedback is and should be an essential part of remote learning environments for several reasons (Hamza-Lup and Stanescu, 2010). Any additional sensory channel will enhance the learning experience, especially in explorative interactional settings. They point out that around 15% of the population are kinesthetic learners which, would essentially benefit from haptic experiences (Hamza-Lup and Stanescu, 2010). Further actual and upcoming learners' generation grew up with gaming interfaces and are used to haptic feedback (Hamza-Lup and Stanescu, 2010). Therefore, potential difficulties to adapt to these technologies will be reduced and the potential gain will be predominant.

3. Conclusion: Technological modalities to enhance social presence experiences in VE

With regard to the different aspects of social presence and technological modalities discussed above, the following tables summarizes relevant categories and possible manifestations in VE and also lists available existing findings about the impact on collaborative learning in VE. It is necessary to note that the given technologies are only examples to illustrate and highlight edge cases of the specific category. In general, the following principles seem to be relevant for distinguishing possible characteristics of technology-based concepts of collaborative learning in VE:

- absence/presence of certain channels or cues
- pertinence of cues and consistency: degree of interconnectedness or correlation of different cues
- reference of cues: Degree of referring to media-external phenomena (realism or arbitrariness)

To continue this research, it would be promising to describe certain use cases of experiential collaborative learning processes in VE, according to different teaching approaches associated with the methodological discussion on evaluating learning outcomes and learning processes.

Table 1: Category depth cues / spatial presence

Dimensions	Positive Effects	Technologies, Examples and Use Cases
from **none** to **full** 3D-perception	place illusion / spatial presence as enhancing factor for persuasiveness of content	By using augmented reality head mounted displays like the HoloLens 2 (https://www.microsoft.com /en-us/hololens). This system allows the creation of the illusion that virtual objects can interact with real objects. By using a VR system like Oculus Quest 2 head mounted display, supports spatial dimension to enter immersive 3D environments (https://www.oculus.com/quest-2/)
from **naturalistic** to **arbitrary** aspects of 3D-environments	No clear need for naturalistic consistency / plausibility - immersive power of 3D-perception overrules inconsistency	
from **2D** to **3D** spatial dimensions of interactions	3D enhances behavioural interactions and spatial presence with objects and avatars	

Table 2: Category virtual visual representation of actors

Dimensions	Positive Effects	Technologies, Examples and Use Cases
		Recorded videos, for example distributed via YouTube (https://youtube.com).

<table>
<tr><th>Dimensions</th><th>Positive Effects</th><th>Technologies, Examples and Use Cases</th></tr>
<tr><td rowspan="3">absence
or
presence</td><td rowspan="3">presence of visual representation</td><td>Display a mouse cursor on a screen or via video-projector as a 2D user representation within a Miro-board (https://miro.com).</td></tr>
<tr><td>Display of a computer-generated 3D-avatar on a 3D-screen using stereo image technology or creating a hologram like the Voxon system (https://voxon.com) by using a high-speed reciprocating screen.</td></tr>
<tr><td>Volumetric recording or movement synchronisation to computer-generated avatars. The Volucap system (https://volucap.de) for example, allows – by using multiply cameras – the generation of 3D copies from real-world objects.</td></tr>
<tr><td rowspan="6">from
naturalistic
to
arbitrary</td><td rowspan="5">behavioural contingency</td><td>The Azure Kinect (https://docs.microsoft.com/en-us/azure/Kinect-dk/) using multiply cameras and infrared laser-beams, which allows a position and rotation estimation of different body parts to determine a full body position.</td></tr>
<tr><td>Support through predictive gesture recognition (full body, mimic, hand, finger etc.). For example, by analysing camera images with neural networks to predict a certain hand gesture, e.g.: https://towardsdatascience.com/training-a-neural-network-to-detect-gestures-with-opencv-in-python-e09b0a12bdf1.</td></tr>
<tr><td>Support through eye-tracking, real-time face detection and gaze point estimation for mimic and gaze prediction. For example, the GazeRecorder (https://gazerecorder.com/) analysing web-cam images to predict a gaze point.</td></tr>
<tr><td>Using convolutional neural networks to determine a certain facial expression or mimic, e.g. https://github.com/amineHorseman/facial-expression-recognition -using-cnn</td></tr>
<tr><td>Video to audio mapping could support this as well. For example, by using the voice input to determine a certain lip position, e.g.: SALSA LipSync Tool (https://assetstore.unity.com/packages/tools/animation/ salsa-lipsync-suite-148442).</td></tr>
<tr><td>hyper realistic enhancement</td><td>This could be achieved by intensified mimic or personalised gaze. For example, Snapchat (https://snapchat.com) using different image filters to enhance video clips.</td></tr>
</table>

Table 3: Category: Audio

<table>
<tr><th>Dimensions</th><th>Positive Effects</th><th>Technologies, Examples and Use Cases</th></tr>
<tr><td>silence
or
sound</td><td>auditive presence of social agents</td><td rowspan="3">From a conceptional point of view, three different types of sounds can be determined: Social, Single and Primitive Level (atmospheric).

From a technological point of view the audio signals for all those levels will be processed in the same way. Therefore, other differentiation could be achieved, for example between Mono- sound and Stereo-sound.

Sound- or 3D-game-engines (e.g. Unity game engine: https://unity.com) create spatial sounds by manipulating audio signals in correspondence to the position of a virtual audio listener. Therefore, it creates the impression of a certain direction and distance to a specific audio source.</td></tr>
<tr><td>impulse-driven
or
atmospheric
sound</td><td>atmospheric sound supports social presence more than impulse-driven sound environments</td></tr>
<tr><td>from
non-spatialized
to
spatialized
sound</td><td>spatialized sound supports the social presence experience</td></tr>
</table>

Table 4: Category interactivity

Dimensions	Positive Effects	Technologies, Examples and Use Cases
from **no** to **rich** forms of interaction possibilities	higher potential of interaction possibilities	Possibilities of verbal and nonverbal interaction with objects, tools and/or other persons support this category, like the rich interaction possibilities within the social platforms Second Life (https://secondlife.com).
		Direct support of explorative learning and active experimentation, for example by simulating the (physically correctly) behaviour of objects, e.g.: Short Circuit VR (https://shortcircuitvr.com).
from **asynchronous** to **synchronous** interactions	synchronous social interactions	Supporting real-time verbal and nonverbal communication seems to have a positive effect in this category. For example, like Zoom (https://zoom.us) calls.
		Support real-time collaboration for example like in Google Docs (docs.google.com)

Table 5: Category haptic feedback

Dimensions	Positive Effects	Technologies, Examples and Use Cases
absence vs. **presence** of haptic or tactile feedback	presence of haptic or tactile feedback	to support experience-based learning with haptic cues the following haptic stimuli could be simulated: grasping virtual objects, experience virtual rendered textures, touching virtual objects, determining stiffness and softness of objects. The Project Microsoft CLAW (https://www.microsoft.com/en-us/research/publication/claw-multifunctional-handheld-virtual-reality-hap tic-controller/) is using a motorized arm that rotates the index finger relative to the palm to simulate force feedback. Additionally, a voice coil actuator in front of the index finger generates vibrations for simulating textures.
tactile and/or **force** feedback	no implications so far on differences with regard to impact on learning effectiveness	
from **non-combined** to **combined** inter-personal deictic gestures with haptic feedback	combination of haptic experience and bodily gestures enhances cognitive and creative activities in collaborative settings	To support those categories, remote participants should for example be able to simultaneously combine and place objects and point at them with hand finger gestures. The inForm (https://tangible.media.mit.edu/project/inform/) demonstrates such an interaction, by using multiple motorized pins aligned in a grid to create a pin-based screen which can display the outline of virtual 3D objects or hands and fingers.
from **non-pertinent** to **pertinent** visuo-haptic cues	haptic cues seem to be dominant to visual cues, haptic cues seem to foster (categorial) learning (children age) even if not pertinent to visual cues	
from **immersive VE** to **object-presence** with haptic-cues	Object-presence with haptic-cues (in a non-immersive VE) seems to have more impact on the user's behaviour when interacting with objects, than immersive VE without haptic experience	The Phantom Premium (https://www.3dsystems.com/haptics-devices/3d-systems-phantom-premium) is a haptic device which allows to grasp and experience virtual objects.

As a result, we can condense our findings into the following conclusion and give a short-term prospect on the next most promising setup for effective collaboration and experience-based learning VE.

First of all, our findings identified social presence as a key factor for trust in remote teams as a basis for meaningful experiences in collaborative and experience-based learning VEs. The analysis of potential factors and components of VR-Environments fostering the experience social presence was then differentiated in five categories: Depth Cues / Spatial Presence, Virtual Representation of Actors, Audio Quality / Sound, Interactivity and Haptic feedback. In a second step, we priories certain aspect of those categories according to positive effects and current affordable technologies. According to our findings most positive effects on the experience of social presence in VEs in the category of **Depth Cues / Spatial Presence** could be created by fostering the spatial experience of interaction with others, e.g. motoric activities, bodily movements and gestures or spatial interaction with relevant objects. Additional spatial experience in general enhances the persuasiveness of the content in VE. In the category **Virtual Representation of Actors**, the representation of nonverbal behaviour seems most important. This could be achieved by technologies, which support mimic behavioural representation and transfer nonverbal cues between participants. While in the category **Audio Quality / Sound**, it seems that current available technologies support already quite good spatial sound effects with a very high impact on the experience of immersion and social presence. However, it is necessary to note that unrealistic or imperfect impulse driven sounds can break the illusion quite easily. Therefore, we recommend focussing on atmospheric sound. In the category of **Interactivity**, technologies which supports real-time interactivity and create experience of social connectedness seems to be the most effective ones. Additionally, we could show that **Haptic Feedback** seems to play an important role for the experience of social presence. However, the technological investment and the rather complex integration into existing learning methodologies makes it very difficult to use beside fundamental research efforts.

These findings indicate on a short-term prospect that especially technologies virtual or augmented reality systems which will become capable of full body tracking and interpretation of gestures and mimic, as well as the support of understanding the surrounding environment and its containing objects combined with rich audio-visual capacities seems to have the highest impact on collaborative and experience-based learning VE in the near future. For example, could existing mobile virtual or augmented reality headsets (Oculus Quest 2 or Microsoft HoloLens 2) extend their possibilities of In-Side-Out and Out-Side-In-Tracking methods to a full limb-tracking. Additionally, those systems should include convolutional neural networks to interpret body movement and face expressions as well as objects in the surrounding environment. Even in an arbitrary designed and represented collaborative and experience-based learning VE would such an extended system create positive social presents experiences as long as the additional generated information will be used to transfer also all small nonverbal behaviour and cues between the participants.

References

Bandura, A. and McClelland, D.C., 1977. *Social Learning Theory*. Englewood cliffs Prentice Hall.

Bente, G., Rüggenberg, S., Krämer, N.C. and Eschenburg, F., 2008. Avatar-Mediated Networking: Increasing Social Presence and Interpersonal Trust in Net-Based Collaborations. *Human Communication Research*, 34(2), pp.287–318. https://doi.org/10.1111/j.1468-2958.2008.00322.x.

Brame, C.J. and Biel, R., 2015. *Setting up and facilitating group work: Using cooperative learning groups effectively. Vanderbilt University Center for Teaching*. Available at: <https://cft.vanderbilt.edu/guides-sub-pages/setting-up-and-facilitating-group-work-using-cooperative-learning-groups-effectively/> [Accessed 22 Apr. 2021].

Breves, P., 2021. Biased by being there: The persuasive impact of spatial presence on cognitive processing. *Computers in Human Behavior*, 119, pp.10–23. https://doi.org/10.1016/j.chb.2021.106723.

Dede, C.J., Jacobson, J. and Richards, J., 2017. Introduction: Virtual, Augmented, and Mixed Realities in Education. In: D. Liu, C. Dede, R. Huang and J. Richards, eds. *Virtual, Augmented, and Mixed Realities in Education*, Smart Computing and Intelligence. [online] Singapore: Springer.pp.1–16. https://doi.org/10.1007/978-981-10-5490-7_1.

Elliott, J.B., Gardner, M. and Alrashidi, M., 2012. Towards a framework for the design of mixed reality immersive education spaces. [online] Conference: 2nd European Immersive Education Summit. Paris, France.pp.63–76. Available at: <https://www.researchgate.net/publication/272164429_Towards_a_framew ork_for_the_design_of_mixed_reality_immersive_education_spaces> [Accessed 7 Jun. 2021].

Gardner, M.R. and Elliott, J.B., 2014. The Immersive Education Laboratory: understanding affordances, structuring experiences, and creating constructivist, collaborative processes, in mixed-reality smart environments. *EAI Endorsed Transactions on Future Intelligent Educational Environments*, 1(1), p.e6. https://doi.org/10.4108/fiee.1.1.e6.

Gill, S.P., 2008. Knowledge as Embodied Performance. In: S. Gill, ed. *Cognition, Communication and Interaction*, Human-Computer Interaction Series. [online] London: Springer London.pp.3–30. https://doi.org/10.1007/978-1-84628-927-9_1.

Gill, S.P. and Borchers, J., 2008. Knowledge in co-action: social intelligence in collaborative design activity. In: S. Gill, ed. *Cognition, Communication and Interaction*, Human-Computer Interaction Series. [online] London: Springer London.pp.38–55. https://doi.org/10.1007/978-1-84628-927-9_3.

Grassini, S. and Laumann, K., 2020. Questionnaire Measures and Physiological Correlates of Presence: A Systematic Review. *Frontiers in Psychology*, 11, p.349. https://doi.org/10.3389/fpsyg.2020.00349.

Haimson, O.L. and Tang, J.C., 2017. What Makes Live Events Engaging on Facebook Live, Periscope, and Snapchat. In: *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. [online] CHI '17: CHI Conference on Human Factors in Computing Systems. Denver Colorado USA: ACM.pp.48–60. https://doi.org/10.1145/3025453.3025642.

Hamilton, D., McKechnie, J., Edgerton, E. and Wilson, C., 2021. Immersive virtual reality as a pedagogical tool in education: a systematic literature review of quantitative learning outcomes and experimental design. *Journal of Computers in Education*, 8(1), pp.1–32. https://doi.org/10.1007/s40692-020-00169-2.

Hamza-Lup, F.G. and Stanescu, I.A., 2010. The haptic paradigm in education: Challenges and case studies. *The Internet and Higher Education*, 13(1–2), pp.78–81. https://doi.org/10.1016/j.iheduc.2009.12.004.

Hite, R.L., Jones, M.G., Childers, G.M., Ennes, M., Chesnutt, K., Pereyra, M. and Cayton, E., 2019. Investigating Potential Relationships Between Adolescents' Cognitive Development and Perceptions of Presence in 3-D, Haptic-Enabled, Virtual Reality Science Instruction. *Journal of Science Education and Technology*, 28(3), pp.265–284. https://doi.org/10.1007/s10956-018-9764-y.

Hofer, M., Hartmann, T., Eden, A., Ratan, R. and Hahn, L., 2020. The Role of Plausibility in the Experience of Spatial Presence in Virtual Environments. *Frontiers in Virtual Reality*, 1, p.2. https://doi.org/10.3389/frvir.2020.00002.

Idrus, Z., Zainal Abidin, S.Z., Hashim, R. and Omar, N., 2010. Social awareness: The power of digital elements in collaborative environment. In: *WSEAS Transactions on Computers*, 9(6). pp.644–653.

Johnson, D.W. and Johnson, R.T., 1989. *Cooperation and competition: theory and research*. 2. printing ed. Edina, Minn: Interaction Book Co.

Kern, A.C. and Ellermeier, W., 2020. Audio in VR: Effects of a Soundscape and Movement-Triggered Step Sounds on Presence. *Frontiers in Robotics and AI*, 7, p.20. https://doi.org/10.3389/frobt.2020.00020.

Kluck, J.P., Stoyanova, F. and Krämer, N.C., 2021. Putting the social back into physical distancing: The role of digital connections in a pandemic crisis. *International Journal of Psychology*, p.ijop.12746. https://doi.org/10.1002/ijop.12746.

Korzenny, F., 1978. A Theory of Electronic Propinquity: Mediated Communication in Organizations. *Communication Research*, 5(1), pp.3–24. https://doi.org/10.1177/009365027800500101.

Krämer, N.C., 2017. The Immersive Power of Social Interaction. In: D. Liu, C. Dede, R. Huang and J. Richards, eds. *Virtual, Augmented, and Mixed Realities in Education*, Smart Computing and Intelligence. [online] Singapore: Springer.pp.55–70. https://doi.org/10.1007/978-981-10-5490-7_4.

Lee, K.M., 2004. Presence, Explicated. *Communication Theory*, 14(1), pp.27–50. https://doi.org/10.1111/j.1468-2885.2004.tb00302.x.

Lee, M., Bruder, G. and Welch, G.F., 2017. Exploring the effect of vibrotactile feedback through the floor on social presence in an immersive virtual environment. In: *2017 IEEE Virtual Reality (VR)*. [online] 2017 IEEE Virtual Reality (VR). Los Angeles, CA, USA: IEEE.pp.105–111. https://doi.org/10.1109/VR.2017.7892237.

Oh, C.S., Bailenson, J.N. and Welch, G.F., 2018. A Systematic Review of Social Presence: Definition, Antecedents, and Implications. *Frontiers in Robotics and AI*, [online] 5. https://doi.org/10.3389/frobt.2018.00114.

Oyarzun, B., Stefaniak, J., Bol, L. and Morrison, G.R., 2018. Effects of learner-to-learner interactions on social presence, achievement and satisfaction. *Journal of Computing in Higher Education*, 30(1), pp.154–175. https://doi.org/10.1007/s12528-017-9157-x.

Poeschl, S. and Doering, N., 2015. Measuring Co-Presence and Social Presence in Virtual Environments - Psychometric Construction of a German Scale for a Fear of Public Speaking Scenario. *Studies in Health Technology and Informatics*, 219, pp.58–63.

Slater, M., 2003. *A Note on Presence Terminology*. Available at: <http://s3.amazonaws.com/publicationslist.org /data/melslater/ref-201/a%20note%20on%20presence%20terminology.pdf> [Accessed 16 Apr. 2021].

Walther, J.B. and Bazarova, N.N., 2008. Validation and Application of Electronic Propinquity Theory to Computer-Mediated Communication in Groups. *Communication Research*, 35(5), pp.622–645. https://doi.org/10.1177/0093650208321783.

Wienrich, C., Schindler, K., Dollinger, N., Kock, S. and Traupe, O., 2018. Social Presence and Cooperation in Large-Scale Multi-User Virtual Reality - The Relevance of Social Interdependence for Location-Based Environments. In: *2018 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*. [online] 2018 IEEE Conference on Virtual Reality and 3D User Interfaces (VR). Reutlingen: IEEE.pp.207–214. https://doi.org/10.1109/VR.2018.8446575.

Social Presence in Times of COVID-19 Distance Teaching

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DOI: 10.34190/EEL.21.013

Abstract: This paper presents a qualitative research study at an Austrian teacher training university. After having a look at the basic terms of Emergency Remote Teaching (ERT) and the concept of social presence, the study which was carried out from April to November 2020 is presented. Pre-service teachers were interviewed at two points of time (spring and fall 2020) about their experience with regards to switching all courses to Emergency Remote Teaching (which means changing from classroom teaching to online-teaching due to Covid-19 regulations). The interviews focused on the experience of social presence which means the perception of other people (university teachers and students) as individuals. The results show that students experienced changing to distance teaching as quite positive at the beginning. However, they suffered from lack of synchronous exchange. This is especially due to the fact that not all university teachers could cope with ERT and were not tangible for the students. Although the results are not representative, they give some interesting insight into the conditions under which online learning can be successful.

Keywords: emergency remote teaching, qualitative research, social presence, distance learning, Covid-19

1. Background and basic terms

When it comes to social presence, discussions about the term are discussed controversially. McLuhan (1992) sees the human being as being enhanced by technology and medium, as a being who changes his body by media and also finds new ways to change technology. Transferring lessons from classroom teaching to distance learning which had to take place at many universities worldwide over night was calling for using digital media more intensively in order to keep up successful learning for students without students and lecturers being at the same time at the same place. Although public discourse in Austria quite often used the term e-learning, the more appropriate term is emergency remote teaching (ERT) which is defined as "a temporary shift of instructional delivery to an alternate delivery mode due to crisis circumstances" (Hodges et al. 2020). This is due to the fact that e-learning and online teaching has a tradition in research and comprises detailed planning in advance as a core feature. The situation at universities when all teaching had to be changed into pure online teaching cannot be described as planned. Although blended learning had been developed at universities during the years before Covid-19 and different forms had been established (Alammary, Sheard & Carbone 2014), KPH Vienna/Krems did not have any form of e-learning. Seminars took place on site and the learning management system moodle which had already been established the years before, was only used for providing materials for students or for handing in tasks. Using moodle always was a voluntary option for lecturers and many seminars took place without an online platform. There was no online conferencing tool available for lecturers and students before April 2020.

Changing from classroom teaching to full distance learning basically over night does not provide any time for planning which is usually needed for e-learning or blended learning concepts (Schlesselman 2020). Thus, new challenges but also new chances arise – on a social and technological level – which need to be looked at (Ferri, Grifoni & Guzzo 2020). Apart from implementing synchronous or asynchronous sessions with various tools, assessment and exams are another challenge which has to be done considering different requirements (Rahim 2020). Learning should not be seen as unidirectional information transfer but as a social and cognitive process (Hodges et al. 2020). As Ferri, Grifoni & Guzzo (2020) state the obstacles that have to be overcome in online teaching and especially in ERT are on technological, pedagogical and social levels.

The concept of social presence is based on the social media theory by Short, Williams & Christie (1976, p. 65) who define the term as "the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships". This means effective communication depends on the possibilities of the medium used for interpersonal involvement. The intensity of social presence and the media used depend on each other. The more intensive acoustic, visual and physical contact is experienced by the participants of the communication the higher will be the involvement of all those participating. Media are put on dimensions regarding intimacy and synchronicity to explain their effect.

In a face-to-face seminar the physical presence of all participants is taken for granted. However, the term presence can also be seen in two different ways: the physical presence and a time dimension. This referso to social interaction which is the requirement for sharing physical surroundings at the same time in which people can react to each other (Goffman 2001). As Houben (2018) shows, traditional theories of sociology use the term of interaction by including bodily involvement (being physically present) and immediate accessibility as features. However, this factor is quite often only realized when the interaction does not take place in a face-to-face setting but is transferred into virtual space. Social presence thus means how participants in a communication are perceived as person from other participants. Factors influencing are gesture, facial expression, prosody, clothing and appearance. Short, Williams & Christie (1976) compared in their media-richness theory media mediated communication to face-to-face communication and stated how many features are kept / lost by using a specific medium. However, as the media mediated communication has been further developed, social presence cannot be seen as solid construct depending only on the medium but should rather be seen as dynamic concept (Kehrwald 2008).

During Covid-19 video conferencing tools were widely used. But even though these enable to transmit video and audio as well as enable sharing presentations, they do not offer the same perception as a face-to-face meeting. Kerres (2020) shows that information like temperature, smell and similar information about a room cannot be transmitted in a video conferencing tool. Moreover, eye contact is missing which makes turn-taking more difficult. The amount of simultaneous speaking in a face-to-face communication is less than 5 % because of all the clues we get that another person wants to speak (Levinson 2017). Although many video conferencing tools try to improve turn-taking by introducing symbols like hand raising, this is still a challenge in communication – especially for more introvert participants or those not being used to online communication. Kerres (2020) adds that watching ourselves (because of the webcam turned on) leads to distraction – distraction that already is there because everybody is sitting in her/his own room. Concentration on one's own behavior, own appearance leads to increased self-watching which results in less social interaction. Klier (2016), however, claims that creating virtual presence does not differ much from creating an analogue presence because the focus is on mental presence to get the attention of students. This, on the other hand, means that lecturers need to know about the characteristics of virtual presence in digital spaces.

2. Methodology

In order to find out about students' point of view regarding their experience of social presence during ERT-teaching in summer term 2020 and winter term 2020/21, a qualitative research design has been chosen. At two points (spring 2020 and fall 2020) students of KPH Vienna/Krems who volunteered for the interview were being asked via the online conferencing tool BigBlueButton suing a partly structured interview guideline. The interview guideline was acting as means to structure the interviews and get interview partners into talking. The students were able to focus on individual parts and could add information wherever they wanted (Lamnek & Krell 2016). The qualitative interviews are centered around a specific problem and thus follow the method of the problem focused interview according to Witzel (2000). All the students being interviewed were studying for becoming a primary school teacher (either Bachelor's or Master's degree). After having been informed by the university that interviews regarding distance learning will take place, interested students contacted the leader of the project to agree on an individual online interview. Only one person took part in interviews in summer and fall, all the other students only took part in one of the interview sessions.

2.1 Interviews in spring 2020

The interviews focused on three areas (using digital media in private areas, using digital media for university and students' assessment of situation at schools). This paper, however, only focuses on the second topic (using social media for university) which deals with students' experience in the first weeks of ERT at KPH Vienna/Krems, which challenges the students had to face due to rapid change from classroom teaching to distance learning. Altogether, 36 interviews were taken from the end of April until the beginning of June. The length of the interview is 30 minutes of average (being between 20 and 60 minutes). The following table shows the distribution of interviewed students as per gender and term. The bachelor courses take 8 terms and the master courses 2 (respectively 3) terms.

Table 1: Overview of participating students in summer term 2020

	BAC 2nd term	BAC 4th term	BAC 6th term	BAC 8th term	Master
female	3	6	7	5	10
male	3	0	0	1	1

2.2 Interviews in fall 2020

For these interviews the focus was put on two topics – first of all, looking back at the summer term 2020 including students' experience regarding ERT and second, a look forward to winter term 2020/21 which started with classroom teaching but had to be changed to distance learning two weeks after having started on 1st October. This contribution focuses on those questions which deal with experience of social presence: Which experience did students have with the online conferencing tools used? Which possibilities did they use for staying in contact with fellow students and lecturers? How did they experience feedback given by lecturers? Altogether, 33 interviews were carried out. At one interview appointment two students were interviewed (according to their wish) so that the total comprises 34 students being interviewed. The interviews took place between the beginning of October and beginning of December and took on average 30 minutes (varying in length between 20 and 60 minutes). The following table shows the distribution of the interviewed students as per gender and term.

Table 2: Overview of participating students in winter term 2020/21

	BAC 1st term	BAC 3rd term	BAC 5th term	BAC 7th term	Master
female	2	4	8	10	7
male	0	0	2	1	0

2.3 Limitations of the study

As students had to actively state that they wanted to take part in the interviews, the sample cannot be regarded as representative for the students at KPH Vienna/Krems. It can be assumed that only students registered who really wanted to talk about distance learning. However, all students who were interested in the interview were actually interviewed. The distribution of students according to the Bachelor's and Master's degree is similar to the distribution in general. Also the apparent underrepresentation of male students shows the actual gender distribution of students at KPH Vienna/Krems as the figures of male students (Bachelor's and Master's degree alike) are less than 10% of all students. The design of the study – qualitative interviews – shows limitations not only in reaching all students but it might also happen that students are too focused on some of the questions and forget about other relevant aspects. To level the disadvantage of using a semi-structured interview guideline the last questions asked for anything else that might be relevant from the students' point of view. In order to be able to compare the results of the interviews, all interviews (in spring and fall 2020) were carried out by the same interviewer.

2.4 Analysing the data

All interviews were recorded and transcribed, pseudonymized as well as structured and coded according to relevant topics by using the software MAXQDA (Flick 2016). The method of creating deductive and inductive categories was used: Categories were introduced according to the semi-structured interview guideline and transferred to the data (Mayring 2008). After that, the categories are revised starting from the data (inductive). The topics mentioned in the interviews are put on an abstract level and categories are introduced according to the wording used in the interviews (Mayring 2015; Mayring 2008).

3. Selected results

The following section presents chosen results of the study. Direct quotes from the students will be translated into English, the interviews are numbered, S stands for summer term 2020 and W for winter term 2020/21. The results only represent the point of view of the students, the point of view of the lecturers was not taken into account for that study.

3.1 Switching from classroom teaching to ERT

Transferring classes to ERT worked quite well in many areas according to the point of view of the interviewed students. Before ERT, digital media were not used extensively for teaching. The learn management system moodle has been used for some years at the university. However, the use was considered as voluntary and mostly was just to provide students with reading material. Due to the change to distance learning the number of moodle courses has increased enormously so that further technical resources (more storage) had to be provided. The online conferencing tool BigBlueButton was only introduced in April 2020, being ready for use from the middle of April. Before, there was no online conferencing tool being provided by KPH. Starting from the introduction of BigBlueButton, lecturers were trained online, guidelines and didactic hints were provided in a moodle course dedicated to the topic of online teaching. Although the university tried hard to support lecturers, only a minority of seminars was held synchronously in summer term 2020. Thus, students who prefer to listen to lecturers and discuss topics had some difficulties in learning. The low figure of online-live-sessions in summer term 2020 was seen as a big disadvantage by many interviewed students:

"That – according to our opinion – BigBlueButton was nearly not used at all and that 99, or 95 percent have been pure online tasks and they are continuing like that which means reading articles, writing reflections and so on. So you miss the social contact. I would have hoped for more. In the beginning I have been quite positive because I thought that – okay they had to switch very fast to online courses. Yes, what I really miss is the social contact. So we only had two – yes, I think we only saw two lecturers giving a video conference and that was only once each." (Interview S32, paragraph 41)

Getting all learning material in an asynchronous mode, means that the students are left alone with the contents. On the one hand, this is seen quite positive, as "I feel that I really profit from dealing with the contents myself" (interview S09, paragraph 48). On the other hand, this leads to feeling stressed and overworked: "I see a mental overload in the meantime due to the change to online learning. Moreover, I am a person who likes to listen and, in the classroom, I like to discuss and take notes" (interview S20, paragraph 36). A fact that can be seen from the interviews is that these asynchronous tasks got more and more difficult the longer the distance learning took because students were missing the system they were used to, being taught face-to-face in classrooms: "[…] but then it started to get too much. I had to learn really much stuff on my own. Which means you get texts, your read them, you have to summarize them, and I think that takes much more time compared to discussing a text in class or if somebody lectures you using a PowerPoint" (interview S24, paragraph 38).

When having a look at the attitude towards working on asynchronous tasks, a tendency could be seen among the interviewed students. Tasks that required them repeatedly to read texts, to summarize or to reflect on them were considered as boing. Moreover, such tasks had an influence on students' motivation to deal with the topic. "Yes, the tasks in A, they were nice articles, but it was rather boring. I have done them in between, not very carefully […]" (interview W04, paragraph 29). Statements like these show that the self-determination theory by Ryan & Deci (2018) also has to be taken into account when it comes to ERT. The more autonomy the students experienced when doing their tasks the higher is the motivation to do them in time and in detail. Apart from the autonomy, it was also the relevance which was of importance for students: "[…] I was really impressed by the tasks by some professors and how they used the situation we are in to give tasks which were really interesting. I am doing a seminar in sociology and the corona situation was used to analyze some things. I really appreciate this because that's what we are all interested in at the moment and we feel included. There are also some seminars which are supposed to be very active and hands-on like crafting or arts. Here, the professors also had some good ideas which you also could do from home. In crafts for example, we had to do some §D projects which you then could print out with a 3D-printer […]" (interview S14, paragraph 36).

3.2 Dimensions of social presence

Social presence in ERT suffers especially from the fact that lecturers and students do not regard each other as real persons, especially when there are few synchronous sessions and/or there is no room for interaction and exchange in synchronous and asynchronous sessions. Lacking non-verbal and paraverbal signals (Argyle 1979) leads to a feeling of being alone in an anonymous lecture. "It was a pity that it was only the professor who was active in the seminar and it was only the professor who had switched on the webcam. I think that many students simply switched off their mic and their camera and did something else during the seminar. I don't want to say that I never did something like that but I can imagine that e-learning will not keep a good reputation if that's the way it is done. If everybody switches off and doesn't participate. In my opinion you should try to take an active part" (interview W01, paragraph 33).

The importance of non-verbal and paraverbal signals to produce a feeling of being perceived as a person and that there is a reaction to problems without voicing them, can be seen from the following statement: "Professor X in whose seminars I always had my webcam switched on saw that I was absolutely desperate with one task and I also came to late to the online meeting although I had tried to enter half an hour earlier […] and I was so annoyed which he must have seen and then he called me after the seminar and agreed on an extra online meeting with me to help me with my task" (interview W04, paragraph 21).

It was back in the 1990s when Moore (2016) stated in his Theory of Transaction that different media enable different possibilities of interaction between teacher and learner. Moore therefore recommends using different strategies for distance learning in order to enable analysis and criticism or different kinds of stimulation to keep up the motivation of learners. Additionally, Holbeck & Hartman (2018) recommend Communities of Inquiry (COI) to bridge the distance gap in distance learning. If there are no measures taken to support cognitive and teaching presence with tools like breakout rooms or enable collaboration and critical thinking, students might withdraw and become inactive. "During the last term it appeared to me that we only switch on the computer and did something else while being in a seminar. It even happened that the professor asked some questions and nobody answered. Yes, that's when I noticed attention would have been much more if the seminar had been face-to-face or at least with webcams turned on" (interview W5, paragraph 24).

3.3 The importance of the lecturer

When there is a sudden change in teaching – in this case changing from classroom teaching to distance learning – the focus is put on the teacher. Studies have shown that didactics that work in face-to-face settings cannot be transferred to online settings one to one (Liu 2010). When it comes to social presence teachers need to make up for the lack of direct contact which can be done via the set-up of the synchronous or asynchronous session or by feedback given on students' assignments. As Sarkar, Ford & Manzo (2017) state students need different incentives in modern learning environments using digital technology to make them participate actively.

Motivation and engagement in an online setting is increased when sessions provide interaction and further social presence, when time is used efficiently and learning activities are connected to objectives (Buck 2016; Frey 2015). As ERT – as has already been shown – does not allow for planning, difficulties seem to be clear. However, the interview results show that some university teachers succeeded in creating social presence. Availability of the lecturers was part of that – students having questions regarding the seminars had to use e-mail in summer term 2020 when the video conferencing tool was not used that much. "A third of the professors didn't react at all, a third of them answered by e-mail and a third showed that they were there (interview W04, paragraph 21).

The importance of synchronous meetings was underestimated by many lecturers in the beginning of ERT. "Yes, once very briefly in physical education. The professor noticed that the students asked many questions. And then he took the time to have a common – very short – meeting as he noticed that there were always the same questions […] and then explained everything … that was really nice. But the rest of the time everything was done via e-mail or moodle" (interview W10, paragraph 17). It was only with the start of winter term 202/21 that BigBlueButton was used more regularly – because the rectorate ordered lecturers to offer the seminars in synchronous form.

Students talked about different experiences with their seminars – there were very positive examples given: Lecturers making efforts to prepare teaching material in a way that it supported learning also without having face-to-face classes, changing tasks and answering students' questions. However, the results also show that some lecturers could not really cope well with ERT. Almost every interviewed student provided a negative example: "Yes, it always depends on the lecturer, how good you are accompanied in a seminar because some of them take their job very seriously and with others – which need not only be a bad thing – you have to work on your own and have to do research. And some even were not willing to have an online meeting to answer questions" (interview W13, paragraph 11).

Media literacy of university teachers played an important role – those lecturers who used digital tools that were available before ERT or were more open towards using digital tools seem to have been better at providing seminars adapted to the new situation. "Yes, some professors didn't even manage after a month to provide us with a moodle course. Others, however, were really quick to enable kind of normal teaching. In some subjects it was possible […] to work on weekly tasks. You really had that feeling that they [i. e. the lecturers] talked to us, that we were really taught. Yes, and in other subject it only felt like working on a list of tasks" (interview W17, paragraph 5).

The results also show that using digital media by the university teachers was not always done in a satisfying way. A reason for this might be that these lecturers did not use any digital media before switching to ERT as they did not see any sense in dealing learning platforms and online didactics. Students, however, were in these cases not very understanding as they – most of the students can be regarded as digital natives (Prensky 2001) – expect being offered didactically well planned lessons. "[…] then there are professors who do not know anything. Students need to prepare chatrooms and you think by yourself why – that's not my job. I also have to learn how to use digital media" (interview S08, paragraph 72). Many students requested more digital media literacy with lecturers when it comes to online teaching.

4. Conclusion

There have already been several studies regarding ERT and social presence. Kear, Chetwynd & Jefferis (2014) showed that there is a direct link between how learning environments are designed and the degree of social presence. ERT has also proved that digital media literacy is important for students and for university teachers (Marek, Chew & Wu 2021). This matches the result of the presented study and requests for more digital media literacy education in both, curriculum and university teacher training.

Those students who experienced their lecturers as being present showed a higher satisfaction with distance learning in general. This matches the results of a study dealing with expectations of Polish students regarding distance learning (Cicha et al. 2021). University teachers need strategies how to include students in phases of e-learning or ERT. It also shows that students need to get used to this new kind of learning as bigger flexibility with regards to time and place also means structuring their own time and task management and motivation. The importance of relations in e-learning processes has already been discussed extensively (Arnold et al. 2018; Beer et al. 2003). These results can also be transferred to ERT so that students are actively involved in forming their learning processes.

References

Alammary, A., Sheard, J. & Carbone, A. (2014) 'Blended learning in higher education: Three different design approaches', Australasian Journal of Educational Technology, 30 (4), pp. 440–454.

Argyle, M. (1979) 'Non-Verbal Communication in Human Social Interaction' in Non-verbal communication, ed RA Hinde, Univ. Pr, Cambridge, pp. 243–269.

Arnold, P., Kilian, L., Thillosen, A.M. & Zimmer, G.M. (2018) Handbuch E-Learning. Lehren und Lernen mit digitalen Medien, W. Bertelsmann Verlag, Bielefeld.

Beer, D., Hamburg, I., Lindecke, C. & Terstriep, J. (2003) E-Learning: Kollaboration und veränderte Rollen im Lernprozess.

Buck, S. (2016) 'In Their Own Voices: Study Habits of Distance Education Students', Journal of Library & Information Services in Distance Learning, vol. 10, 3-4, pp. 137–173.

Cicha, K., Rizun, M., Rutecka, P. & Strzelecki, A. (2021) 'COVID-19 and Higher Education: First-Year Students' Expectations toward Distance Learning', Sustainability, vol. 13, no. 4, p. 1889.

Ferri, F., Grifoni, P. & Guzzo, T. (2020) 'Online Learning and Emergency Remote Teaching: Opportunities and Challenges in Emergency Situations', Societies, vol. 10, no. 86, pp. 1–18.

Flick, U. (2016) Qualitative Sozialforschung: Eine Einführung, Rowohlt, Reinbek bei Hamburg.

Frey, J. (2015) 'The Importance of Learning Experience Design for Higher Education', Getting Smart 25 April. [online] https://www.gettingsmart.com/2015/04/the-importance-of-learning-experience-design-for-higher-education/.

Goffman, E. (2001) 'Die Interaktionsordnung' in Interaktion und Geschlecht, eds E Goffman, H Knoblauch & H Kotthoff, Campus-Verl., Frankfurt am Main, pp. 50–104.

Hodges, C., Moore, S., Lockee, B., Trust, T. & Bond, A. (2020) 'The Difference Between Emergency Remote Teaching and Online Learning', Educause, 5/6, pp. 1–15.

Holbeck, R. & Hartman, J. (2018) 'Efficient Strategies for Maximizing Online Student Satisfaction: Applying Technologies to Increase Cognitive Presence, Social Presence, and Teaching Presence', Journal of Educators Online, vol. 15, no. 3. https://eric.ed.gov/?q=cognitive&ff1=audTeachers&id=EJ1199226.

Houben, D. (2018) 'Von Ko-Präsenz zu Ko-Referenz – Das Erbe Erving Goffmans im Zeitalter digitalisierter Interaktion' in Leib und Netz. Sozialität zwischen Verkörperung und Virtualisierung., eds M Klemm & R Staples, Springer VS, Wiesbaden, pp. 3–20.

Kear, K., Chetwynd, F. & Jefferis, H. (2014) 'Social presence in online learning communities: the role of personal profiles', Research in Learning Technology, vol. 22.

Kehrwald, B. (2008), 'Understanding social presence in text-based online learning environments', Distance Education, vol. 29, no. 1, pp. 89–106.

Kerres, M. (2020) 'Frustration in Videokonferenzen vermeiden: Limitationen einer Technik und Folgerungen für videobasiertes Lehren' in Handbuch E-Learning, ed K Wilbers, Wolters Kluwer, Köln, pp. 59–78.

Klier, A. (2016) Digitales Präsenz Lernen! [online] https://www.alexander-klier.net/digitales-praesenz-lernen/.

Lamnek, S. & Krell, C. (2016) Qualitative Sozialforschung. Mit Online-Material, Beltz, Weinheim, Basel..

Levinson, S.C. (2017) Der Sprecherwechsel bei der zwischenmenschlichen Kommunikation und seine Folgen für die Sprachverarbeitung, Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V.

Liu, C-H. (2010) 'The comparison of learning effectiveness between traditional face-to-face learning and e-learning among goal-oriented users', 6th International Conference on Digital Content, Multimedia Technology and its Applications, pp. 255–260.

Marek, M.W., Chew, C.S. & Wu, W.V. (2021) 'Teacher Experiences in Converting Classes to Distance Learning in the COVID-19 Pandemic', International Journal of Distance Education Technologies, vol. 19, no. 1, pp. 89–109.

Mayring, P. (2008) 'Neuere Entwicklungen in der qualitativen Forschung und der Qualitativen Inhaltsanalyse' in Die Praxis der qualitativen Inhaltsanalyse, eds P Mayring & M Gläser-Zikuda, Beltz Verlag, Weinheim, Basel, pp. 7–19.

Mayring, P. (2015) Qualitative Inhaltsanalyse. Grundlagen und Techniken, Beltz, J, Weinheim, Bergstr.

McLuhan, M. (1992) Die magischen Kanäle. Understanding Media, ECON Verlag, Düsseldorf, Wien, New York, Moskau.

Moore, M.G. (2016) 'Theory of Transactional Distance' in Theoretical Principles of Distance Education, ed D Keegan, Routledge, London, pp. 22–38.

Prensky, M. (2001) 'Digital Natives, Digital Immigrants Part 1', On the Horizon, vol. 9, no. 5, pp. 1–6.

Rahim, A.F.A. (2020) 'Guidelines for Online Assessment in Emergency Remote Teaching during COVID-19 Pandemic', Special Communication, vol. 12, no. 2, pp. 59–68.

Ryan, R.M. & Deci, E.L. (2018) Self-determination theory. Basic psychological needs in motivation, development, and wellness, The Guilford Press, New York, London.

Sarkar, N., Ford, W. & Manzo, C. (2017) 'Engaging Digital Natives Through Social Learning', Proceedings of The 8th International Conference on Society and Information Technologies, pp. 178–182.

Schlesselman, L.S. (2020) 'Perspective from a Teaching and Learning Center During Emergency Remote Teaching', American Journal of Pharmaceutical Education, 84 (8), pp. 1042–1044.

Short, J., Williams, E. & Christie, B. (1976) The social psychology of telecommunications, Wiley, London.

Witzel, A. (2000) 'Das problemzentrierte Interview'. Forum Qualitative Sozialforschung / Forum: Qualitative Social Research, Vol 1, Methodical and Empirical Examples / Forum Qualitative Sozialforschung / Forum: Qualitative Social Research, Vol 1, No 1 (2000): Qualitative Research: National, Disciplinary, Methodical and Empirical Examples

Narratives in Gamification: Considerations for Support of Digital Literacy of the Elderly

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DOI: 10.34190/EEL.21.042

Abstract: Many publications have been published on gamification in recent years, especially in the educational context. Research suggests that gamification can positively impact the learning experience and increase learner engagement. So far, gamification elements have been used or examined primarily to signal performance and progress. However, immersion-oriented elements or mechanics, such as narratives and storytelling, have been examined in research studies less frequently. Previous studies on gamification neglected the group of senior learners, although gamified systems hold a motivating potential for all ages. Therefore, this publication presents considerations for a narrative as part of the gamification approach for senior learners in the ePA-Coach project. The project aims to develop an e-learning environment for the elderly to improve their digital literacy in the context of the German electronic health record (EHR). Based on the review of the current literature, this paper provides an overview of different definitions, types, frameworks, and application examples. On the basis of this overview, we derived an approach and requirements for designing narratives in the context of gamification. Furthermore, we outline considerations for designing a narrative for senior learners with focus on learning outcomes in the field of digital literacy related to the use of the electronic health record. This narrative includes the mission called *Find & Fill the Golden Record* in which senior learners visit different places in a virtual small town. We describe options for design of the narrative including the stations as part of the learner's journey. The narrative was developed based on the derived requirements for designing narratives, the reification generic template by Mader et al (2019), the brainstorming design-thinking method, and qualitative feedback from experts. The narrative approach described in this paper offers a first conceptual approach for the development of narratives for gamified digital learning applications for the elderly that other researchers and designers can use and extend. The paper ends with conclusions and next steps in the research and development of a narrative as part of the gamification approach in the ePA-Coach project and proposes recommendations for further research.

Keywords: narrative, gamification, learners' journey, e-learning, electronic health record

1. Introduction

Gamification, the use of game elements in a non-game context, has already been used in various areas and shows particular and growing relevance in education (Dicheva et al, 2015). Majuri et al (2018) reported that gamification was most studied in the educational context, and there were strongly positively oriented results, so most authors share the opinion that gamification can improve learning. Sailer & Homner (2020) identified significant effects on cognitive, motivational, and behavioural learning outcomes in a meta-analysis and Dicheva et al (2015) referred to higher student engagement in forums, projects, and other learning activities. So far, Majuri et al (2018) show that gamification has primarily been used to signal achievement and progress, but immersion-oriented techniques or mechanics such as narratives and storytelling were rarely examined in research papers. Toda et al (2019) reported that the surveyed experts considered these game elements important because they intrinsically motivate human behaviour and telling stories.

In the project ePA-Coach, we investigate the need for a narrative in a gamified e-learning environment. The goal of this environment is to improve the digital literacy of senior learners. For participation in today's social life and the use of various services, digital literacy is essential. Especially with the introduction of the electronic health record (EHR) in Germany (German: Elektronische Patientenakte, ePA) from 1st January 2021 (Pott, 2019), digital literacy and digital sovereignty are becoming increasingly important for senior citizens so that they have the opportunity to use the electronic health record to manage their health data. This electronic health record enables the digital collection and sharing of health-related data or documents connected to an extensive network of healthcare institutions. The ePA-Coach project aims to support seniors in improving their digital literacy to act sovereign in today's digital world and deal with the electronic health record.

This paper describes considerations for a narrative as part of the gamification approach for the mentioned e-learning-system. Research suggests that gamification and narratives may positively impact the learning experience and make learners more engaged. The paper starts with a review of the literature and research using and designing narratives as part of gamification in the education context, especially in e-learning. This review includes definitions, types, and frameworks for narratives and application examples that have narrative approaches. Based on the review, requirements, success factors and frequently used contents for designing narratives are summarized in the third section. In the fourth section of the paper, there are considerations for designing a narrative and the developed narrative approach as part of the gamification approach of the e-learning system in the ePA-Coach project. The paper ends with conclusions, including the next steps in research and development in the ePA-Coach project and recommendations for further research.

2. Background and literature review

As previously described, the concept of narratives as part of gamification approaches was rarely used or examined in research papers. Toda et al (2019) identified that most gamification frameworks do not include narratives and storytelling, they are not considered a relevant game element. They found only one paper that provides for the concept of narrative or storytelling. However, providing a narrative context in learning can positively impact motivation (Schneider et al, 2020; Gabele et al, 2019; Ibarra-Herrera et al, 2019) and behavioural learning outcomes (Sailer & Homner, 2020). In addition, using stories or narratives in education enables more variations, personalisation, real-life situations, more engagement of the learners and interactive learning (Van Gils, 2005). As a basis for developing a narrative for senior learners, we conducted a background and literature review on definitions, types, frameworks for narratives, and application examples with narratives focusing on the educational context. The results are described in the following subsections.

2.1 Definition of a narrative

The review of the literature shows that there are various definitions of narrative and (digital) storytelling. Robin (2006) explains that all of them include telling stories with different digital multimedia elements. The author mentions that a digital story compromises a theme and sometimes a particular viewpoint. Lugmayr et al (2017) call this concept *serious storytelling* and define it as “storytelling outside the context of entertainment, where the narration progresses as a sequence of patterns impressive in quality, relates to a serious context, and is a matter of thoughtful process”. Palomino et al (2019) define a *narrative* in gamification as “[...] a process in which the user builds his own experience through a given content, exercising their freedom of choice in a given space and period of time, bounded by the system’s logic.” The authors describe that narratives for gamification (in education) are underused and misunderstood elements and justify this with the frequent confusion of story and narration and the synonymous use. Finally, Toda et al (2019) describe a definition for narrative and storytelling and mentions that a narrative aims at learner’s motivation and storytelling promote the learner’s engagement. The authors define a narrative as an “Order of events where they happen in a game. These are choices influenced by the players’ actions […]”. However, storytelling “[…] is the way the story of the game is told (as a script). It is told within the game, through text, voice, or sensorial resources […]” (Toda et al, 2019, p. 87).

2.2 Types of narratives

The current literature describes different types of narratives. Robin (2006) mentions three types of digital stories. The first two types are *personal narratives* and *digital stories that examine historical events*. The third one is *stories that inform or instruct* and include instructional material. Palomino et al (2019) describe two types of narratives. *Embedded* narratives are pre-generated content and already exists before the player's or learner's interaction. *Emergent* narratives are generated dynamically through the interaction of the player or learner. Sometimes the same actions can lead to different outcomes. The authors mention that the user experience and the system are essential aspects regarding narrative in interactive digital systems. Further, Rasmusson & Bourne (2017) differentiate *linear* and *nonlinear* stories. In nonlinear stories, the learners can make choices, while linear stories do not provide any choice for the learner.

2.3 Frameworks for narratives

Current research reveals a few frameworks for developing narratives. Robin (2006) presents the *Seven Elements of Digital Storytelling* for creating digital stories, which include the following elements: point of view, dramatic question, emotional content, gift of your voice, power of the soundtrack, economy, and pacing. Lugmayr et al (2017) propose storytelling components, including the perspective, narrative as the actual content of the story, interactivity, and a medium that represents the message of the story. They also present the *4C serious storytelling model*, including four components: context, course, content, and channel. Palomino et al (2019) recommend that narratives of gamified educational projects should include the following elements: a user or student as an actor, a choice for available options for content progression, interactivity, sequence of events, (virtual) space, date, time of interaction and user experience. Finally, Mader et al (2019) introduce the *reification* generic template for gamification and the *synapses* generic template for educational games. Reification is the learning progression in the form of a visualized landscape where each element can be placed by the learner and represents a learning task. Atomic tasks reward a learner with an object upon completion of a task. In progress tasks, the learner receives the object before the goal is achieved, but its visualization and state change once the goal is achieved. In synapses, students are given the task of structuring the concepts learned in a lecture into a concept map that aims to overcome or prevent misconceptions.

2.4 Application examples

Researchers and practitioners already used narrative and storytelling methods in a few (gamified) learning applications for different topics. Schneider et al (2020) developed an e-learning course for micro-entrepreneurs to gain data protection knowledge with three modules based on a storyline with sub-stories that include meaningful fictional stories or everyday situations in business. In each sub-story, the learner has to decide the correct reaction or answer in the described case. Gabele et al (2019) developed a software prototype for cognitive rehabilitation training of divided attention, including gamification and interactive storytelling. The narrative represents a drama with exposition, climax, and resolution and includes one main quest that the learner can reach through different turning points. In the role of a detective, the learner has to solve independent criminal cases contesting a mystery. A quest giver gives the cases with information on possible routes and advice for solving the case. Ibarra-Herrera et al (2019) designed an educational app called *Bio3D* with three levels for learning biology for students in the engineering school. Students had to select one biomolecule or protein avatar and got theoretical information about the chemical or physical characteristics of the avatar. Then they could interact in the first level with the structures of cells of different nature, watching videos on processes of the central dogma of biology in the second level, and create a story of an attack by a biological molecule in the third level. The levels include puzzle and minigames, and in each step of the game, the students collect points. Furthermore, Rahim et al (2019) developed the gamified learning application Kingdom Linear Algebra for learning Linear Algebra based on a narrative. In the role of a king or queen, students learn five calculation methods while supporting different fictional characters (e.g. police) in solving problems in real-life situations (e.g. traffic control in the roundabout) by answering questions. Finally, Coccoli et al (2015) developed the video course *Star Words* in the university context for the training on using office automation software programs based on the Star Wars™ narration. The learning content was adapted to the students' chosen character (e.g. Hans Solo) and based on the original plot of the Star Wars saga. For example, the learners become an "Office Jedi", and references to specific scenes or quotes were made. The literature review did not yield any application examples aimed explicitly at senior learners and integrated or focused a narrative in an e-learning system like the application examples described above or as planned for the ePA-Coach. Regarding the ePA-Coach learning program topic, we only found one somewhat similar narrative example in Schneider et al (2020). The subject of data protection focused there will be one of the subject areas in the ePA-Coach.

3. Requirements for narratives

Based on the literature review results on types, frameworks, and examples of narratives, we derived requirements as a summarized approach for designing narratives. The first requirement is the specification of narrative type such as personal narrative, a digital story that examines historical events or a story that informs or instructs (Robin, 2006). The next one is to decide whether the narrative structure should be linear or nonlinear (Rasmusson & Bourne, 2017). Furthermore, the narrative can be embedded or emergent, so the content is fixed or generated dynamically (Palomino et al, 2019). A further requirement is related to using a framework, or parts that can be a basis for the narrative design. The presented frameworks mainly include an initial situation such as a context, point of view, perspective, or dramatic question. In addition, considerations for the content like emotional aspects, events, and available options are recommended. Interactivity and interaction are also important (Palomino et al, 2019; Rasmusson & Bourne, 2017; Robin, 2006). The designed narrative can be embedded in the reification or synapses generic templates (Mader et al, 2019). Finally, as a requirement, in the narratives of the presented application examples, the learners mostly had the opportunity to act in a specific role and choose an avatar. That could be a lifelike or fictional person or role. The learners worked on specific tasks in this role, and sometimes they had to support somebody. The tasks mostly represented real-life problems or cases and addressed the main theme of the narration.

4. Considerations for narrative for the ePA-Coach project

This section describes the used methods and the development process for the ePA-Coach narrative and presents the narrative approach, including details and stations as part of the learners' journey.

4.1 Methods and development process

We developed the narrative approach for the digital learning environment of the ePA-Coach project based on the derived requirements and approach for designing narratives described in the third section, including the Reification generic template by Mader et al (2019). In addition, the brainstorming design-thinking method was used and obtained qualitative feedback from experts. Figure 1 shows the development process in summary.

Figure 1: Development process of the ePA-Coach narrative approach

In second step, we decide for a type and mission. The ePA-Coach narrative will be a nonlinear, embedded story that instructs. The senior learners will have a mission as the central task called "*Find & Fill the Golden Record"*, where they visit different places in a virtual small town. Once these fundamental aspects were established, we brainstormed as a third step initial considerations for the details of the narrative, created a first draft with an initial situation and the flow and steps in the narrative. Fourth, we gathered seven qualitative expert's feedback on the draft from the project partners, including professors, researchers, research assistants of universities from different fields, and partners from the industry. The experts have knowledge and experience in public health, focusing on geriatrics and senior's use of the technique, educational technologies, artificial intelligence, sociology with a focus on participatory technology design, and web-based applications. The feedback was generally positive (e.g. "I find the story very successful, as well as the learning of the various competencies in the individual locations.") and was supplemented by minor recommendations for change. Primarily, the experts criticized that the purpose of the mission was not yet entirely clear in the narration described and that the introduction was too text-heavy. Finally, we adapted the narrative according to the feedback and developed minimal and maximum requirements for integration into the learning environment.

4.2 Narrative and learners' journey

The learners' journey starts with the introduction to the narrative called "*Find & Fill the Golden Record"* where the learner represents the protagonist who has moved to a new home in a new small town and presents himself or herself to the new family doctor with the analogue health record. However, on the way to the doctor, an accident happens, and the record file is destroyed. The protagonist seeks help from the health insurance company, whose advice is completing the new membership program with the narration title. In doing so, the person will find his or her golden electronic health record and fill it with the destroyed health files. Along the way, the learner is accompanied by a virtual learning coach, visits various institutions and places depicted on a magical map of the city, solves obligatory and additional tasks with the help of a virtual smartphone, unlocks new learning content and achieves intermediate goals such as the bronze or silver electronic health record. The structure of this narrative is shown as learners' journey in Figure 2.

There will be several competence areas in the ePA-Coach, including partial competencies with three competence levels (beginner, advanced, and expert). In the central part of the narratives, the learner visits different institutions representing a partial competence and comprising several learning units, considering the competency levels. Once the learner has completed the beginner level within a competence, the map opens up more, and new institutions become visible. These institutions are topic-related in the area of health care and health care technology. Initially, the learner sees the German Federal Ministry of Health (FMH), the health insurance company, and a medical technology company on the map. Figure 3 shows an example of the narrative situation in the beginner level within the FMH for the competency "Understanding concepts of EHR".

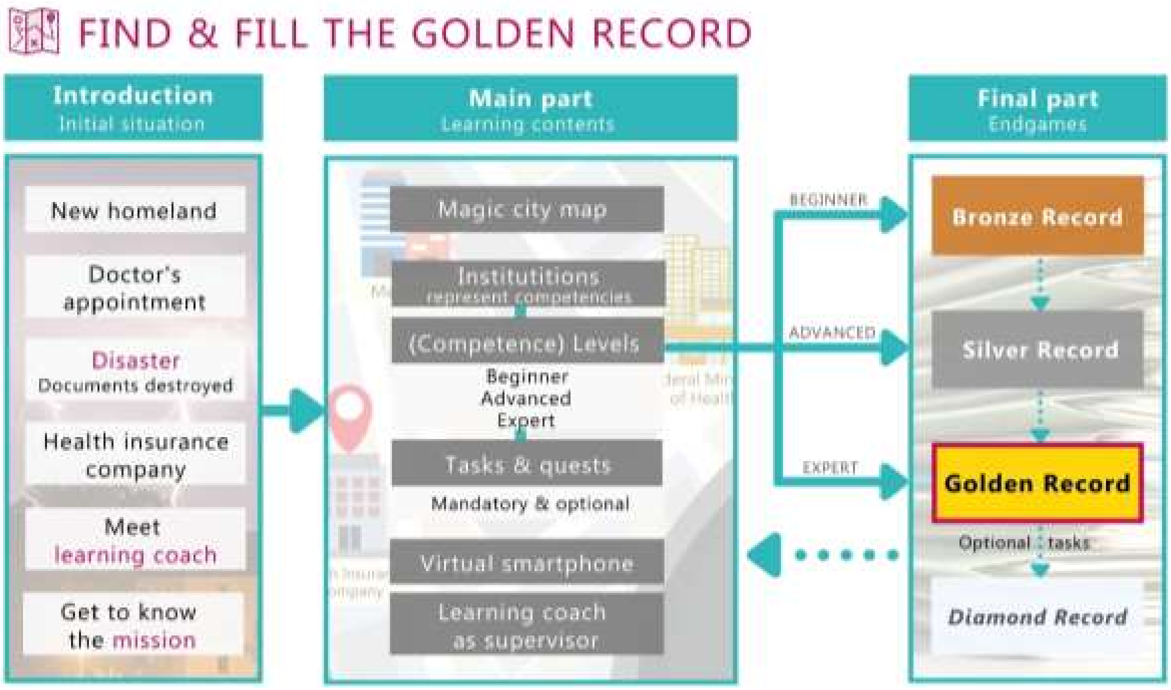
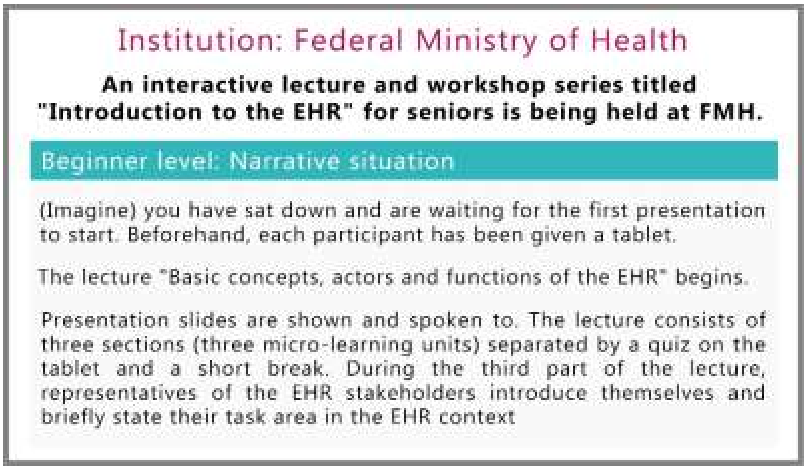


Figure 2: ePA-Coach narratives' structure as learners' journey


Institution: Federal Ministry of Health

An interactive lecture and workshop series titled "Introduction to the EHR" for seniors is being held at FMH.

Beginner level: Narrative situation

(Imagine) you have sat down and are waiting for the first presentation to start. Beforehand, each participant has been given a tablet.

The lecture "Basic concepts, actors and functions of the EHR" begins.

Presentation slides are shown and spoken to. The lecture consists of three sections (three micro-learning units) separated by a quiz on the tablet and a short break. During the third part of the lecture, representatives of the EHR stakeholders introduce themselves and briefly state their task area in the EHR context

Figure 3: Narrative situation in the beginner level within the institution FMH

Each time, the learner can complete the following task within the institution or go to another unlocked institution and complete a task there. There are "mandatory quests", which are requirements for unlocking other institutions, and additional quests, which can be done voluntarily (e.g. explaining something to a person) by the learners. For each completed learning task at a beginner level, the learner receives a letter but is not told which letter it is. Once all beginner tasks have been completed, or a minimum number has been completed, the learner learns the solution word and unlocks the *Bronze Record* (first endgame). The endgame task represents a quiz on the different contents of the beginner competency levels of all competencies. As a result, the (virtual) Bronze Record is only created, opened and decoded with the solution word, but not yet filled with content. Once the learner has completed the advanced levels of the competencies, mandatory competencies or a minimum number of competencies, the endgame task for the Silver Record is unlocked. As a result, the record is filled with previously collected documents (virtual elements). In addition, the record turns silver coloured to the *Silver Record*. Suppose the learner has completed all expert competency levels, the mandatory competencies, or a minimum number of competencies. In that case, the endgame task for the *Golden Record* is unlocked. As a result, the record is completed with all other collected mandatory documents and turns golden coloured to the Golden Record. When the learner has completed some additional quests, the endgame for the *Diamond Record* is unlocked and the record is finished with the collected other elements. Finally, the learner has found and filled his or her personal Golden Record or Diamond Record as a gamified and narrative virtual alternative for the German electronic health record.

5. Conclusions and further work

In this paper we described the current literature of narrative in gamification and derived considerations for a narrative as part of the gamification approach of the e-learning system for digital literacy of senior learners in the project ePA-Coach. As part of the literature review, we described definitions and different types of narrative or (digital) storytelling. In addition, we have presented frameworks for the design of narratives. Furthermore, we showed application examples of gamified learning applications that are based on narratives. In the next step, we summarized requirements and frequently used contents for the development of narratives in gamification context. In addition, we showed that there is little research in narratives in e-learning for senior learners. Furthermore, the narrative was developed based on the derived approach and requirements for designing narratives, reification generic template, the brainstorming design-thinking method, and qualitative feedback from experts. Finally, we outline considerations for designing a narrative for senior learners with focus on learning outcomes in the field of digital literacy related to the use of the electronic health record. This narrative includes the mission called *Find & Fill the Golden Record* in which senior learners visit different places in a virtual small town. In addition, we described options for design of the narrative including the stations as part of the learners' journey. The next steps in research and development for the implementation of the narrative in the ePA-Coach as part of the gamification approach will be the testing of the described narrative especially with regard to the perceived influence on motivation by the seniors. Further research is necessary for designing and using narratives in (gamified) learning applications. Research results from past research showed that narrative as a gamification element can have a positive impact on learning experience and motivation but is rarely used. In addition, there is a lack of research on effects and preferences, especially of senior users. The research conducted in ePA-Coach project aims to close this gap.

Acknowledgements

This publication was produced as part of the project ePA-Coach: Digital sovereignty in the context of the electronic patient file, founded by the Federal Ministry of Education and Research under the program Human-technology interaction for digital sovereignty. For more information, please visit https://technik-zum-menschen-bringen.de/projekte/epa-coach.

References

Coccoli, M., Iacono, S. and Vercelli, G. (2015). APPLYING GAMIFICATION TECHNIQUES TO ENHANCE THE EFFECTIVENESS OF VIDEO-LESSONS. *Journal of E-Learning and Knowledge Society*, *11*(3), 73–84.

Dicheva, D., Dichev, C., Agre, G. and Angelova, G. (2015). Gamification in Education: A Systematic Mapping Study. *Educational Technology & Society*, *18*(3), 75–88.

Gabele, M., Thoms, A., Alpers, J., Hußlein, S. and Hansen, C. (2019). Effects of interactive storytelling and quests in cognitive rehabilitation for adults. *CEUR Workshop Proceedings*, *2359*, 118–129.

Ibarra-Herrera, C. C., Carrizosa, A., Yunes-Rojas, J. A. and Mata-Gómez, M. A. (2019). Design of an app based on gamification and storytelling as a tool for biology courses. *International Journal on Interactive Design and Manufacturing*, *13*, 1271–1282.

Lugmayr, A., Sutinen, E., Suhonen, J., Sedano, C. I., Hlavacs, H. and Montero, C. S. (2017). Serious storytelling – a first definition and review. *Multimedia Tools and Applications*, *76*(14), 15707–15733.

Mader, S., Heller, N., and Bry, F. (2019). Adding Narrative to Gamification and Educational Games With Generic Templates. *Proceedings of the 18th European Conference on E-Learning (ECEL 2019)*, 45.

Majuri, J., Koivisto, J. and Hamari, J. (2018). Gamification of education and learning: A review of empirical literature. In J. Koivisto and J. Hamari (Eds.), *Proceedings of the 2nd International GamiFIN Conference (GamiFIN 2018)* (Vol. 2186, pp. 11–19). CEUR-WS.

Palomino, P. T., Toda, A. M., Oliveira, W., Cristea, A. I. and Isotani, S. (2019). Narrative for gamification in education: Why should you care? *Proceedings - IEEE 19th International Conference on Advanced Learning Technologies, ICALT 2019*, *2161-377X*, 97–99.

Pott, A. (2019). *EHR and PHR : Digital records in the German healthcare system*. https://www.gesundheitsindustrie-bw.de/en/article/news/ehr-and-phr-digital-records-in-the-german-healthcare-system

Rahim, R. H. A., Tanalol, S. H., Ismail, R., Baharum, A., Rahim, E. A. and Noor, N. A. M. (2019). Development of Gamification Linear Algebra Application Using Storytelling. *ICTC 2019 - 10th International Conference on ICT Convergence: ICT Convergence Leading the Autonomous Future*, 133–137.

Rasmusson, T. and Bourne, J. R. (2017). INTERACTIVE STORYTELLING, GAMIFICATION, AND ONLINE EDUCATION: STORYELLING MADE EASY. *International Journal on Innovations in Online Education*, *1*(3).

Robin, B. (2006). The Educational Uses of Digital Storytelling. *Proceedings of SITE 2006–Society for Information Technology & Teacher Education International Conference*, 709–716.

Sailer, M. and Homner, L. (2020). The Gamification of Learning: a Meta-analysis. *Educational Psychology Review*, *32*, 77–112.

Schneider, B., Bontempo, N., Asprion, P. M. and Habbabeh, A. (2020). Storytelling and Gamification in E-Learning – An Empirical Study to Educate Swiss Microenterprises in Data Protection. *Expanding Horizons: Business, Management and Technology for Better Society*, 319–328.

Toda, A. M., Cristea, A. I., Oliveira, W., Klock, A. C., Palomino, P. T., Pimenta, M., Gasparini, I., Shi, L., Bittencourt, I. and Isotani, S. (2019). A Taxonomy of Game Elements for Gamification in Educational Contexts: Proposal and Evaluation. *19th International Conference on Advanced Learning Technologies (ICALT)*, 84–88.

Van Gils, F. (2005). *Potential Applications of Digital Storytelling in Education*. 3rd Twente Student Conference on IT.

On-Demand Placement Test Options Within a Moodle Environment

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DOI: 10.34190/EEL.21.035

Abstract: Members of a private Liberal Arts College in Japan have administered a placement test for new, returning, and transfer students at the beginning of each academic year for more than ten years. The placement test until the onset of COVID-19 in 2020 had been a 57-item test composed exclusively of material from Cengage Learning for use with the World Link textbook series, the series of choice for all first-year students. Since 2020 and the onset of the COVID-19 pandemic, the placement test has changed from an in-house sit-down event to an online, On-Demand format. Audio questions were removed, and questions with meaningless Facility Index rankings were removed to be replaced with original items. The once 57 item test became a 40 item, smartphone-friendly test. The same 40 item test from 2020 was administered again in 2021 to a cohort of 504. Four hundred eighty-one took the test, leaving 23 non-participants to be placed manually. A mean score of 51.24% was observed with a more or less normal bell curve. Students spread across eight departments need placement in level-appropriate, uniformly sized classes. Recent years have shown that score clustering occurred where classes needed dividing. Clusters refer to identical scores that group students into subgroups making line-drawing a subjective, time-consuming task. The trouble score clustering had to be addressed given the time constraints for announcing class memberships and being ready to answer allegations of unfair or capricious approach to class membership creation. In answer to this, the test items were re-weighed from a uniform weight of 1.00 to weights within a set range (1.00 - easy to 1.09 - difficult) to ensure greater score diversity and hence ease with student ranking. The 2020 40 Item test's Facility Index was used as a guide for setting the weights for the 2021 test. This paper will share the process undertaken to avert score clustering and enable class creation in an informed, principled manner, all within a matter of hours from data download with benefit to all concerned.

Keywords: ESL program, leadership, matriculated students, placement test, placement procedure, ranking, testing

1. Introduction

The importance and need for placement testing are well established and show no signs of going away. Whether the placement test is for a local application, as in this case, or as per a larger application for further study, TOEFL or IELTS, one can readily see its need. Determining, however, what is "good" and "bad" at the question level is relatively new. What makes for an effective Placement Test? Item analysis must be taken seriously. Increasingly, universities must do more with less. Mukerjee reports that Australian universities are now scrambling for their place in a highly competitive market, exploring new revenue and educational opportunities and digital transformation to achieve cost savings and efficiencies (Mukerjee, 2014). While not limited to Australia, many universities, needless to say, are in the middle of a digital revolution. For many, it is the only way out to a more stable environment. Yet, the digital revolution is ongoing with no end in sight. It is no longer about digitizing print material but of managing the data generated. Should such be overlooked, vast amounts of otherwise useful information will remain ignored. When data from placement tests are considered, simple descriptives, modes, means, and median scores simply are not enough. More is needed.

Within online testing environments, teachers and program administrators have plenty of options. As far as Learning Management Systems are concerned, there are more than a few. For this paper, however, Moodle is the LMS as it is preferred by the university. Moodle is a well-established first choice with institutions carrying over 50% of the LMS market share in Europe, Latin America, and Oceania (“Academic LMS Market Share,” 2017).

As for placement testing in general, one has options, Item Response Theory being one. Presently, Moodle does not offer IR testing directly as a core function, but data can be downloaded in CSV files for finishing in any number of applications(“Moodle in English: Item response Theory,” 2013) and (Mair, 2021). Deciding upon and implementing any of the fifty ancillary programs listed by Mair would likely require an expert skill level to say the least.

That being said, Moodle does provide highly useful tools that were once the reserve for data agencies. Such can be found inside Moodle’s Quiz Statistics pane. Here, one can easily receive feedback regarding a Facility Index, Discrimination Index, and Discriminatory Efficiency. Knowing when and where to look, when and where to apply these indices is key to revising and maintaining an effective placement test.

As of late, the COVID-19 pandemic was, and continues to be a disruptive event that resets even the most basic approaches to otherwise indispensable events. In the case of this study, an English language program had to respond to the disruption by re-tooling its online placement test to something that would not only function, but deliver the requisite data for sorting students into level appropriate classes without even a single student stepping foot on campus. A paper based test was out of the question. A test that presupposed students sitting in front of a 21 inch monitor was also out of the question. What was required had to be smartphone friendly. Thus, in the midst of pandemic disruption, innovative approaches were employed meaningfully to create level appropriate classes.

Placement tests are Criterion-Referenced tests, or gateway tests, and differ from Norm-Referenced tests as one finds from in-class quizzes to final exams (Brown, 1989). The placement test in use requires revision in advance with every application with every cohort. It is here that Moodle's Facility Index is employed for either confirming or reassigning question weights. In effect, with the constant revision, the previous cohorts serve as a field of reference from which their previous performance results are used as a reference to set weights to anticipate likely success.

Placement tests sort students into level-appropriate classes for student educational benefit. Not doing so can be detrimental to students, teachers, and institutions (Brown, 1989). Ling et al. (2014) indicate no shortage of articles extolling the benefits of placement tests (Ling et al., 2014). Nevertheless, there is a void when it comes to weighing items according to task ease and difficulty. In most, if not all cases, items appearing within Norm-Referenced tests have equal weight. The weight equality is assigned as a default setting within the LMS of preference which only exacerbates two glaring problems: 1) not all tasks are on par, and equal to each other, and 2) inevitable and problematic score clustering. By weighing questions to reflect task burden, clustering is largely eliminated, taking the guesswork out of line drawing within groups with the same score (Goetz, 2019). ESL placement tests ask learners a variety of tasks with differing expectations. Adapting question weights to reflect task difficulty needs to happen in advance of every cohort to pay respect to the ever-growing population that contributed to each questions' performance. Such additional attention can only benefit the students, instructors, and administrators.

2. Research design

Subjects: The participants include 504 newly matriculated first-year and transfer students within the faculties of Economics, Social Welfare, and Department of Psychology and Communication. The groups were self-selected in that they 1) selected to study English as opposed to other foreign languages, and 2) they are grouped into departments from where English classes are offered at set times throughout the week according to faculty and departmental membership. Selection is made at the institutional level based on student preference. Of the 504 students, 481 actually participated. The remainder failed to do so for sundry reasons.

Task and Instrumentation: Cengage Learning has provided the placement test used as an adjunct to the World Link textbook series (“World Link, Third Edition,” 2016). The World Link series is used in the 1st year English Program, a program designed to build foundational English communication skills (Goetz et al., 2019). The 40-item multiple-choice test is administered on Moodle to roughly 500 students, producing mean scores from 51% to 54% with a more or less normal bell curve. The test includes mainly Bottom-Up questions that assess vocabulary grammar. By default, all items have equal weight: 1.00 points. In light of the previous year, however, Moodle's Facility Index was employed to assign lighter weights for easy items and heavier weights for difficult ones.

The current test is in its second year. It is both valid and reliable, doing what it claims to do. It produces consistent scores across various variables, thus making it fair and defensible (*Test Quality*, 2006). The questions fall into three groups: the Cengage, Paper Version, and the Q-set. The first group holds questions from the Cengage Examview collection: 15 items, 6 Grammar, 8 Vocabulary, and 1 Comprehension, respectively. Two professors supplied additional content, namely converting the test to be smartphone-friendly. All audio JPEG-based and lengthy reading questions were removed in light of the smartphone-friendly questions: concise multiple-choice questions that included grammar, vocabulary and short inferential comprehension items. Later, when asked where the questions had been sourced, both said they came from their respective collections. The Paper_Version includes 13 items: 5 Grammar, 4 Vocabulary, and 4 Comprehension questions. The Q-set includes 12 items: 4 Grammar, 6 Vocabulary, and 2 Comprehension questions.

Cobbling together a major, program-level Placement Test was not desired but a necessity. It is worth mentioning that a 60 item paper-based mark sheet version was created and readied, only to be printed and then shredded in favor of a completely remote, smartphone-friendly Placement test. Given the chaos of March and April 2020, the leaders had no other choice.

Administered within a set number of days within a Moodle environment, only one day was needed to sort into level-appropriate classes. Given the lingering nature of this pandemic, the same 40 item placement test was used in April 2021. Furthermore, after downloading the data, the problem of sorting students into level-appropriate classes was noticeably easier since the problem of score clustering had been largely erased since the Facility Index from 2020 served as a guide for setting question weights for 2021.

Brown states that placement tests need to be taken seriously in that initial group assignments can have a major impact on career opportunities and other lifetime-related possibilities (Brown, 1989). The question about weighing questions evenly among a question set that requires various linguistic tasks has been addressed (Goetz, 2019). The need to remedy score clustering is underrepresented if not non-existent in the literature (Ling et al., 2014).

Research Question: Employing a systematic and principled way to eliminate score clustering needs to include a re-examination of weight credit in balance to item task burden in light of previous cohorts. Weight refers to an attribute of importance or value to an item. And task burden refers to the load associated with the relative ease or difficulty needed to resolve an item. It is appropriate to re-weigh items from a uniform 1.00 weight to weights that range from 1.00 to 1.09 in light of the 2020 Facility Index to minimize score clustering.

Method: The 2020 Placement Test was modified in the following manner. Items were identified as Grammar, Vocabulary, or Comprehension. Overwhelmingly, the items were Bottom-Up as opposed to Top-Down. Realizing that most subjects are products of a language learning environment that rewards test takers for achieving high scores on largely Bottom-Up tests, this was not seen as problematic.

The framework developed uses items from three sources, among which and between the Facility Index was compared. The Facility Index refers to the (F) or mean score of students on an item. The following rubric is a generally accepted interpretive guide within the Moodle community. Data appear in percentages.

Table 1: Facility Index (F) interpretation table

Facility Index (F)	**35-65 About right for the average student.**
5 or less Extremely difficult or error.	66-80 Fairly easy.
6-10 Very Difficult.	81-89 Easy.
11-20 Difficult.	90-94 Very easy.
21-34 Moderately difficult.	95-100 Extremely easy.

The following tables indicate a range of weights covering a variety of tasks. The Facility Index confirms that, in general, the greater the weight a question was assigned, the more difficult it was for the students. Conversely, the lighter the weight assigned, the easier it was for the students. The various items included comprehension, grammar, and vocabulary questions.

Table 2: Cengage question set examples

Questions from the Cengage Set

Cengage	**Item Sample**	**Task**	**Distractors**	**Wt.**	**Facility Index**
Comprehension	The sports ______ is my favorite part of the newspaper.	*Select one:*	a. publish b. media *c. section* d. subscribe	1.07	30.15% About Right

Cengage Vocabulary	Brigid is easy to talk to. What is Brigid like?	*Select one:*	a. creative b. serious c. shy *d. friendly*	1.00	89.40% Easy
Cengage Grammar	It is important to drive ______on wet roads.	*Select one.*	*a. carefully* b. carelessly c. careless d. careful	1.03	65.70% Fairly Easy

Table 3: Paper version question set examples

Questions from the Paper Version Set

Paper Version	**Item Sample**	**Task**	**Distractors**	**Wt.**	**Facility Index**
Grammar	Please ____ me off in front of the station.	*Select one.*	a. drive b. put *c. drop* d. take	1.09	22.40% Moderately Difficult
Paper Version Vocabulary	In the end, we ______ up our minds to go by train.	*Select one.*	a. took b. had c. got *d. made*	1.06	32.43% Moderately Difficult
Paper Version Comprehensio n	The news _____ me.	*Select one.*	a. walked *b. surprised* c. held d. packed	1.00	87.96% Easy

Table 4: Q-Set examples

Questions from the Q-Set

Q-Set	**Item Sample**	**Task**	**Distractors**	**Wt.**	**Facility Index**
Comprehensio n	My daughter is very _____.	*Select one.*	a. independency b. independence *c. independent* d. independently	1.08	29.52% About Right
Q-Set Grammar	If ____ I were a native speaker of Spanish!	*Select one.*	a. that was b. it was *c. only* d. should	1.04	44.49% About Right
Q-Set Vocabulary	Where is _____ passport, Gina?	*Select one.*	a. yours b. your's *c. your* d. you	1.02	67.98% Fairly Easy

3. Table summary

Table 5: Summary of the example questions

Weight	Facility Index	Comment
1.00	89.40%	Easy
1.02	67.98%	Fairly Easy
1.04	44.49%	About Right
1.06	32.43%	Moderately Difficult
1.08	29.52%	Moderately Difficult
1.09	22.40%	Moderately Difficult

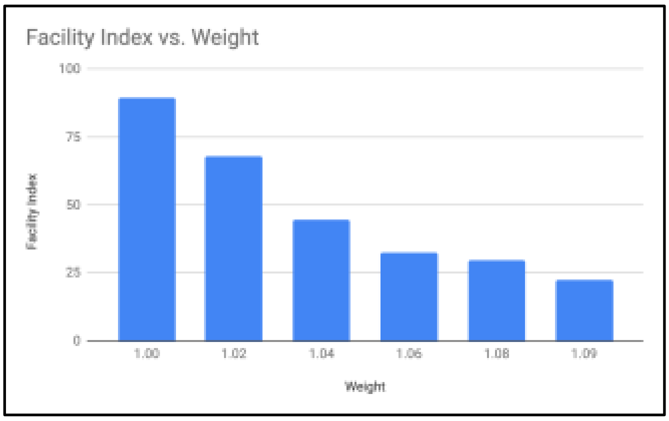

Figure 1: The lighter the weight, the easier the task

Data Gathering: The Placement Test was made available on-demand within a Moodle environment. An opening and closing time was set and announced to students by way of their online orientation materials. Students had up to 20 minutes to finish. In case of time running out, Moodle automatically saved the attempts. Administering the test happened in an unsupervised environment. Students could take the test an unlimited number of times; however, they would not know their scores. Once completed, data were downloaded to an Excel file.

Results: Of the 482 participants, 152, or 31.53%, shared identical scores. When seen in the aggregate 23 classes across seven different departmental groups that comprise four major divisions in the overall schedule, it was observed that there were no cases where two students with identical scores straddled a class border.

Analysis Of Variance: Consideration of a means comparison reassures that the manipulation of the weights did not change the means differences at the population level. Within and between departments is another consideration. An Analysis of Variance was carried out. Considering the four groups and between the weight treatments or question sets. The profile of the subjects appears below.

Subjects: The subjects are defined by the two factors, the Question Sets (Factor A), and the Departmental Groups (Factor B), as expressed by the Facility Index scores from the Placement administered to 481 new students. A Two Way, Factorial ANOVA test, using F distribution df (7, 1038) (right-tailed) was used to test against the Null Hypothesis

3.1 Findings

Regarding the Question Sets, or Factor A, it was found that there is a significant variation between the groups where p-value<α (0.05). H_0, the Null Hypothesis is rejected. It was observed that some of the groups' averages are to be considered as not equal, as evidenced by the large F Statistic for Question Sets (Factor A). The difference between the averages of some groups is big enough to be statistically significant.

Table 6: Two-Sample ANOVA - fixed test, using F distribution (right-tailed). ("Two Way ANOVA Calculator," 2021)

F table
Two Way, Factorial ANOVA table

Source	DF	Sum of Square (SS)	Mean Square (MS)	F Statistic (df_1,df_2)	P-value
Question Sets (A)	2	23959.2961	11979.6481	33.3164 (2,148)	1.132e-12
Dept. Groups (B)	3	784.2063	261.4021	0.727 (3,148)	0.5374
Interaction of A & B	6	296.9982	49.4997	0.1377 (6,148)	0.9911
Error	148	53216.6853	359.5722		
Total	**159**	**78257.186**	**492.1836**		

Regarding the Departmental Groups, or Factor B, it was found that there is no significant variation between the groups where p-value<α (0.05). H_0, the Null Hypothesis is accepted. It was observed that groups' averages are considered equal, as evidenced by the relatively small F Statistic for Departmental Groups. The difference between the averages of some groups is not big enough to be statistically significant.

Regarding the Interaction between Factor A, the Question Sets, and Factor B, Departmental Memberships, it was found that there is no significant interaction between the two factors where p-value<α (0.05). H_0, the Null Hypothesis, is accepted. It was observed that groups' averages are assumed to be equal, as evidenced by the minimal F Statistic for the interaction.

Kruskal Wallis Non-parametric Test For Non-conformity

The Paper Version and Q-Set question collections were found to be more challenging than the Cengage question set by all test takers, as the Boxplot indicates. The three-question sets combined to create a placement test with a wide variety of questions that ranged from easy to difficult, something one would want in any placement test. But is this significant?

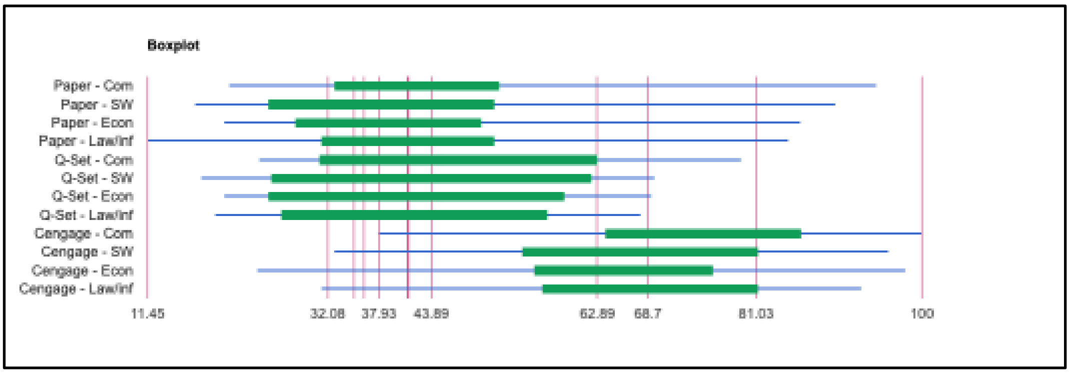

Figure 2: The boxplot provides an easy visual for perceiving variation between the question groups

Among the test takers, there is noticeable, albeit visual, variation among the students according to their departmental membership. One could infer that the students who have self-selected themselves are somewhat different when it comes to questioning difficulty. From the chart (Figure 3), it appears that students in the Communications Department outperformed their peers in all instances. On the whole, students experienced greater difficulty with the Paper Version and Q-set questions, which together comprised roughly two-thirds of the test. Does this inference have merit?

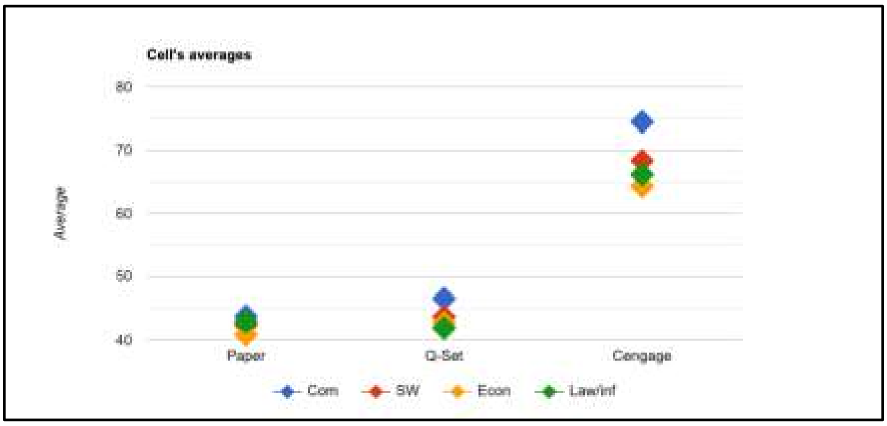

Figure 3: Average clusters suggest test fairness

A Kruskal-Wallis test ("Kruskal-Wallis Test Calculator - One-Way ANOVA on ranks," 2021), using Chi-Square (df=2) distribution (right-tailed) was used to check if the difference between the mean ranks of the groups is big enough to be statistically significant. In other words, to see if the test was fair. Moreover, in this case, it was. The Kruskal Wallis test searches for a group or groups containing a value that is considered the highest value than others. The probability of occurrence was relatively high in the questions from the Cengage Set confirmed as such. The p-value confirms this as it equals 0.001505, which means that the chance of type I error (rejecting a correct H0) is tiny at 0.001505or (0.15%). The smaller the p-value, the more it supports H1. The test statistic associated with the Kruskal Wallis is H, and it equals 12.9985, which is not in the 95% region of acceptance. The strength of the Kruskal Wallis lies in that it pinpoints just where the difference lies. In this case, when one considers the mean ranks of the following pairs, they are significantly different: x1-x3 x2-x3 where x1 represents the Paper Version questions, x2 the Q-Set, and x3 the Cengage questions. The chart is helpful, but the Kruskal Wallis test establishes the visual with unquestionable certainty.

4. Discussion

Not only program directors but teachers need to know on the whole what the Facility Index is and how it can provide salient information about students. With this, teachers would be better positioned to add supplementary material, expect more output in class or build up bottom-up skills to maintain motivation among the learners. According to their study, "Demotivation and Dropout in Adult EFL Learners," one of the biggest demotivators occurs when the instruction is either too easy or difficult. In either case, it is outside of the i+1 zone according to Krashen's Monitor Model (Krashen and Terrell, 2011). Evan and Tragant (2020) identify vital systematic demotivators that keep contributing to student dropout. Such factors include the following reasons: teaching method; lack of progress; teacher; language difficulty; and resources (Evans and Tragant, 2020). These reasons shed light on why some students are prone to underperforming in comparison to their peers.

When students underperform, one needs to look at the overall DFWI rates; namely, "D" referring to the below-average grade of D, "F" for failure, "W" for withdrawal, and "I" for incomplete. DFWI represents the ratio of students per class or within a program who underperform. Such ratios are beneficial for program development and reevaluation. While varying from culture to culture and whether a program is a high-stakes program or not, most would agree that a DFWI rate that is over 20 to 30 percent indicates a problematic disconnect between the students, materials, and the teacher ("Data of the Week," 2021), (Koch and Pistilli, 2015), (Swan et al., 2017).

When seen within this local context, members of the Cross-Departmental English Program, CEP, are in a new era. The number of CEP classes is now fixed as well as the maximum number of seats per class. In the past, when there was a surplus of new incoming students indicating English as their first choice, additional classes would be added. Such is not the case anymore. When dealing with the same surplus of students, some students have their second choice given to them by a lottery. When repeaters for the first year are considered, the number of seats for the new students who wish to study English as their first choice language is reduced. Similarly, when such happens in the second year English classes, overcrowding happens.

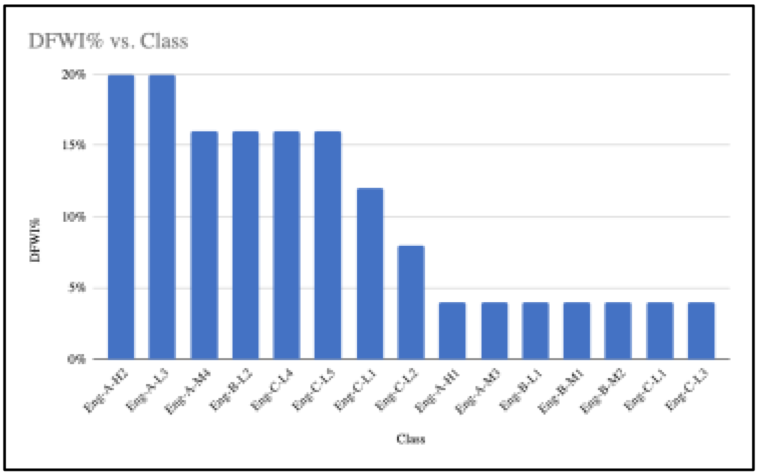

Figure 4: 2020 DFWI percent by High - H, Medium - M, and Low - L class levels

By attenuating to Facility Index data at the departmental level, teachers can anticipate where student strengths and needs may be. Furthermore, in light of respective DFWI rates from the previous year or years, teachers and directors will be in a much more informed position to make program-level adjustments by 1) selecting better level appropriate textbooks, 2) editing and adapting online adjunct materials, and 3) discussing with teachers the types of challenges they faced.

5. Conclusion

ESL Placement Testing has been around for a long time, and they are to be taken seriously. Placement tests need to be seen in the broader picture, focusing strictly on students and providing information for improvement from which teachers and administrators may take action. With scores re-weighted to reflect relative ease and difficulty, score clustering is a minimal concern. By looking at Facility Index scores for test items according to departmental membership, program directors and teachers can see where their overall strengths and weaknesses are at the departmental level and class. This helps with class creation and class management and meets the educational needs of students with more meaningful accuracy. Finally, when previous year(s) DFWI rates are considered, teachers and administrators may make adjustments where needed, thus ensuring greater reward among the students.

References

Academic LMS Market Share: A view across four global regions [WWW Document], 2017. . E-Lit. URL https://eliterate.us/academic-lms-market-share-view-across-four-global-regions/ (accessed 7.20.21).

Brown, J.D., 1989. Improving ESL Placement Tests Using Two Perspectives. TESOL Q. 23, 65–83. https://doi.org/10.2307/3587508

Data of the Week: DFW Rates | Academic Affairs, 2021. URL https://uwm.edu/academicaffairs/student-success/data-of-the-week-dfw-rates/ (accessed 5.26.21).

Evans, M., Tragant, E., 2020. Demotivation and Dropout in Adult EFL Learners 20.

Goetz, T., 2019. Placement Test Options within a Moodle Environment, in: The Clute Institute International Proceedings. Presented at the 2019 Clute International Academic Conferences New York Conference, Clute Institute International, New York, New York, pp. 318-1-318–8.

Goetz, T., Nishihara, A., Allison, J., Tanase, E., 2019. Student Guide English I – II World Link Book 1 [WWW Document]. URL https://docs.google.com/document/d/1DEutkDCvc_NXiFs18GqhzPQdmD5Cu3eUgR0wRb3YTh0/edit (accessed 10.14.20).

Koch, A.K., Pistilli, M.D., 2015. Analytics and Gateway Courses: 30.

Krashen, S.D., Terrell, T.D., 2011. The natural approach: language acquisition in the classroom. Phoenix, New York.

Kruskal-Wallis Test Calculator - One-Way ANOVA on ranks [WWW Document], 2021. URL https://www.statskingdom.com/kruskal-wallis-calculator.html (accessed 5.27.21).

Ling, G., Wolf, M.K., Cho, Y., Wang, Y., 2014. English-as-a-Second-Language Programs for Matriculated Students in the United States: An Exploratory Survey and Some Issues. Research Report. ETS RR-14-11. ETS Res. Rep. Ser.

Mair, P., 2021. CRAN Task View: Psychometric Models and Methods.

Moodle in English: Item response Theory [WWW Document], 2013. URL https://moodle.org/mod/forum/discuss.php?d=239025 (accessed 7.21.21).

Mukerjee, S., 2014. Agility: A Crucial Capability for Universities in Times of Disruptive Change and Innovation. Aust. Univ. Rev. 56, 56–60.

Swan, K., Bloemer, W., Day, S., 2017. Gap Analysis: An Innovative Look at Gateway Courses and Student Retention. Online Learn. 21. https://doi.org/10.24059/olj.v21i3.1233

Two Way ANOVA Calculator [WWW Document], 2021. URL https://www.statskingdom.com/two-way-anova-calculator.html#vmes (accessed 5.27.21).

World Link, Third Edition: Developing English Fluency - National Geographic Learning [WWW Document], 2016. URL https://eltngl.com/search/productOverview.do?N=200+4294918503&Ntk=NGL%7CP_EPI&Ntt=PRO0000000589%7C7684844052769954531776847452982950685&Ntx=mode%2Bmatchallpartial&homePage=false (accessed 5.25.19).

Student Perspectives on the Digital Learning Experience During COVID-19 Lockdown

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DOI: 10.34190/EEL.21.076

Abstract: As a result of lockdowns due to the COVID-19 pandemic, students and lecturers in higher education worldwide had to move from campus-based teaching to digital learning environments. Almost over-night, lecturers and students had to adjust to teaching and learning through live streams like Zoom as well as video recordings of lectures. Several differences from campus teaching were immediately apparent. As an example, many lecturers experienced less interaction with their students during lectures, as most students were reluctant to speak or turn on their web cameras. This paper presents a study exploring the learning experiences and overall situation as seen from the student perspective. 15 participants were recruited among first- and second-year bachelor students enrolled in IT studies at a Norwegian university college. A qualitative approach was taken, and the students were interviewed in a semi-structured manner. This research reveals that the individual experiences differ greatly among the students, due to personal circumstances like family and living situation. However, challenges related to self-discipline, motivation and communication seem to be experienced by most of the participants. Our findings suggest that when facilitating for courses with a larger amount of the content delivered online, one should have particular focus on how to guide the students to be more independent and self-motivated, in addition to helping them develop a daily routine. For instance, the role of live lectures, as opposed to pre-recorded videos, may be a way of scaffolding the digital learning environment. Furthermore, there should be increased focus on how to support the students to meet with their peers. Measures could be social or informal gatherings, meetings in smaller groups, or group assignments demanding collaboration.

Keywords: higher education, COVID-19, digital learning environment, zoom, student interaction, qualitative study

1. Introduction

During 2020, because of the COVID-19 pandemic, higher education institutions worldwide had to close campuses, and move lectures and supervision to digital learning environments. As of May 2021, most learning activity in higher education is still online, and people worldwide are forced to do collaboration digitally. Several differences in how people collaborate and do work in general are expected when working from home compared to when meeting in physical offices, classrooms, and auditoriums.

The current study was conducted at Kristiania University College, in Oslo, Norway, during the spring and fall of 2020. Many lecturers at the college experienced reduced interaction with their students during lectures, as almost none of the students were willing to use web cameras or speak during lectures. The objective in this study was to get insight in how the students experienced the lockdown with emphasis on their study progression and learning experience. The main motivation was to learn from the initial experiences with the lock-down, and to be able to plan for a better learning environment for the students in similar situations in the future.

2. Related work

Power and Warren (2021) use social learning theory by Bandura (2002) as a framework for finding countermeasures to issues arising when new faculty learn from home during the pandemic. In social learning theory one has the concept of observation and modelling. Learners observe others and learn behaviours depending on the outcome of their actions, i.e., vicarious reinforcement. The student’s self-efficacy is connected to social modelling and vicarious experiences as they observe peers, student assistants and teachers. Power and Warren conclude that scheduled formal and information meetings using platforms like Zoom are valuable for social learning to take place.

Gonzalez et al. (2020) report that students have become more autonomous during the lockdown, which has affected their study habits and learning efficiency. The authors suggest that these changes are due to the students’ awareness of the COVID-19 situation and their own perceived responsibility for succeeding. This situation may make them work harder to avoid missing any important content or fail their courses because of the confinement.

Castelli and Sarvary (2021) find that students (N=276) choose to not turn on their cameras during synchronous class meetings. The main reason given is the students' concern regarding their appearance. Other reasons reported are not wanting to disturb others, fear of being observed not paying attention, and that is seems to be the norm to not use the camera. Castelli and Sarvary propose to encourage and explain why they should turn on their cameras and establish it as the norm from the first day of class. They also mention providing sufficient breaks to stay attentive and putting students in smaller groups online to encourage use of camera.

Handel et al. (2020), Elmer et al. (2020) and Cao et al. (2020) investigate the issues arising from social isolation in the COVID-19 pandemic. Handel et al. find that the students who self-reported having the highest skills in use of digital tools and information seeking scored better with respect to tension, overload, joy, worries, and loneliness. Elmer et al., comparing earlier cohorts, and Cao et al. report how stress levels, anxiety, loneliness, and depressive symptoms got worse, and recognise the importance of planning for social contact in future combinations of on-site and online teaching.

Nambiar (2020) investigates teachers' (N=70) and students' (N=407) perceptions and concerns when it comes to participating in online classes that have been made mandatory in the wake of COVID-19. The findings show that student-lecturer interaction, technical support, structured online class modules, and appropriate modifications to conduct practical classes are important factors for teacher and student satisfaction with online classes.

Aristovnik et al. (2020) state that moving from onsite to online courses requires appropriate mode of delivery to ensure that students do not feel isolated. The authors claim that students prefer real-time video conferences, followed by available video recordings. Internet connection does not seem to be an issue for most parts of Europe, although around 18% of students report such issues. Both Aristovnik et al. and Tejedor (2021) report an increase in workload and report difficulties in focusing and having lower study performance.

To summarise, several studies have focused on the Covid-19 lockdown effect on higher education, and many measures to improve learning and student well-being have been proposed. However, no studies seem to address the diversity of students, with respect to their different needs and situations, and how this may affect their individual experiences.

3. Research methodology

A qualitative approach has been chosen for this study, with the objective to gain a deeper understanding and insight in the individual experiences of the students. 15 students from 1st and 2nd year bachelor of IT from Kristiania University College (Norway) were recruited, and semi-structured interviews with each participant were conducted. During the interviews, the students were asked questions related to how they experienced the COVID-19 lockdown situation and how they perceived it affected their studies and learning experience. Examples of topics discussed were their home working conditions, what type of learning activities that were offered from the college during lockdown, how they perceived the quality of what was offered, what they chose to participate in, and how they collaborated with other students. During the interviews, the students were able to speak freely about anything that came to mind related to what was discussed. All data was fully anonymised, and the participants could withdraw from the interview at any time. An overview of the participants, including data about their age, gender and various characteristics valued as relevant for their reported experiences is presented in Table 1.

To analyse the data from the interviews in a structured way, thematic analysis as described by Gibbs (2012) has been conducted. We thoroughly read and reread the interview transcripts while creating codes and finally themes. In the process we compared both notes, codes and themes refining our findings.

Table 1: Overview of participants in this study

Participant	Age	Gender	Relevant information related to each participant.
P1	25	Female	Shared a flat with her partner who was temporarily laid off. Had no dedicated office space in the flat.

Participant	Age	Gender	Relevant information related to each participant.
P2	26	Female	Had technical issues related to Internet access. Worked part time, so had to work on studies during evenings and at night-time.
P3	29	Male	Lived with his partner in a smaller flat. Had to share a desk and had challenges related to noise and disturbances. Could not use a microphone during lectures.
P4	29	Male	Had to share flat with his younger brother at times ("crowded"). He saved time not having to travel to the college.
P5	27	Male	Motivated and independent student. On sick leave from work due to risk of infection (diabetes).
P6	27	Male	Participated in all lectures. Had issues related to Internet access and *Zoom.* He suffered from stress related to being temporarily laid off from work.
P7	29	Male	Domestic partner, good working conditions from home. He was able to work more efficiently due to a less noisy environment. Sees himself as older and more self-disciplined than some of his peer students.
P8	25	Male	Lives with a large family. Had a desk but chose to do everything study-related from his bed.
P9	24	Male	Work habits unchanged. Collaborated actively with other students through Discord.
P10	20	Male	Had good working conditions at home (separate office space). He enjoyed less disturbances and time saved from not travelling.
P11	25	Male	Lost his job and had various personal challenges. Stated that he "fell out a bit".
P12	20	Female	Seemed a bit demotivated and insecure. Lost structure during lock-down.
P13	27	Female	Shared home office with domestic partner. Struggled with self-discipline. Got temporarily laid off, and thus lost motivation.
P14	23	Female	Some distractions at home but still appreciated working from home due to long travel distance to college. Had a part time job.
P15	23	Male	Ok working conditions. Sees himself as a typical procrastinator.

4. Findings

4.1 The students' home situation

The students had to move from a physical learning environment on campus with auditoriums, workspaces, libraries, cafeterias etc., to working from home. A starting point for this inquiry was getting an overview of the students' working conditions at home.

4.1.1 Physical space

Most of the participants responded that they had adequate space to work, but some reported that they did not have dedicated office space. Some had to work from their sofas, which did not motivate them to work efficiently: "*It is important that it is an office, not a sofa where one can relax (P10)"*. Minor issues regarding Internet connection were mentioned by a few participants. Several students discovered the importance of having two computer screens. This applied especially in courses with live coding, since the students needed to see what the teacher wrote on one screen while coding on the other.

4.1.2 Living situation

The students' living situation ranged from living by themselves, to sharing flat with a partner or sibling, to living in a larger family with little private space. The ones living alone reported good working conditions, while students living with their family or others working from home experienced frequent disturbances and worried that they would disturb people around them: "*If I had to talk with my study group it got too noisy. I couldn't talk as it would disturb my girlfriend (P3)."* Some found themselves studying more in the evening as they experienced disturbances during the day. The amount of space in the student's home also became an issue when it required sharing workspace with another person.

4.1.3 Separating work and leisure

Studying from home means using the same area for schoolwork and leisure, which is a challenge for some. "The worst part is that home should be the place I can do anything I want to. The place where there is no stress and no pressure. It is difficult to switch context. Now it is the place where I have to do everything (P1)." It is also easy to get distracted by the TV for example, which makes it harder to focus and maintain motivation and momentum.

4.2 Participation in learning activities

The participants were asked how they chose to participate in the different learning activities offered by the university college, for instance with respect to how much time they spent on their studies and which activities they preferred to spend time on.

4.2.1 Time effort

The participants' replies varied regarding how much they worked after moving to digital setting. Some reported working as before, while others worked both during the day and in the evening. A lack of structure in combination with distractions or chores at home made them work less efficiently and more sporadically. However, we also saw that some students (P4, P10, P11) worked less but more efficiently than at school. Reasons mentioned include saving time on travelling and working more efficiently than at school, where casual chatting with peers stole time.

Among the students who reported participating and working as before, some managed organizing their academic day through a schedule. The schedule usually included participating in live video lectures, which set the topic for the day. P1 put it this way: *"I like it when lectures are live on Zoom. With recordings, you can watch them any time. In a way, I feel it would be better not to have recordings, since with only live sessions there is more pressure to participate. With live sessions, there will also be "a fixed task" for that day – an activity that you set aside time for. And then you can work the rest of the day related to that activity."*

A select few increased their participation, working and learning more. P10 reports: *"I feel I have worked more than before. Study time has gone up. I have avoided traveling-time and thus I have had more time for study-related tasks."* This participant was the only one who perceived the lockdown situation positive regarding studying and learning: *"I feel I actually have learned more during corona. The stress of being on time is gone. I distinguish between work and private life by working from a home-office."*

4.2.2 Communication

The threshold for communicating with student assistants and peers was high. Participants reported being in contact only with those they knew from before lockdown, i.e., they were not able to establish new connections. In group projects it became harder to get to know the collaborators and work with them. This was partially caused by a dislike for participating in breakout rooms, connected to students not wanting to turn on their cameras and a threshold concerning speaking in Zoom. P5 stated *"It can be a bit awkward, there are several that don't fix themselves"* and continues *"It is especially difficult in bigger classes. It is awkward being the one person who has the camera on."* P6 reported that it was difficult to have the camera on as a student because they could be in bed or not properly clothed. He further explained how in the beginning saw peers suddenly realised they were not properly dressed and quickly closed their laptop.

4.3 Pedagogical facilitation

During the interviews, the students were asked in-depth questions about how they perceived the quality of the pedagogical facilitation provided by the university college. Topics discussed were related to the type of digital teaching (live or pre-recorded), how the lecturers facilitated for interaction during lectures, access to tutors and quality of lab exercises, how to get to know each other online, and how to best utilise allocated time on campus.

4.3.1 Live vs pre-recorded lectures

All the participants in this study reported that most of the lectures had been conducted live using the platform *Zoom.* Many of the lectures had also been recorded and made available afterwards. Most of the participants stated a preference for live digital lectures compared to pre-recorded material. Several participants argued that having to show up for live lectures helps structure the day, and hence increases motivation and productivity. Being able to interact with and ask questions to peers and the teacher also presents an advantage with live lectures compared to video recordings.

Some participants mentioned how pre-recorded videos may be fine for pure theoretical lectures, if they are short and stick to a specific topic. The students explained that this makes it easier to navigate the videos and select the ones they want to focus on in more detail. Another benefit of recorded videos, especially when preparing for exams, is the availability and flexibility they afford.

Challenges related to participation in live lectures were mostly due to intensity and speed of the lectures. The latter was particularly related to programming lectures, where students would code along with the lecturer. When comparing physical live lectures with digital ones, some of the participants experienced it harder to stay focused during the digital live lectures, as breaks where not as regular and lectures thus became intense and tiresome to follow.

4.3.2 Facilitating for interaction

The participants reported little use of student response systems in the lectures. Some mentioned the use of *Mentimeter* and *Kahoot*, but most interaction seems to have been through Zoom chat. In Zoom, students can chat privately or openly with the lecturer and their peers. Many participants reported that this was a convenient way to communicate with the lecturers, and P7 also believed it had a lower threshold for communication in class compared to a physical auditorium. However, other participants pointed out how having to write down their questions constituted a higher threshold to reach out to the lecturers compared to raising their hand in class and ask. As P3 reported: *"It can be difficult to formulate a question about stuff you do not know so well using written text."*

4.3.3 Access to tutors and lab exercises

All participants mentioned issues regarding access to tutors and lab exercises. With lab exercises on campus, these sessions are normally led by student assistants, typically 2nd or 3rd year students. After the lock-down, lab exercises had to be done online. Many participants reported that they were a bit unsure about how to contact their tutors, while others experienced them as available through Slack. Some participants stated that Slack was not a good substitution for on-campus sessions. One reason for this was students' higher threshold for asking questions in Slack channels, which often led to them trying other online resources (YouTube, etc.) for help. It was also mentioned that by losing the physical lab exercises, the students also lost an arena for social networking: *"I miss being able to talk more casually with the supervisors, to hear all sorts of things from more experienced students (P5)."*

4.3.4 Establishing relationships

Getting to know each other and establishing relationships when all interaction is online is challenging. One aspect in this study was hence to investigate the mechanisms that affect how students can build connections to their peers and lecturers during such a setting.

Several of the participants mentioned how certain lecturers would have so-called open Zoom sessions that had no curriculum-based content but had the primary function to be a place for social hangouts and getting to know each other. *"Not very productive, but many of us enjoyed it. And he (the lecturer) could present himself as a normal human-being (not just a lecturer) (P1)".* The students were asked about their preference with respect to how the lecturers presented themselves visually during the live sessions; if they used a virtual background or if they revealed their personal homes while lecturing. The responses were quite diverse; many of the students enjoyed getting a better impression of who the lecturers were through seeing their home environments, while some commented that it could be distracting, particularly if children would appear in the background.

4.3.5 Preferred use of campus time

Kristiania University College planned some sessions on campus for most students, depending on the size of the class. This meant that students would have some lectures on campus and the rest online. Related to this, the participants were asked how they would prefer the allocated time on campus being used. Many participants stated that they would prefer to have lab exercises with teaching assistants on campus, both to be able to ask questions and get help solving issues related to programming exercises, and for socialising. Others stated that they missed the on-campus lectures and did not believe students would show up on campus if "only" lab exercises were offered. Finally, it was mentioned that the most difficult subjects should be given time on campus, with student assistants and teachers, as these were more challenging for students to do from their homes.

4.4 Well-being and social relations

When it comes to well-being, none of the candidates said they felt better during lockdown. P9 was the most positive and chose to see the lockdown restrictions as a necessity to avoid becoming ill. This participant also seemed less affected than others by restrictions that resulted in little physical contact with others. All other participants felt socially restricted in the lockdown situation, with the big, returning reason being the already mentioned: *"missing campus as a social place to meet fellow students."*

According to the participants, having relations to fellow students was difficult during lockdown. While some managed to keep good relations to the network they had from before lockdown started, most gradually lost contact with other students, and it changed from a setting where they collaborated well on lab exercises and tasks to a setting where they worked individually or with one fixed study-partner. Like P5 said: *"I have previously worked with a group of friends that was formed during the sponsor week. But three of them have now left, I work with the one person remaining from that group."*

Several said they did not collaborate with other students at all. A single participant, P12, reported better student collaboration through Discord than in physical locations. However, even this participant agreed that it was taxing not to be able to meet fellow students at campus. Regarding relations to, and communication with student assistants and lecturers, the participants reported similar patterns.

5. Discussion

Although institutions almost overnight had to move from providing education in physical locations to providing it in a digital setting, the participants overall reported that the quality of the lectures did not differ much from when on campus. The students also seem to prefer the lecture style they have experienced before the lockdown. However, important issues regarding the online learning environment have been identified.

The respondents report missing the opportunity to socialise, work together with others and communicate with the teachers and student assistants on campus. It could be assumed that students would make full use of the digital platforms to communicate with others to compensate for lack of social contact. Instead, we observe an important obstacle for achieving a good online learning environment, being that students are not fully comfortable interacting with their peers through the provided platforms. For the most part they seem to avoid using camera and microphone when they participate in online sessions. Hence, the opportunity to learn with others, observe and model peers, such as the more experienced student assistants, mostly disappears. They also lose the opportunity to motivate each other or sufficient vicarious experiences, i.e., seeing their peers fail, overcome, and succeed.

The students acknowledge that seeing each other is beneficial for a good learning environment, but still mostly keep their cameras off, even in smaller groups and in situations like project exams. The findings are consistent with Castelli and Sarvari (2021) on camera use. In addition, our findings show that some students find it awkward to turn on their camera even when their peers do, the issue being exposure. And most students feel it as an obstacle to be the first to turn the camera on – they wait for others to do it first. The collective self-efficacy hence becomes low, i.e., it seems futile to try to change the norm.

Several participants said they are comfortable using the chat functionality during lectures but are reluctant to use the microphone for questions and comments. The chat can be used for direct messages to the lecturer or peers, or public for everyone to see. Even when chatting, many students indicate that they do not feel comfortable if everyone sees their messages, and some react negatively if the lecturer reveals their name after they have asked a question with a direct message. Students also report it difficult to get to know each other online, and that they mainly collaborate with people they already knew from before the lockdown. This is also consistent regarding the literature on students working more alone and feeling more isolated, as our students reported they had decreasing contact with others during the semester.

Regarding how the lecturers should present themselves during video lectures, there were slightly mixed responses. The participants agreed that they like a personal touch to lectures and that it should be done in a way that is not disrupting. However, what they perceive as disrupting varies. While most feel that a digital, overlaid backdrop is disrupting because it flickers around the edges of the person, some instead feel that seeing the actual room and everything in it is disrupting, especially if something is happening in the background.

While Gonzalez et al. (2020) report that students become more autonomous and improve their learning and study habits, this study shows varying ability to create structure when working from home. Most participants reported how they miss having their home mainly as a place to relax and unwind, and that going to campus is how they structure their workday and focus on studies. As a result, several students struggle with procrastination, particularly when the lecture material is available 24/7. The most extreme case was a participant who did a full 24-hour exam from his bed. Most of those who managed to hold efficient workdays from home anchored this in a live video lecture and then branched out with related tasks. Summing up, the literature and findings point to some possible directions for handling situations where the education setting moves from a physical location to a digital scene. Scaffolding the lecture environment and the general digital environment to "break the ice" between students seems needed. This can be done by clearly showing the benefits, by establishing the norm of using camera and microphone as quickly as possible, and by hosting social meetings in bigger and smaller groups to build student-confidence.

The teacher should be aware that students may have challenges regarding focusing and working efficiently from home. The live lecture gives students structure and motivation, and interactivity and a personal touch may be beneficial for the teacher-student relationship. Using the real background in live digital lectures can be a way of "inviting the students in". When teachers cannot see their students' faces, they may forget to provide breaks which may have a negative effect on attention.

While it is not something the lecturer can control, the infrastructure at the audience's end plays a part in this too. A quiet and dedicated place to work with adequate hardware. Meaning decent bandwidth, and - if the audience are to participate - probably also a double monitor setup.

6. Conclusion

The COVID-19 lockdowns have forced higher institutions to move from a physical classroom setting to a digital learning environment where students study and attend lectures from home. Even though we have the infrastructure for delivering education online, there are challenges that need to be addressed that are not due to the technical limitations, but rather to how students are able to adapt to the situation and make use of the systems provided by the institution. This especially concerns two issues, the first being the students' ability to structure their study day. The second issue concerns the learning situation itself with synchronous communication in online lectures and between students through tools such as breakout rooms in Zoom. Higher education is aware of the benefits of student participation and active learning in social settings; however, one also need to reflect on how the students' situation at home is, and how the students will handle exposure of themselves through camera and microphone.

References

Aristnovnik, A., Kerzic, D., Ravselj, D., Tomazevic, N. and Umek, L. (2020), Impacts of the COVID-19 Pandemic on Life of Higher Education Students: A Global Perspective, Journal of Sustainability 2020, 12(20), 8438, MDPI.

Bandura A. (2002) Social cognitive theory in cultural context. Applied Psychology: An International Review. 51(2):269–290.

Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J. and Zheng, J. (2020) The psychological impact of the COVID-19 epidemic on college students in China, Journal of Psychiatry Research 287.

Castelli F. R. and Sarvary, M. A (2021), Why students do not turn on their video cameras during online classes and an equitable and inclusive plan to encourage them to do so, Wiley Online Library, Ecology and Evolution.

Elmer, T., Mepham, K. and Stadtfeld, C. (2020), Students under lockdown: Comparisons of students' social networks and mental health before and during the COVID-19 crisis in Switzerland. PLoS ONE 15(7): e0236337.

Gibbs, G. R. (2012), Analysing Qualitative Data: Thematic Coding and Categorizing, SAGE Publications.

Gonzalez T., de la Rubia, M. A., Hincz, K. P., Comas-Lopez, M., Subirats L., Fort S., et al. (2020), Influence of COVID-19 confinement on students' performance in higher education. PLoS ONE, 15(10): e0239490.

Handel, M., Stephan, M., Gläser-Zikuda, M., Kopp, B., Bedenlier, S. and Ziegler, A. (2020), Digital readiness and its effects on higher education, Journal of Research on Technology in Education, pp 1-15.

Nambiar, D., (2020), The impact of online learning during COVID-19: student's and teachers' perspective, The International Journal of Indian Psychology, Volume 8, Issue 2, April-June.

Power, P. J., & Warren, G. M. (2021). The leap to faculty in the time of COVID19. Journal of professional nursing: official journal of the American Association of Colleges of Nursing, 37(1), 34–37. https://doi.org/10.1016/j.profnurs.2020.11.008

Tejedor, S., Cervi, L., Perez-Escoda, A., Tusa, F. and Parola, A. (2021), Higher Education Response in the Time of Coronavirus: Perceptions of Teachers and Students, and Open Innovation, Journal of Open Innovation: Technology, Market and Complexity, MDPI.

Enhancing Pedagogy to Andragogy in the Redesign of Teacher Training Courses on Programming

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DOI: 10.34190/EEL.21.032

Abstract: Many countries have a new policy with an aim of involving computer programming earlier in the compulsory school curricula. In Sweden this should be implemented as a part of secondary school mathematics and technology. This reform has created a nation-wide need for teacher professional development with programming courses given by universities. For the universities this is a new learner group with a higher average age and different learning needs than the traditional younger students. The aim of the study was to identify and discuss opportunities and barriers for increasing the pass rate and learner satisfaction in programming courses for secondary school mathematics and technology teachers. Main research questions in the study were, 1) Which factors for increased pass rates and participant motivation could be identified for teacher training courses on programming? and 2) How might these identified factors be related to course participants learning needs? This study was carried out as a case study involving triangulation of multiple data sources. Data has been gathered in a combination of self-assessment questionnaires, course evaluations and essays written by course participants from three different course instances. A content analysis was conducted to find and group themes in the data that are relevant to answer the research questions. The analysis has been partly inductive, and partly deductive with adult learning as the theoretical lens. The study identifies 8 main themes that are important to consider as factors for course pass rate and participant motivation. The identified themes are: 1) Exchange of experience, 2) Practical work, 3) Help and support, 4) Alignment to prior knowledge, 5) Required time and commitment, 6) Level of difficulty, 7) Clarity and structure, 8) Participant expectation. Dependent on how these are addressed in teacher professional development courses, they can be opportunities or barriers for increased pass rate. The next step will be to apply and evaluate the identified themes in future course re-design.

Keywords: adult learning, andragogy, programming, teacher training, teacher professional development

1. Introduction

Teacher professional development on 21st century skills such as technology literacy is an important ongoing process where higher education needs to adapt to adult learners' daily work and life conditions. Several research studies have found examples of traditional educational methods failure, and that the frequently linear instructional design in higher education does not align to the dynamic nature of contemporary workplaces (Hase, 2009; Moore, 2020). The Corona/Covid-19 pandemic has also been a catalyst for the shift from face-to-face activities to online learning (Hodges et al., 2020; Mozelius, 2020), a fact that strengthens the need for redesign of technology enhanced teacher professional development.

Many countries have recently introduced new policies on involvement of computer programming early in the compulsory school curricula. An ongoing process in the Swedish context is to introduce computer programming as a tool to reinforce problem solving and visualisation in K-12 education. A reform that has created a nation-wide need for teacher professional development on computer programming with contract courses given by universities. This is a new learner group with a clearly higher average age, and with different learning needs if compared to student groups at the regular bachelor's and master's programmes. For this new learner group there is a need for a tailored pedagogical model related to the daily life situation for adults with full-time employment. The aim of the study was to identify and discuss opportunities and barriers for increasing the pass rate and learner satisfaction in programming courses for secondary school mathematics and technology teachers.

This study was carried out with a case study approach with data gathered from three instances of a teacher training course on fundamental programming. In all the course instances authors have had the roles of teachers, subject matter experts and course designers. The important research questions to answer were: 1) Which factors for increased pass rates and participant motivation could be identified for teacher training courses on programming? and 2) How might these identified factors be related to course participants learning needs?

2. Theoretical framework

Looking at adult learning as a concept of its own with a specialised design, there are still similarities to what we call traditional pedagogy for childhood learning (Brookfield, 1995). Instead of emphasising the differences between the two, the recommendation is to also pay attention to what they have in common (Tuijnman and van der Kamp, 1992), and to see adult learning as an extension building upon pedagogy (Knowles, Holton & Swanson, 2015). Furthermore, it seems sensible to choose the parts of adult learning that are relevant for the actual learning context. This study has focused on how adult learning has been described by Knowles, Holton and Swanson (2015), with a set of fundamental core principles. According to Knowles, Holton and Swanson (2015) it is especially important for the adult learner to be able to relate what is to be learnt with previous knowledge and experiences. Besides goals and purposes, and situational and individual differences, that affect the learning, adult learning also has a set of core principles. The core adult learning principles that should guide the adult learning are summarised in 1) Learner’s need to know; 2) Self-concept of the learner; 3) Prior experiences of the learner; 4) Readiness to learn; 5) Orientation to learning; 6) Motivation to learn. (Knowles, Holton & Swanson, 2015)

The first core principle (Learner’s need to know), state that it is important that the adult learner not only know *what* is to be learnt; but also, *why* and *how* it is to be learnt. Learning how to learn might look superfluous in teacher training, but a concrete example from the teacher training courses on programming is that participants with a long experience of traditional learning sometimes have no experience at all of online learning. Learning to learn should also consider awareness of individual learning preferences. Most adult learners have developed a self-conscious awareness of how they have learnt what they know, and also an insight into the process of assumptions and justifications of what can be seen as true. (Brookfield, 1995) The second core principle (Self-concept of the learner), explains that the learning should be autonomous and self-directed by the adult learner. Self-directed learning, building on the idea that learners take control of their learning process, could preferably be applied to younger target audiences as well. Anyhow, adult learners with a long professional experience have a better opportunity to outline their own suitable learning methods. They also know better where to search and find relevant resources to facilitate the learning process. This might probably be pushed even further in teacher training, where participants are trained in pedagogy and didactics.

In the presentation of adult learning, Knowles, Holton and Swanson (2015) have argued that Andragogy should not be set in opposition to Pedagogy, and rather seen as a complementary extension for adult learning. Building on the same idea, adult learning can preferably also involve the extension of Heutagogy in what has been defined as the pedagogy–andragogy–heutagogy continuum (Blaschke, 2019; Moore, 2020). Applying this continuum, the learner's personal journey should involve the transition from traditional learning towards a more self-directed and self-determined learning. Course design must of course be related to this continuum, with a dependency on factors such as learning objectives and assessment requirements. The self in self-direction must not be interpreted as selfishness, and au contraire include that an adult learner ought to engage in social networks and collaborative learning (Brookfield, 1995). Adult learning also involves that the teacher role should shift towards a coach or facilitator of learning, instead of the traditional lecturer role (Hase & Kenyon, 2007; Henschke, 2011). However, as highlighted by Knowles, Holton and Swanson (2015, p. 53), adults can have strong habits of teacher dependency from earlier education, and *that "they often experience a culture-chock when first exposed to adult educational programs that require them to participate in the planning"*.

The third core principle (Prior experiences of the learner), suggest that the mental models and prior experiences of the adult learner should be used as a resource for learning. Experiential learning is a recommendation both in adult learning and in Heutagogy. An important principle that should build upon the learners' earlier unique experiences, and that those experiences become an integrated part of a more non-linear learning process (Hase, 2009). Like in other forms of work-integrated learning, diversity must be seen as an asset, and not the opposite. Learners with different backgrounds, different skill sets, and different perspectives should solve real-world problems in interdisciplinary activities with a course design instructional design that emphasises context-aligned and problem-focused assignments (Cremers et al., 2016) This is aligned to the fourth core principle (Readiness to learn), and to highlight the importance of that adult learning should be life related and that tasks conducted in this setting are developmental. Adult learning should, by definition, adapt to adults' life conditions (Brookfield, 1995), which like the third principle, also can be found in constructionism, the pedagogical branch that is frequently used in programming education (Boyer, Langevin & Gaspar, 2008; Konecki, 2014). Constructionism should be implemented as learner-centred activities where learners are supposed to work with concrete tasks using prior knowledge to acquire new knowledge and to create mental models. A fundamental idea in constructionism is to visualise learning and thinking to engage learners in a process-oriented construction of useful real-world artefacts. (Alimisis & Kynigos, 2009)

The fifth core principle (Orientation to learning) points out that the adult learning should be problem centred and contextual. Problem-based learning could preferably be combined with constructionism in programming education (Mozelius, 2017), but the combination has been found to be fruitful also in the context of social sciences (Hmelo-Silver & Barrows, 2006). Regarding the aspect of contextualisation, teacher training courses on programming need a different course outline than traditional programming courses. Programming courses at university level has a tradition of training younger students for system development in the industry. Teacher training courses should instead have a focus on didactic concepts that after the course could be reused in the teachers' daily activities. An important design idea is to use programming techniques in teaching and learning activities aligned to the teachers' actual curricula (Mozelius, 2018). Finally, the sixth core principle (Motivation to learn), stress that the learning should focus on intrinsic value and personal payoff for the adult learner. This principle could further be underpinned by the Self-determination theory, an approach to understand human motivation and the role of humans' inner resources for personal development (Ryan, Kuhl & Deci, 1997). The Self-determination theory is based on three psychological needs, the need for competence (White, 1963; Harter, 1978), the need for relatedness (Reis, 1994; Baumeister & Leary, 1995), and the need for autonomy (deCharms, 1968; Deci, 1975).

3. Method

The study has been conducted as a case study with data collected from three different sources with the idea of data triangulation (Denzin, 2007; Fusch, Fusch & Ness, 2018). The use of multiple data sources is a common approach in case studies, since it allows for a deeper understanding of the studied phenomenon (Remenyi et al., 2002; Denscombe, 2014; Bryman, 2016). Data used in this study have been collected from three different instances of a professional development course on programming fundamentals for K-12 teachers (autumn semester of 2018, spring semester of 2019, and autumn semester of 2019). The three different data sources consist of self-assessment questionnaires conducted before the course, course evaluations conducted at the end of the course, and essays written by the course participants during the course (Table 1).

Table 1: Collected data

	Autumn 2018	Spring 2019	Autumn2019
Participants	60	32	15
Self-assessment questionnaires	57	26	15
Course evaluations	25	9	6
Essays	31	18	6

Data have been collected with the same instructions and within a similar context and time frame in all three course instances. The self-assessment questionnaire asked the course participants about their previous experience in programming and their expectations on the course. The course evaluation asked the course participants about their perception of the course and how it related to their expectations about the course. The self-assessment questionnaires and the course evaluations were free-text answers, except for some initial background questions. The instruction for the essay was to write a reflection on what challenges the course participants experienced in learning programming during the course.

The collected data have been analysed with content analysis to identify themes of interest to answer the study aim and research questions (Drisko & Maschi, 2016; Bryman, 2016). A mixture of inductive and deductive coding was used in the process of analysis. Inductive coding was used to identify and group themes of opportunities and barriers for increasing pass rate and learner satisfaction. Deductive coding was used to group these themes in bigger themes (categories) that relate to the core principles of adult learning (Knowles, Holton & Swanson, 2015).

4. Results and discussion

This study has identified 8 main factors (opportunities and barriers) for increased pass rate and learner satisfaction in programming courses for secondary school mathematics and technology teachers. In this section, these are presented and discussed in relation to the core principles of adult learning (Knowles, Holton & Swanson, 2015).

4.1 Exchange of experience

A theme in the course evaluations is that the teacher participants appreciated the discussion and cooperation with fellow teachers in the course. In this, they had the opportunity to share and learn from each other's experience and reflections on using programming in classroom practice. The self-assessment questionnaires also show that many teachers have a similar background and previous knowledge of programming. That is, teachers in grade 7-12 mathematics or technology with little or no prior knowledge in programming. This facilitates the exchange of experience among the teachers.

The exchange of experience is considered an opportunity for increasing the pass rate and learner satisfaction in the programming course. It is something that the teacher participants mention that they appreciate in the course evaluation, and it can be related to the core adult learning principle of *Learner’s need to know* (Knowles, Holton & Swanson, 2015). By sharing and learning from each other, the course’s *what* to learn is complemented by the teacher participants *why* and *how* to learn.

4.2 Practical work

A theme in the course evaluations is that the teacher participants appreciated the practical, hands-on, work with programming in the course. In this, they had the opportunity to test and develop their skill as programmers and develop their own teaching and learning material. A theme in the essays that the teacher participants wrote during the course is also that programming is perceived as a fun activity. Which is an important factor if the teacher participants are to pass this knowledge along to their students.

The practical work with programming in the course is mainly considered an opportunity for increasing the pass rate and learner satisfaction; and have a clear connection to the *what* in the core adult learning principle of *Learner’s need to know* (Knowles, Holton & Swanson, 2015). Although many teacher participants considered programming difficult, and the pass rate could be increased by reducing the programming exercises in the course. It would be difficult to motivate teachers to take a course in programming if they did not learn how to program, which would affect learner satisfaction.

4.3 Help and support

A theme in the essays that the teacher participants wrote during the course is that there is a lot of freely accessible material available on the web. This can act as support for the teachers during and after the course in developing their own programming skill and their teaching and learning materials to be used with students. In the course evaluations it was also pointed out that the teacher participants wished for more one-on-one help by the course teachers.

The factor of help and support is considered both an opportunity and a barrier for increasing the pass rate and learner satisfaction in the programming course. It is a problematic factor since most teachers would, if they could, provide their students (adult or not) with all the help and support that they wanted. However, teachers at all levels of education are limited by the time that they are allocated. The factor could be made an opportunity for increasing pass rate and learner satisfaction by drawing on the core adult learning principle of *Orientation to learning* (Knowles, Holton & Swanson, 2015). By helping the teacher participants to orient their learning towards seeking their own support, for example through the web, they gain a skill that will serve them even after the end of the course.

4.4 Alignment to prior knowledge

A theme in the essays that the teacher participants wrote during the course is that they consider programming easy to relate to their subjects and to previous knowledge in other fields. Some examples that the teachers mention are the subjects of mathematics, crosswords, problem solving and logical thinking. The teachers further state in the essays that they believe that this could be used to motivate their own students when they integrate programming.

The alignment to prior knowledge is considered an opportunity for increasing the pass rate and learner satisfaction in the programming course; and can also be related to the core adult learning principle of *Prior experiences of the learner* (Knowles, Holton & Swanson, 2015). But it can also be related to the core adult learning principle of *Self-concept of the learner* (Knowles, Holton & Swanson, 2015). By building on what the teacher participants already know, it allows for the learners to take control over their own learning; and the learning can be both autonomous and self-directed.

4.5 Required time and commitment

A theme in the course evaluation is that the teacher participants wished for more time in the course to learn programming, get help and tutoring from the course teachers, and have more campus lessons. Further, the teacher participants mentioned that they had not received sufficient time from their employer to participate in the course. A theme in the essays that the teachers wrote during the course is also that programming is perceived to take a lot of time and commitment to reach the level of proficiency that is required to be able to use it as a tool in their teaching and learning activities.

Required time and commitment is considered a barrier for increasing the pass rate and learner satisfaction in the programming course. It is an especially difficult barrier to overcome since it to a great extent is outside the course teachers and the participating teachers control how much time they get allocated. But it is a crucial barrier to overcome since it considerably undermines the core adult learning principle of *Learner's need to know* (Knowles, Holton & Swanson, 2015). To overcome this barrier both university/department leaders and school leaders must be included in the dialogue. In the meantime, the core adult learning principle of *Orientation to learning* (Knowles, Holton & Swanson, 2015) can be drawn upon to orient the participants towards problem centred learning that is situated in their own teacher practice. But this also requires time to prepare the teacher participants with sufficient programming knowledge to build upon.

4.6 Level of difficulty

A theme in the essays that the teacher participants wrote during the course is that programming is perceived as difficult to learn. Some reasons provided in the essays are that there are many new concepts to learn and a structure and logic that is unfamiliar to the participants. Further, some of the teachers mention that they consider it difficult to judge what learning support on the web is valid to use.

The level of difficulty in the course and the course-material is considered a barrier for increasing the pass rate and learner satisfaction. It is a delicate balance to find a level of difficulty that is appropriately challenging to motivate the participants to keep developing their knowledge; and not simply give up. This barrier relates to the core adult learning principles of *Prior experiences of the learner* and *Readiness to learn* (Knowles, Holton & Swanson, 2015). The course content should be based in what the participants already know. But the participants also need to be in a state or situation where they are ready, or are encouraged, to learn and be challenged.

4.7 Clarity and structure

A theme in the essays that the teacher participants wrote during the course is that they perceive a lack of guidance and clarity for the integration and use of programming in K-12 education. Some questions that are asked in the essays are: what is expected by the teachers? How should programming be used in their subjects? What is expected to improve by integrating programming? A theme in the course evaluation is also that some of the teacher participants perceived a lack of structure in the programming course. An assignment that was added during the course, in an early iteration of the course, was mentioned in relation to this.

Clarity and structure are considered a barrier for increasing the pass rate and learner satisfaction in the programming course. It is a difficult barrier to address since perceived clarity and structure are individual to each participant; and you mainly notice them when they are lacking. A possible approach to address the barrier is to draw on the core adult learning principles of *Learner's need to know* and *Readiness to learn* (Knowles, Holton & Swanson, 2015). The course content should be as clear and structured as possible regarding *what* is to be learnt, and *why* and *how* this is to be done. Unnecessary surprises, such as adding course assignments during a course, should of course be avoided since the participants' allocated time is limited. But the teacher participants should also be made aware that not everything can be understood and perceived as clear in the beginning of a course. To reach this is part of the learning.

4.8 Participant expectation

There are three important themes in the self-assessment questionnaires that the teacher participants conducted before the course that related to their expectations on the course. The first theme is that they expect to learn more about programming. The second theme is that they expect to learn how to integrate and use programming in classroom practice. The third theme is that they expect to receive suggestions, ideas, and materials that they can use in their own teaching activities.

Participant expectation is considered both an opportunity and a barrier for increasing the pass rate and learner satisfaction in the programming course. The decisive factor if it is an opportunity or barrier is how the teacher participants expectations are addressed during the course. Some of the expectations that the teacher participants express in the self-assessment questionnaires are easier to satisfy. The expectations to learn more about programming and how it can be used and integrated in classroom practice are reasonable in a programming course for teachers. However, the expectation to receive suggestions, ideas and materials that can be used in teaching activities is more demanding and not typically what a university course provides. Nevertheless, since the participants' expectations on the course is closely related to the core adult learning principle of *Motivation to learn* (Knowles, Holton & Swanson, 2015) it is important that these are addressed. If the expectations cannot be meet, this should be explained to the participants, in line with the core adult learning principle of *Learner's need to know* (Knowles, Holton & Swanson, 2015).

4.9 General discussion

The identified factors for increased pass rate and learner satisfaction that has been presented and discussed in this section are all considered either an opportunity or a barrier, in some cases both, in relation to the programming courses in which they have been identified. All identified factors can of course be both an opportunity and a barrier for increased pass rate and learner satisfaction. This is dependent on how the course in question addresses these factors.

The identified factors have all been discussed and related to one or two core adult learning principles (Knowles, Holton & Swanson, 2015). This was based on the most obvious connections between the core adult learning principles and the identified factors in the programming course and should not be viewed as the only possible connections. If the identified factors are to be placed in another learning context, other connection to the core adult learning principles could potentially emerge.

In the analysis of the collected data, all identified factors for increased pass rate and learner satisfaction could be related to one or more core adult learning principles. In that sense, the study could be considered to confirm what is already known about adult learning. However, the study has also highlighted practical examples of these factors, or core adult learning principles, in action. An especially interesting example is that of *Required time and commitment*, which has the potential to undermine other core adult learning principles if not properly addressed. Further, in the context of teacher professional development courses, the participants' time and commitment for learning needs to be part of an ongoing discussion between the university/department and the participating teachers' schools and school leaders.

5. Conclusion

This study has identified 8 important factors for increased pass rate and learner satisfaction in teacher professional development courses. All of these relate to learning needs among the participants and can constitute opportunities or barriers for increased pass rate and learner satisfaction. Although these factors are identified in professional development courses on programming, they might also be valid for other forms of adult learning. The identified factors are: 1) Exchange of experience, 2) Practical work, 3) Help and support, 4) Alignment to prior knowledge, 5) Required time and commitment, 6) Level of difficulty, 7) Clarity and structure, 8) Participant expectation.

6. Critical reflection and future research

As highlighted by Agonács and Matos (2019), and further discussed by Moore (2020), self-determined learning and heutagogy have, despite their popularity and wide use, been criticised for lack of thorough evaluation. The same criticism can be found for adult learning and andragogy, and that Knowle's assumptions have become a wide-spread doctrine in adult education without solid empirical evidence (Henschke, 2011). Quite surprising since the term andragogy was used by the German educationalist Alexander Kapp as early as in 1833 (Henschke, 2011; Loeng, 2017). However, with the increased use in lifelong learning more evaluations will probably be carried out in the coming years.

As mentioned earlier, it is for every actual learning context a matter of choosing the parts of theory that are relevant, and to be open for other aspects of adult learning. The next step for further redesign and refinement of the teacher training courses on programming could be to further investigate the pedagogy-andragogy-heutagogy continuum and look at how ideas from heutagogy might facilitate adult learning in technology-supported personal learning environments (Blaschke, 2019). In a strive towards teacher professional development with autonomous learners who are capable of self-determined learning, and to build upon their earlier knowledge in tailored online environments.

References

Agonács, N., & Matos, J. F. (2019). Heutagogy and self-determined learning: a review of the published literature on the application and implementation of the theory. *Open Learning: The Journal of Open, Distance and e-Learning, 34*(3), 223-240.

Alimisis, D., & Kynigos, C. (2009) Constructionism and Robotics in education. *Teacher Education on Robotic-Enhanced Constructivist Pedagogical Methods,* 11-26.

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: desire for interpersonal attachments as a fundamental human motivation. *Psychological bulletin*, *117*(3), 497.

Blaschke, L. M. (2019). The pedagogy–andragogy–heutagogy continuum and technology-supported personal learning environments. In *Open and distance education theory revisited* (pp. 75-84). Springer, Singapore.

Boyer, N. R., Langevin, S., & Gaspar, A. (2008). Self direction & constructivism in programming education. *In Proceedings of the 9th ACM SIGITE conference on Information technology education* (pp. 89-94). ACM.

Brookfield, S. (1995). Adult learning: An overview. *International encyclopedia of education, 10*, 375-380.

Bryman, A. (2016). *Social research methods*. Oxford university press.

Cremers, P. H., Wals, A. E., Wesselink, R., & Mulder, M. (2016). Design principles for hybrid learning configurations at the interface between school and workplace. *Learning Environments Research*, *19*(3), 309-334.

Deci, E. L. (1975). Intrinsic motivation. New York: Plenum.

Deci, E. L., & Ryan, R. M. (1985). Intrinsic motivation and self-determination in human behavior. New York: Plenum.

deCharms, R. (1968). Personal causation. New York: Academic Press.

Denscombe, M. (2014). *The good research guide: for small-scale social research projects*. McGraw-Hill Education (UK).

Denzin, N. K. (2007). Triangulation: the blackwell encyclopedia of sociology.

Drisko, J. W., & Maschi, T. (2016). *Content analysis*. Pocket Guides to Social Work R.

Fusch, P., Fusch, G. E., & Ness, L. R. (2018). Denzin's paradigm shift: Revisiting triangulation in qualitative research. *Journal of social change*, *10*(1), 2.

Harter, S. (1978). Effectance motivation reconsidered. Toward a developmental model. *Human development*, *21*(1), 34-64.

Hase, S. (2009). Heutagogy and e-learning in the workplace: Some challenges and opportunities. *Impact: journal of applied research in workplace e-learning*, *1*(1), 43-52.

Hase, S., & Kenyon, C. (2007). Heutagogy: A child of complexity theory. Complicity: *An international journal of complexity and education, 4*(1).

Henschke, J. A. (2011). Considerations regarding the future of andragogy*. Adult Learning, 22*(1), 34-37.

Hmelo-Silver, C. E., & Barrows, H. S. (2006). Goals and strategies of a problem-based learning facilitator. *Interdisciplinary journal of problem-based learning, 1*(1), 4.

Hodges, C., Moore, S., Lockee, B., Trust, T., & Bond, A. (2020). The difference between emergency remote teaching and online learning. *EDUCAUSE Review*. (Accessed 05/18/2021) from: https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning

Konecki, M. (2014). Problems in programming education and means of their improvement. *DAAAM International Scientific*

Knowles, M. S., Holton, E. F., & Swanson, R. A. (2015). The Adult Learner: The definitive classic in adult education and human. *Florence: Taylor and Francis*.

Loeng, S. (2017). Alexander Kapp–the first known user of the andragogy concept*. International Journal of Lifelong Education, 36*(6), 629-643.

Moore, R. L. (2020). Developing lifelong learning with heutagogy: contexts, critiques, and challenges. *Distance Education*, *41*(3), 381-401

Mozelius, P. (2017). Constructionism and Game-Based Learning as Didactic Strategies in Programming Education. *Progress in Education*, pp 147-166. Nova Science Publishers, Inc. New York.

Mozelius, P. (2018). Teaching The Teachers to Teach Programming: On Course Design and Didactic Concepts. In *11th annual International Conference of Education, Research and Innovation* (Vol. 11, pp. 8031-8037). The International Academy of Technology, Education and Development.

Mozelius, P. (2020). Post Corona Adapted Blended Learning in Higher Education. *In Responding to Covid-19: The University of the Future*. ACPI Reading, UK.

Remenyi, D., Money, A., Price, D., & Bannister, F. (2002). The creation of knowledge through case study research. *Irish Journal of Management*, *23*(2), 1.

Reis, H. T., Sheldon, K. M., Gable, S. L., Roscoe, J., & Ryan, R. M. (2018). Daily well-being: The role of autonomy, competence, and relatedness. In *Relationships, Well-Being and Behaviour* (pp. 317-349). Routledge.

Tuijnman A, Van Der Kamp M (eds.) (1992). *Learning Across the Lifespan: Theories, Research, Policies.* Pergamon, Oxford

White, R. W. (1963). Ego and reality in psychoanalytic theory. New York: International Universities Press.

Speculative Design as a Method of Inquiry in an Online Workshop Setting

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DOI: 10.34190/EEL.21.093

Abstract: This paper presents an empirical study and the resulting insights from a speculative design process in online workshops with students from a K1–12 teacher education programme. The empirical investigation consisted of five online workshops with the purpose of exploring Augmented Reality. Each workshop had a duration of 2.5 hours, with three to six participants per workshop. The theoretical frame was speculative design workshop and methods of inquiry inspired by Dewey, as well as the utilisation of storyboard and design tools for personal reflection. This paper explores three interrelated research questions: What are the implications of conducting an online speculative design workshop? How can speculative design be used as a method of inquiry? What are the potentials and challenges of the tools and exercises used? The research investigates the knowledge that speculative design workshops bring into play, as seen from two perspectives: the participants' learning process and the knowledge the workshops bring to the research field. It also investigates the implications of conducting speculative design workshops in an online setting, where it becomes essential to apply structured facilitation, and provide common tools that allow for creative and material exploration. Though the literature argues that speculative design provides an opportunity where the potentials uncovered are less influenced by the current implementations of the context under investigation. This research shows that working with speculations on preferred futures in various contexts is a challenging endeavour. The findings also show that the format can bring new insights for the participating students, and that it is essential to consider participants' well-being, learning frustrations, and keeping participants on track during the workshop.

Keywords: speculative design, online workshop, inquiry

1. Introduction and research questions

This empirical study materialised due to the need for knowledge closely linked to a local context, namely, investigating the learning potentials of Augmented Reality (AR) in a Danish K1–12 setting. It was therefore desirable to obtain input from people close to this context, who were not only able to think about but also develop existing practices, and who had the time and energy to do so, which made student-teachers (K1–12 students) a relevant choice. Furthermore, from a surrounding society perspective and the learning objectives of the teacher study programme, it is important that these student-teachers acquire technological understanding in general, and particularly knowledge about new technologies such as AR, and about how to work with teaching school children such understandings.

The intention of the study was to plan for workshops within the frame of the specific context (here AR and schools) that would engage participants in an online process of inquiry through speculative designs, supported by reflective, dialogical, and explorative design tools, such as storyboards, to investigate the learning potentials. This resulted in three interrelated research questions: What are the implications of conducting an online speculative design workshop? How can speculative design be used as a method of inquiry? What are the potentials and challenges of the tools and exercises used?

The investigation had a participatory and design-oriented perspective, and due to the futuristic perspective of wanting to investigate and speculate about possibilities and learning potentials, the research design took point of departure in a speculative design workshop (e.g. Auger, 2013; Dunne and Raby, 2013) in an online format. Workshops can function as both a research method that enables researchers to investigate the phenomena in question and to allow participants to acquire capabilities in and develop their own practice about those phenomena (Ørngreen and Levinsen, 2017). However, when planning the details of such workshops, it became clear that the speculative design approach seldom specified approaches in a detailed manner (Piet, 2019), or addressed tools that allowed for a concrete level of inquiry for the participants and the researchers in the role as facilitators of the workshop. In this study, the objective was to engage participants in the social process of making inquiries and thinking about educational design in their context. In this light, the theoretical work became inspired by Dewey, and his work on "how we think" (1920/2011). However, the level of abstraction was still somewhat high, and there was a need for input on which tools and thinking processes could aid in the workshops. Consequently, the workshop design turned to design tools for further inspiration, and more specifically storyboards (Truong, Hayes and Abowd, 2006), with the intention of finding formats that worked in online workshops.

Below, brief theoretical insights are provided (Section 1.1–1.3), followed by information about the research design (Section 2) and a presentation and analysis of the overall workshop (presenting the workshop programme), then analysis of the findings by first offering insights into two participants with different experiences, examples of storyboards, and the potentials and challenges for online speculative design inquiries (Sections 3 and 4). The paper ends with a discussion of the findings and conclusion (in Sections 5 and 6), which highlight the challenges regarding the knowledge required about the field before experiencing being able to speculate, about the exercises and tools used in the study, and about the online environment. Our findings also suggest that these workshops can inform both the current state of a situation or topic and direct future inquiries in the research field.

1.1 Speculative design

The purpose of design, according to Auger (2013), is traditionally to solve problems or invent new products in relation to a commercial market. By extension, design has primarily been regarded as a problem-solving practice (Mitrović, 2015) and is usually aimed at problems detected by other professions (such as economics, sociology, and philosophy). However, according to Dunne and Raby (2013), designers must act speculatively when facing complex problems or attempting to open a dialogue about how the world can be (Dunne and Raby, 2013). Speculative design is an activity in which imagination or speculation is recognised as knowledge, in which futuristic and alternative scenarios can convey ideas, and in which the goal is to emphasise the consequences of 'thoughtless' decisions (Dunne and Raby, 2013). As shown in Figure 1, speculative design has much in common with other design approaches (Auger, 2013), except it differs from traditional design in its outlook towards the future.

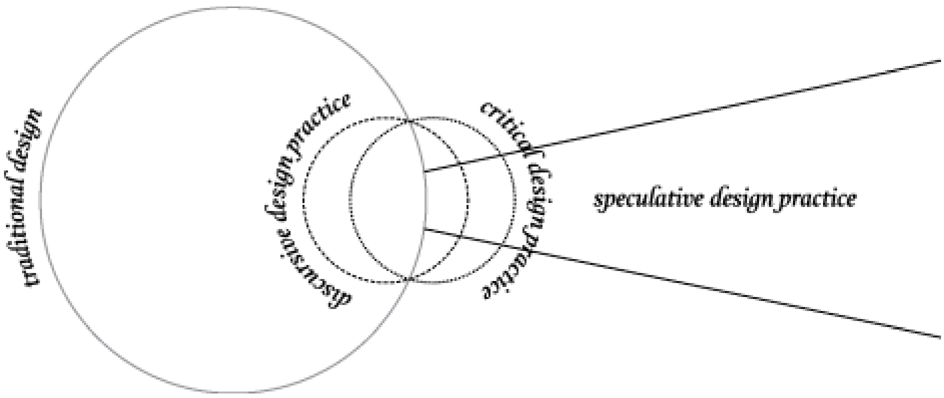


Figure 1: Traditional design vs speculative design (Source: Figure 1 in Mitrović, 2015, p. 9)

With a view directed towards the future, it becomes central for speculative design to propose, suggest, or offer something. Design is well suited to outline possibilities, and although the proposals are based on thorough analysis and research, they must retain their imaginative, improbable, and provocative qualities (Dunne and Raby, 2013). Design can play an important role in expanding the perception of what is possible by integrating ideas, ideals, and ethics into speculative proposals (Dunne and Raby, 2013). Speculative design is not about predicting the future but about allowing all possible possibilities to be discussed and used to jointly define a preferable future for a given group of people (Dunne and Raby, 2013).

With Figure 2, Dunne and Raby (2013) attempted to illustrate the position of the preferred future relative to other ways of thinking about the future. Most designers work within the middle cone, as it represents *the probable*, and it also describes what is most likely to happen. The next cone represents *the plausible* future, and is the space for what can happen, using methods such as scenario planning and foresight to explore alternative futures to be prepared. The broadest cone represents *the possible*, where the key is to create a connection between the existing world and the imagined world through the description of a series of credible actions (even if these are fictitious). Outside this cone is pure imagination, which is the source of much literature, film, art, and others. The cone that overlaps the area of the probable and the plausible represents *the preferable* future. Within this area, speculative design can suggest and discuss what a preferred future might look like.

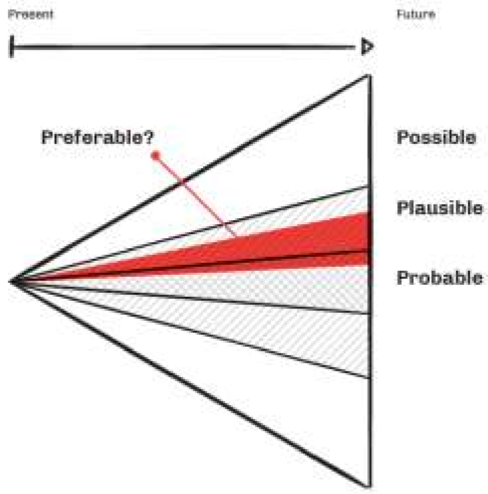


Figure 2: Model of potential futures (source: Figure 7 in Johannesen, 2017, p. 9)

1.2 Methods of inquiry in a Deweyan interpretation

According to Dewey (1938), the world is a place of constant change and development, which makes the world uncertain and changeable, which is why action and change are central elements in the ontology of pragmatism (Goldkuhl, 2012). We are in the world as beings of action who, through participation and reflective thinking, can master how the world changes and develops (Brinkmann, 2007). The process by which one actively intervenes in the world and feels the consequences was described by Dewey as experience, and is something one can actively try to create, whereby one produces knowledge (Brinkmann, 2007). Through exploration, one can gain knowledge about a world marked by action and change. Dewey called the practice of changing an indeterminate and uncertain situation into a determinate and certain situation an inquiry (Brinkmann, 2007).

Dewey identified five steps, later recognised as the five steps of inquiry, in which people relate experience, reflective thought, and action: *"(i) a felt difficulty; (ii) its location and definition; (iii) suggestion of possible solution; (iv) development by reasoning of the bearings of the suggestion; (v) further observation and experiment leading to its acceptance or rejection; that is, the conclusion of belief or disbelief"* (Dewey, 1910/2011, p.73). Dewey's inquiry, as well as his and fellow researchers' thoughts on pragmatism and experience (among others, Pierce, James and Lewin), takes point of departure in that experience offers a method of exploring the world and acquiring knowledge not only about what exists but also towards what 'could be' or towards a possible but not yet realised world (Goldkuhl, 2012).

1.3 Tools and exercises in the workshops—exemplified with storyboards

The literature on speculative design practice is inspired by art, but little has been described about the details of how to carry out such designs (e.g. Dunne and Raby, 2013; Auger, 2013), and this point was also raised by Piet (2019). In Nadia Piet's work, she provided an overview plan for a three-four hour workshop on "Exploring potential AI futures". However, she did not sketch out in detail which tools could be used or how and with which learning. Piet's workshop was therefore used as a starting point and template but further developed to address which tools and exercises can be used. The template was filled using tools that have previously proved themselves successful in design processes and that have been used in educational design and collaborative processes for critical design thinking (Lupton and Leahy, 2019). In this context, storyboards seemed to be an adequate option that was worth exploring.

A storyboard can be described as a short graphic representation of a narrative, and in a design process, storyboards often illustrate how a situation unfolds (Truong, Hayes and Abowd, 2006). Storyboards can show how a user interacts with a product in a specific context over a given period and use a common visual language that people with different backgrounds can 'read' and understand (van der Lelie, 2006). According to Truong, Hayes and Abowd (2006), storyboards are characterised by five features:

- 1. Details - Quantity of details needed to be able to convey the desired narrative.
- 2. Text - Text can be used to convey context, dialogue, or time.
- 3. People and emotions - Creating empathy by including people and their emotional reactions in the situation.
- 4. Number of pictures or slots.
- 5. Visual time - Portray time or show transitions.

2. Research design

In this section, the setting of the empirical study, the data collected, and the steps in the analysis are briefly described. The project's knowledge approach was based on pragmatism (cf. Section 1), and the research process had an overall abductive approach. The empirical data consisted of various data sources over a four-month period in 2020, within the frame of the specific context (here, AR, and schools).

At first, a state of the art and a literature review on AR were conducted, which contributed to the identification of the potentials of using AR in learning situations. The review also included speculative design approaches (on which very little has been described). Second, two in-depth interviews with experts were conducted, with the intention of gaining deeper knowledge about learning situations in a K1–12 setting (Lise Dissing Møller, Lector at KP) and AR as a technology (Lucas Nygaard, Founder of Hololink). Third, five workshops with K1–12 students attending the course "Technology Literacy and Digital Formation" (Rehder et al. 2019) were held, with the purpose of investigating the use of AR in a learning situation, using a speculative method in an online setting, as well as an investigation of the use of speculative design as a method of inquiry. Each of the five workshops was 2.5 hours in duration.

The data consisted of observations and audio recordings of the workshop sessions, visual storyboards created by the students, the students' written documentation of five creative exercises during the workshop, and field notes written after the workshops. Fourth, a thematic analysis of the workshops investigated the AR learning potentials that the K1–12 students identified and visualised through storyboards. Furthermore, the analysis focuses on the K1–12 students' experiences with the speculative design in an online workshop format to identify potentials and challenges.

3. Designing the online speculative design workshop

The type of empirical evidence obtained in a workshop is different from the empirical evidence produced through observations, interviews, or interventions in the participants' everyday practices. A workshop provides an opportunity to address issues through presentations, experiments, and discussions, where the researcher can advantageously create space for contemplation and collaboration. This can provide an opportunity to continuously identify new factors that neither the participants nor the researchers were aware of before the workshop. Through a workshop, the researchers have an opportunity to inquire into and immerse themselves in the process (Ørngreen and Levinsen, 2017). With room for presentations, experiments, and discussions and the ability to create space for contemplation and collaboration, the workshop format can be used as a frame for engaging in inquiry in the form of speculative design (Lupton and Leahy, 2019; Piet, 2019).

Due to unforeseen circumstances, the speculative design workshop was held in an online setting, which gave the opportunity to gather the participants without them gathering in a specific physical location. This also required contemplation of how to transfer the template for the speculative design workshop into an online setting, with the opportunities and challenges this setting presented.

To provide the K1–12 students with an understanding of AR as a technology and its possibilities and limitations beforehand, a flipped learning approach was chosen, where the K1–12 students could prepare before participating in the workshop. Two videos on AR and speculative design were developed and recorded, which the students could watch asynchronously, and at their own pace acquire knowledge about speculative design, storyboards, and AR before the workshop. Two academic texts on speculative design and storyboards were used, as well as a brief description of the purpose of the workshop and how the workshop supported the goals of their course. The intention was to incorporate knowledge from the material into the workshop and build on this knowledge through the planned exercises.

For the online workshop exercise, templates, and a document for sharing and taking notes were used, and the participants chose to use either pen and paper or storyboardthat.com for creating their storyboards to visualise their ideas and speculations. These tools were chosen to create a shared space for collaboration and mutual inspiration as well as because of their usefulness in an online setting.

Students' learning objectives

The participants consisted of K1–12 students attending the course "Technology Literacy and Digital Formation" (Rehder et al. 2019), and the workshop was designed to align with some of the learning objectives of the course where the students should have the opportunity to "be critical and to explore the intentionality of the technology" and "develop and test teaching courses with iterative design process" (Rehder et al. 2019). It was also meant to provide the participants with knowledge about the speculative design method and storyboards to give them the opportunity to reflect on learning, technology, and what a desirable learning situation with AR looks like.

The programme

Based on inspiration from Piet (2019) and considerations of conducting a speculative design workshop in an online format, the following programme with the approximate time was created:

- 1. **Introduction** - 15 minutes
- 2. **Build the world** - 15 minutes
- 3. **Story making** - 20 minutes
- 4. **Anticipating the consequences** - 30 minutes
- 5. **Build the future scenario with storyboards** - 35 minutes
- 6. **Reflection** - 20 minutes

The intention was to become more and more concrete through exercises within the set framework: the use of AR as a learning support technology in the year 2030. The exercises are elaborated on in Table 1, in which the experiences of two participants are shared.

4. Analysis of data

4.1 Presentation of two different experiences of the speculative design workshop

To elaborate even further on the workshops, the following presents a walkthrough of the exercises and highlights two participants' experiences. The two participants were chosen based on their very different experience with/approach to the workshop, where one was more agreeable/accepting of the premise of the workshop/the framework than the other.

4.2 Presentation of three exemplary storyboards from the workshops

The 20 participants created 20 storyboards in all, with 7 of them involving learning situations without the use of AR. Below are three examples of visualisations of learning situations from the workshops. They show different ways of creating storyboards, depending on the tools used, and show different levels of detail.

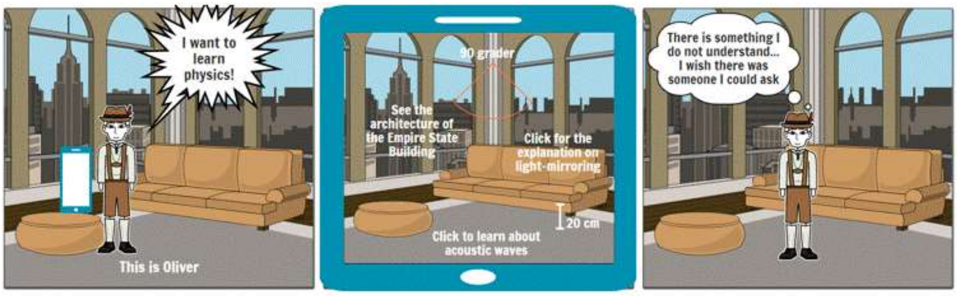
4.3 Analysis of potentials and challenges

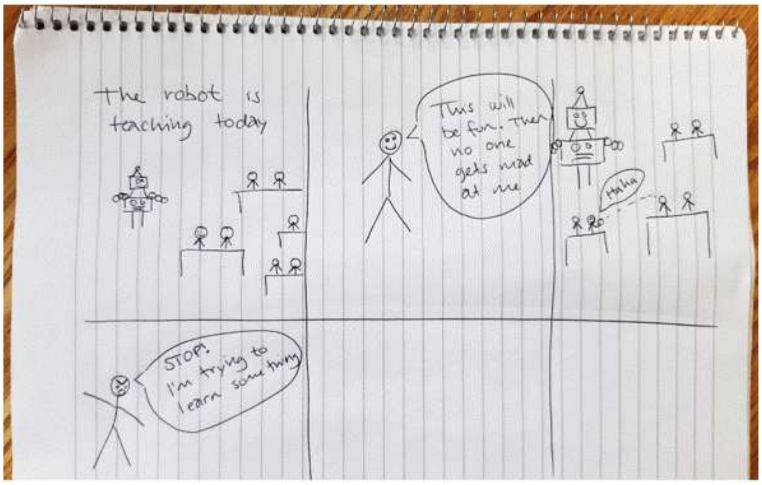
Several challenges and potentials emerged through the analysis of the data from the workshops. First, because speculative design is an approach, there was a need to frame and fill in the workshop with exercises that support the participants' speculative exploration. In this case, some of the exercises worked well to encourage collaboration between the participants, especially since the participants could then follow the development of the ideas in a collaborative way, and they could choose any of the discussed ideas to visualise through storyboards. However, the findings show that some of the exercises were too abstract, as observed in participant B's experience of the workshop (Table 1).

Table 1: A trail of the exercises, their content, and two participants' reflections on the workshop

Exercise	**Participant A**	**Participant B**
World building is used to frame the workshop, and encourage the participants to think within the framework (i.e. AR-technology). Within the context the participants answer two questions: A. Where and how does learning occur? B. What forms of technology-assisted learning exist?	The participant chose to elaborate on question A. He finds that AR is an obvious possibility to be shown a new way of doing things, and to learn through that. *"...in augmented reality you can just point out where the mistake lies (...), and that way you can just show people how to learn something new (...) It will be much easier to complete the learning, I think."*	The participant found it difficult to answer question B, because she thought of everything as technologically supported. *"So I find it very difficult to define definite technological support of learning processes because it just becomes a big part of it all the time no matter what one does."* She also finds it difficult to separate AR and VR.
Story making uses some of the findings from the last exercise to create a learning situation (using AR) Using an answer from the questions A and B from the last exercise the participant creates a learning situation.	The participant chose: *"learning occurs when you are shown a new way of doing things + using the camera on a Smartphone = individually tailored learning based on the student's learning positions."* He elaborates on the learning situation, and points to the lack of development in machine learning, that would be essential for the process (and how the technicalities might not be there yet)	The participant did not complete the exercise as she *"... do not think one should use technological support unless it is very much necessary. So, I think it's very difficult to relate to"* She also tells us that she finds it very difficult to understand it all.
Anticipating the consequences uses one of the learning situations created in the previous exercise, where the goal is to explore and anticipate the consequences. The participants elaborated on two different exercises; A: mapping the positive and negative consequences of the learning situation, B: identifying contradictions in the learning situation based on part A - both positive and negative / intended and unintended within the identified contradictions.	He points to the contradicting relation of being problem solving-oriented and answer-oriented, as a possible negative consequence of always being able to ask a teacher or a programme. *"You could go and become dependent on getting the technology to solve the problem"*	She finds it difficult to find possible contradicting consequences by herself, but with the support of the facilitators finds the contradiction of technology as both a motivation and demotivation *"... because it is harder to understand because you have to include the virtual as well"*
Build the future scenario with storyboards using the findings from the previous exercises. The participants visualize and create a storyboard (depicting a concrete learning situation using AR)	The participant points out the need for a human teacher when he explains his storyboard *"... he wants to learn some physics and then he turns on his iPhone (...) he can press a lot of different things and get a lot of explanations about what is happening in the room around him. (...) But what he then eventually finds out is that he cannot move on because there is something he does not understand and he has no one to ask. And augmented reality as such does not understand the question, it has to be programmed by a human so he has no one to ask and that is of course a problem."*	The participant chose to elaborate on another participant's idea of a learning situation from the earlier exercise. In the elaboration it becomes clear she is not clear on the difference between AR and VR.
Reflection on the process and the workshop	**Speculative Design Workshop** *"I think it's very good, the thing about looking like 10 years into the future (...) You are not so bound by what is actually going to happen, you are just bound by your notion of what is going to happen. So, you are quite free to imagine for yourself how mechanisms can develop and what you can do in 10 years, and then you can assess it yourself, and look at the consequences that could then be of the possible development that things could take from there. It has been quite creatively stimulating."* **AR** *"So, I think that augmented reality can support a student if the students themselves want it to help their learning, but if they do not care, then I also think it is an easy way to skip it because, you need not to listen to your iPad, you have to listen to your teacher, right?"*	**Speculative Design Workshop** The participant found it helpful that each exercise built on the last exercise, *"...because now it was something we had talked about beforehand. So, I think it was very good that you kind of went back to the same thing (...). It had a bit of that red thread through it all, so it wasn't all that fluffy".*

Table 2: Three storyboards from the workshops (reproduced and translated for anonymity)

<table>
<tr><td>


</td><td>Storyboard made in storyboardthat.com which illustrates an AR situation</td></tr>
<tr><td>


</td><td>Storyboard made with pen and paper, where the participant did not incorporate AR in the learning situation</td></tr>
<tr><td>


</td><td>Storyboard made in storyboardthat.com which illustrates a VR (not AR) situation</td></tr>
</table>

Another issue to consider is the topic (here AR) and choice of participants for the speculative design workshop, and the relation between topic and participants. The workshops needed to be framed in a way that made sense for the participants and at the same time challenged them to go beyond and engage in speculation. The topic, AR, was a difficult and elaborate technology that was too challenging to comprehend for some. Moreover, AR and virtual reality were not separate concepts in the minds of all the participants. The lack of understanding can make it difficult for the participants to visualise details when they are not familiar with or have a complete understanding of the technology. However, innovative or new ideas might emerge because the participants are not bound by the limitations of the technology. In this case, the participants were mostly limited by their understanding or misunderstanding of the technology, as the examples in Table 2 show, and as observed in the high number of storyboards visualising a learning situation without the use of AR (7 out of 20).

The use of a template, such as storyboardthat.com, also influenced the visualisations the participants created. Some found the template helpful, as it offered backgrounds, pre-existing characters, and items, giving the possibility to visualise their ideas in great detail without drawing, which some participants expressed was a challenge. Others found that the template required too much effort to navigate and chose to use pen and paper, which was then shared as a picture in the shared document. The use of templates offers many choices, and there is a risk of the participants becoming too engaged in the choices, and they might end up using too much time on making the storyboard look just right and not focussing on conveying the concept of the idea in a clear way. However, this issue did not present itself during the workshops.

Using a template, as well as the opportunity to use pen and paper for creating the storyboards, offers a materiality to the participants' ideas. The findings show that by using storyboards, the ideas of the participants became clearer, and more details were revealed through the visualisation than through the verbal explanation of the idea. For example, participant A described an idea where learning arises when you, through the use of AR and the camera in a smartphone, can tailor the learning experience to suit the individual. Through image recognition, the smartphone enables students to engage the surroundings. Even though this participant was quite adept at explaining the idea, details, and context, new perspectives were revealed when participant A was asked to create a storyboard outlining the idea. The first storyboard in Table 2 shows how the character, Oliver, can see different examples of applied physics in his surroundings through the smartphone, which supplies details to participant A's idea. The storyboard also shows that, when Oliver meets something, he does not understand, he needs someone to ask. The creation of the storyboard revealed something new about participant A's idea, and the idea became more substantial.

Other implications arise when conducting a speculative design workshop in an online format. After conducting five online speculative design workshops, it was clear that muted microphones, turned off cameras, and a lack of nonverbal communication meant that the facilitator did not get enough feedback from the participants to deduct the participants' involvement in and understanding of an exercise. The structure and management of the workshop had to be precise, and the facilitator had to engage the participants directly, as the online format could be construed as a barrier to the participants engaging in the exercises and dialogue. It showed that it is important to actively and regularly ask about the participants' understanding to gauge where they are in their involvement in the workshop. The use of preselected examples coupled with thorough explanations helped facilitate the participant's understanding of the exercises and foster engagement. The structured facilitation of the online workshops and the direct engagement of the participants ensured that every participant was heard and involved in the different exercises, and consequently, the involvement was more evenly distributed between the participants. Facilitating more workshops (here five) with fewer participants (here three to six) also gave the participants the possibility of following the development of the ideas. It would be difficult for the participants to follow the development of each other's ideas in the same way if the workshops were conducted with 20 participants and breakout rooms. The facilitators would face similar challenges gauging the participants' understanding of and engagement in the exercises when they had to divide their attention across the different breakout rooms. However, such setups may be difficult for others to replicate, as they require more resources (time).

5. Discussion

Dunne and Raby (2013) argued that a designer must act speculatively when attempting to open a dialogue about how the world can be. The presentation of speculative design by Dunne and Raby (2013) is somewhat abstract and does not support the designer with concrete ways to explore. With the intention to support engagement, action, critical reflection, and visualisation, a more inquiry-based approach was sought, one that would support the phases of action and reflection (cf. Section 1.3). The initial investigations in this research project, and prior to the workshops showed a clear need for framing speculative design. In studying other practitioners' approaches, the format of Nadia Piet (2019) was found to be useful, as it had a hands-on descriptive level. However, even here, concepts were not described in detail, and some aspects were found too abstract for this context, with the double purpose of learning about a subject (here AR) and the participants' own learning (here K1–12 students) (cf. Section 1.). Storyboards were found to support the two modes: thinking (future) actions and reflecting on them in collaboration. Through the use of design tools, the speculation became much more concrete, had more detail, outlined the context of use, and revealed new perspectives or what might be missing in the implementation of the idea. A speculative design workshop combined with the use of design tools allowed the researcher to frame the speculation in such a way that knowledge and learning from the exploratory design approach were gained.

The analysis of the data shows that the participants were scaffolded in the inquiry process through exercises and facilitation. In the workshop, the participants became engaged in a process of inquiry and speculative design became an exploratory design approach. In the workshops, some participants (K1–12 students) engaged in this inquiry positively, while others were more reluctant. This is for example observed in participant B's experience (Table 1). This participant was critical of technology in education in general, and knew little about the chosen topic (AR). There is no doubt that this student felt frustrated and not aligned during the process; however, this person still went through an inquiry, and the critical thinking and inquiry processes were present, nevertheless.

Interestingly, that same student also commented positively that the workshop had a clear narrative and structure. In addition to being careful about which topic is chosen (here AR), speculative design might be too different or too abstract a concept to participate in.

Thus, the research found that the speculative design approach challenges the common understanding of design (cf. Section 1.1), and therefore using this approach can place the participants in a position where they experience a conflict between the different ways of viewing/conducting design. A participant said that when reflecting on the process, "...I put a lot into, maybe just doing something that can be realised (...) and maybe forgot a little about the speculative part…". When using speculative design as a method of inquiry with structured scaffolding, there is a risk of losing the potential of "going wild" and taking speculation to the extreme. However, applying inquiry to speculative design scaffolds a process in which participants can follow and engage.

6. Conclusion

The paper explored three interrelated research questions: What are the implications of conducting an online speculative design workshop? How can speculative design be used as a method of inquiry? What are the potentials and challenges of the tools and exercises used?

Conducting a speculative design workshop in an online format requires explicit scaffolding through a progressional programme with exercises and structured facilitation. This online setup enables the facilitator, when conducting workshops with a limited number of participants, to engage and involve the participants in a more direct manner. As speculative design is not a method of inquiry in itself, there is a need for exercises, scaffolding, and reflections that enable the inquiry process. In this project, design tools were used to expand speculative design into a method of inquiry. The main challenges of the tools and exercises are whether they can work with the complexity of the speculative design approach and the chosen topic in such a way that the participants are able to engage in inquiry and speculate on a preferable future. The found potentials include design tools, such as storyboards, which offer a way of engaging in inquiry in a way that lends materiality to otherwise abstract ideas and scaffolds the speculative design process in which the participants can engage.

References

Auger, J. (2013) "Speculative Design: Crafting the Speculation", *Digital Creativity*, Vol 24, No 1, pp 11–35.

Brinkmann, S. (2007) *John Dewey. En Introduktion*, Hans Reitzels Forlag, København.

Dewey, J. (1910/2011) *How We Think*, Project Gutenberg eBooks, EBook ##37423

Dewey, J. (1938). *Experience and Education*, Macmillan, New York.

Dunne, A. and Raby, F. (2013) *Speculative Everything: Design, Fiction, and Social Dreaming.* MIT Press, Boston, MA.

Goldkuhl, G. (2012) "Pragmatism vs interpretivism in qualitative information systems research", *European Journal of Information Systems*, Vol 21, No 2, pp 135–146.

Johannesen, L. K. (2017) *The young designer's guide to speculative and critical design*. Norwegian University of Science and Technology, Norway.

Lupton, D., and Leahy, D. (2019) "Reimagining digital health education: Reflections on the possibilities of the storyboarding method", *Health Education Journal*, Vol 78, No 6, pp 633–646.

Mitrović, I. (2015) An introduction to speculative design practice, in I. Mitrović, M. Golub and O. Šuran (eds): *An Introduction to Speculative Design - Eutropia, a Case Study Practice*, Croatian Designers Association, Department for Visual Communications Design, Arts Academy, University of Split, pp 8–23.

Ørngreen, R. and Levinsen, K. T. (2017) "Workshops as a research methodology". *Electronic Journal of E-Learning*, Vol 15, No 1, pp 70-81.

Piet, N. (2019) "Speculative design workshop", [Online] Accessed 6.7.2021. https://medium.com/mobgen/the-full-agenda-learnings-from-my-1st-experiment-in-facilitating-a-speculative-design-workshop-ec9f6daee9f8 and https://medium.com/@nadiapiet.

Rehder, M. M., Møller, T. E., Hjorth, m., Fibiger, J., Hansbøl, M., Jensen, J. J., Kornholt, B., Laier, B., Møller, L. og Schrøder, V. (2019) *Teknologiforståelse og Digital Dannelse – Undervisningsvejledning til et nyt modul på læreruddannelsen.* Københavns professionshøjskole - pp 3–89 [course description].

Truong, K. N., Hayes, G. R. and Abowd, G. D. (2006) "Storyboarding: An Empirical Determination of Best Practices and Effective Guidelines. *Conference: Proceedings of the Conference on Designing Interactive Systems*, University Park, PA, USA, June 26-28, 2006.

van der Lelie, C., (2006) "The value of storyboards in the product design process". *Pers Ubiquit Comput* 10, 159–162.

Creation of Interactive Educational Trail by Secondary Education Students

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DOI: 10.34190/EEL.21.081

Abstract: The article is focused on modernizing and increasing efficiency of teaching process within environmental education in upper secondary education. It deals with application of several pedagogical approaches (interdisciplinary learning, cooperative education, outdoor education, mobile learning, location-based learning, e-learning) and necessary phases in the creation of an interactive educational trail by students themselves. The aim of the paper is to present the possibility of implementing environmental education for secondary schools, taking into account the above-described pedagogical approaches in order to make environmental issues more attractive. The described proposal was verified in practice through the project E.T. in Nitra (Edu trail in Nitra).

Keywords: environmental education, information and communication technologies, interdisciplinary learning, cooperative education, outdoor education, mobile learning, location-based learning

1. Introduction

According to many definitions (Wals, 1990; Howe a kol., 1991), environmental education aims to create students´ relationship towards the environment. However, what does represent their environment?

Students most of their time spend in an urban environment. They are getting their education there, they live there and have their part-time jobs and also often spend the free time there. A city is their living environment. Caring for this environment ends many times outside their room or apartment and environmental issues interest them only marginally. This is also proved by the results of the Programme for International Student Assessment (PISA) coordinated by the Organization for Economic Co-operation and Development (OECD, 2018), which measures the level of students in the areas of knowledge, cognitive skills, social skills and attitudes, values. The results refer to the need to turn abstraction into action and lead students to civic engagement (OECD, 2018).

Environmental education in Slovakia has been compulsory part of education at all school levels since 1997 by introduction of a curriculum called the Environmental Minimum (Ministry of the Environment of the Slovak Republic, 1997). It is implemented in form of a cross-curricular theme and it can be carried out as a part of the teaching content of subjects or through individual projects, seminars, lesson units, courses and since 2008 also as a separate subject (The National Institute for Education, 2015). Environmental education in schools enables students to acquire knowledge, skills, attitudes and habits towards protecting and enhancing the environment important for sustainable life on Earth. It has been over 20 years and we have to conclude that existing system of environmental education is ineffective and unattractive for students. This is proved by the conclusions of the National Conference on Environmental Education in the Slovak Republic (Enviromagazín, 2018) as well as studies initiated by the Ministry of the Environment and Environment Agency of Slovak Republic (The Ministry of the Environment of the Slovak Republic, 2021).

There is no need for scientific evidence or citing the conclusions of the Environmental Education Conferences. What is enough, is just to have a look at the actual state of the environment in our neighbourhood, at expanding global problems and their effects on the environment, at prevailing lack of interest of youth about what is happening around them etc. We agree with the works of Hmelo-Silver (2004); Zimmerman (2000); Palmberg & Kuru (2000), which consider that a change in young people's thinking is based on their own active work, discovering, learning and appreciating cultural and natural values.

The project is based on the idea that if we want to change the thinking of young people and bring them to discovering nature and culture themselves, they must do it purposefully in order to create new values and do so in a way that is natural and close to them. Exploration and mediation of interesting information about the environment in an interactive form, directly by high school students, was the essential intention of the project E.T. in Nitra, which was implemented in the years 2019 to 2020.

The aim of the paper is to present the possibility of implementing environmental education (EE) for secondary schools, in which students are placed in the role of creators of an interactive educational trail about cultural and natural values of particular place taking into account its problems. In this way, they not only get to know the area and carry out its analysis, but they also create interactive texts and tasks using ICT.

2. Methodology

The basic idea of our proposed form of teaching is based on one of the oldest goals of environmental education according to Stapp (1969): „producing a citizenry that is knowledgeable concerning their biophysical environment and associated problems, aware of how they can help solve these problems, and motivated to work toward effective solutions“ (Stapp, 1969).

The teaching combines and logically interconnects the following pedagogical approaches:

- Interdisciplinary learning – Rowntree (1982) defines interdisciplinary approach as an approach, in which two or more disciplines are brought together, preferably in such a way that disciplines interact with one another and have some effect on one another's perspectives. Ivanitskaya et al. (2002) suggests that interdisciplinary learning is characterized by the integration of multidisciplinary knowledge into the central theme in our case the central theme is students´ environment;
- Cooperative education – is considered as structured educational strategy integrating classroom studies with learning through productive work experiences in a field related to a student's academic or career goals (Groenewald, 2004). In practice, it is possible to link cooperative learning with other pedagogical approaches such as project based learning (Bell, 2010; Kolodner, 2003) or inquiry based learning (Anderson, 2002; Edelson et al., 1999);
- Outdoor education – refers to a method of developing knowledge, skills and attitudes relating to the world in which we live. It is an expression of the place where teaching takes place, but also of the topic that will be discussed (Ford, 1986). The purpose of the outdoor activities is to give students out-of-classroom educational experiences involving direct contact with various environments (Palmberg, Kuru, 2000);
- Location-based learning – is education based on interactive negotiation by the learner with their natural or cultural environment (Brown, 2010), which is including activities such as collecting and analysing various data, uploading information, videos or photographing for example to identify plants or animals.
- Mobile learning – includes the use of mobile or wireless devices for learning purposes (Kukulska-Hulme, Traxler, 2005). According to Čapek (2015), such devices can be laptops, tablets, mobile phones, MP3 players, navigators, but also cameras, dictaphones or other technology. Moreover specific possibilities in using mobile learning can be in form of individual mobile applications such as applications for measuring various values, maps service and various educational or search games.
- E-learning - presents all forms of electronic supported learning and teaching, which are procedural in character and aim to effect the construction of knowledge with reference to individual experience, practice and knowledge of the learner. Information and communication systems, whether networked or not, serve as specific media to implement the learning process (Tavangarian, 2004). The range of possibilities of using e-learning in the educational process is wide and currently strongly influenced by the pandemic situation caused by the corona virus. Thus, in addition to the possibility of blended learning, which according to Delialioglu, O., & Yildirim, Z. (2007) combines the potentials of web-based training with those of classroom techniques, it is possible to use e-learning to manage the whole study, for communication between students and teachers as well as between students.

The creation of an interactive educational trail was verified in pedagogical practice through the E.T. in Nitra (Edu trail in Nitra) within the Nitra Community Foundation grant scheme of the program Innovative with Foxconn. The project was implemented in 2019 in cooperation with the Secondary Vocational School of Gastronomy and Tourism in Nitra (just SVS G&T). The primary target group of the project were students of the SVS G&T, in field of study of Tourism Services, who via team work created an interactive educational trail, thus directly linked their vocational subjects with practice. Secondary target group are pupils and students from other primary and secondary schools, university students, as well as tourists or visitors of the city Nitra, who after installing the necessary application will be able to use the created trails.

3. Results

The result of the project is a proposal for the modernization and increasing efficiency of EE through its practical focus on creation of a specific product, which in our case is an interactive educational trail. The proposal logically connects interdisciplinary learning, cooperative education, location based learning, outdoor education and mobile learning in order to modernize and increase efficiency of the teaching of environmental education as well as to make environmental issues more attractive for secondary school students.

The methodological procedure of EE is contained in the following steps:

- *1. Introducing the problem and defining individual steps and tasks* - the first step is to get acquainted with the basic problem students will solve through teamwork and it is the absence of an interactive educational trails of a city (village), which would introduce to young people in an interesting way natural and cultural values of an area or the problems that occur in the area. Part of this step is also introducing the individual partial tasks and methodological steps to students through which they gradually will come to a final version of the educational interactive trail. Within this step cooperative learning, interdisciplinary learning and e-learning is applied (Figure 1). During the implementation of the project E.T. in Nitra, to the process of creating the interactive educational trail enrolled 12 students of SVS G&T, of the field of study Tourism Services, whom we divided into three creative teams. Each team received one selected area of the city Nitra and assigned consultant. The consultants were volunteers from the ranks of students and teachers of Department of Ecology and Environmental Sciences, Faculty of Natural Sciences, Constantine the Philosopher in Nitra (just DEES).
- *2. Analysis of the area of interest and creation of thematic content of the trail by students* - this is a time-consuming step in which students get to know the area of interest in detail and select suitable objects and features into the content of their educational trails. This step also include consultation about the content of individual stages of the trail with chosen teachers from their school (mainly teachers of subjects Geography, Biology, History, etc.) as well as of field work focused on reconnaissance of the selected area. Students can use a variety of ICT not just for obtaining information of selected objects and features, but also for their localization, for making photos, videos or sound recordings. In addition to these ICTs, this step also uses the outdoor education and location-based learning with the possibility of sharing materials and communication through E-learning (Figure 1).
- *3. Creation of interactive digital trail content* – before the creation of the interactive elements of the educational trail itself, it is necessary to introduce the use of the application to students, the medium for their upcoming work (Figure 1). In our case we have chosen the ActionBound application for project E.T in Nitra. The training of the student teams about how to create a mobile interactive trail was focused on possibilities of creating a trail, the method of locating selected places and presentation about the options of interactive elements offered by the mobile application. After becoming familiar with the application is time for creating interactive tasks, quizzes, videos, audio tracks, accompanying story, necessary photo documentation and so on. The activity may include consultation with teachers or other experts (etc. university lectors) to make the content of the trail more attractive.
- *4. Verification of the content and functionality of the created educational trail* – the final version before the actual bringing into operation must be tested in the field. The verification should focus on: degree of comprehensibility of textual (information-bearing) parts and instructions by which authors speak to the educator (user); verification of the accuracy of the location of the individual stages and tasks as well as verification of navigation to them; testing the function of interactive tasks, testing the correctness of response options, scoring, fluency, etc. Within the project E.T. in Nitra, we carried out a verification of all individual trails in parallel through solving the tasks by students in pairs. During the testing students noted down their comments, ideas and observations, which they exchanged during the creative discussion afterwards. Detected errors and proposed improvements were then integrated into the individual trails.
- *5. Launch and use of the interactive educational trail* – a very important step is to enliven and ensure sustainability of the trails created by students. Creators themselves can be involved in its use, as well as disinterested users (Figure 1). Within the project, we have officially brought the trails into operation in the

form of an event intended for schools but also for general public. The proposed trails were walked through by the concerned registered persons and then all interactive educational trails in Nitra were offered to the Tourist Information Centre of city Nitra as a modern interactive material for the needs of tourism development in the city.

Among the first users of the created trail were also students of the lower grade studying at the same school, the same field of study as our co-creators of the interactive trail. By practical testing of the created trail, they gained their first contact with the interactive trail as well as with the used mobile application, which is necessary in the school's initiative to continue in creating interactive trails in the region. By continuing the activity with new topics, or with new partners, the cycle of methodological steps closes, while new students become new actors. Older students with experience will be for them not only a source of inspiration and an example of good practice, but also suitable consultants or lecturers, in the involvement of peer education according to Damon (1984).

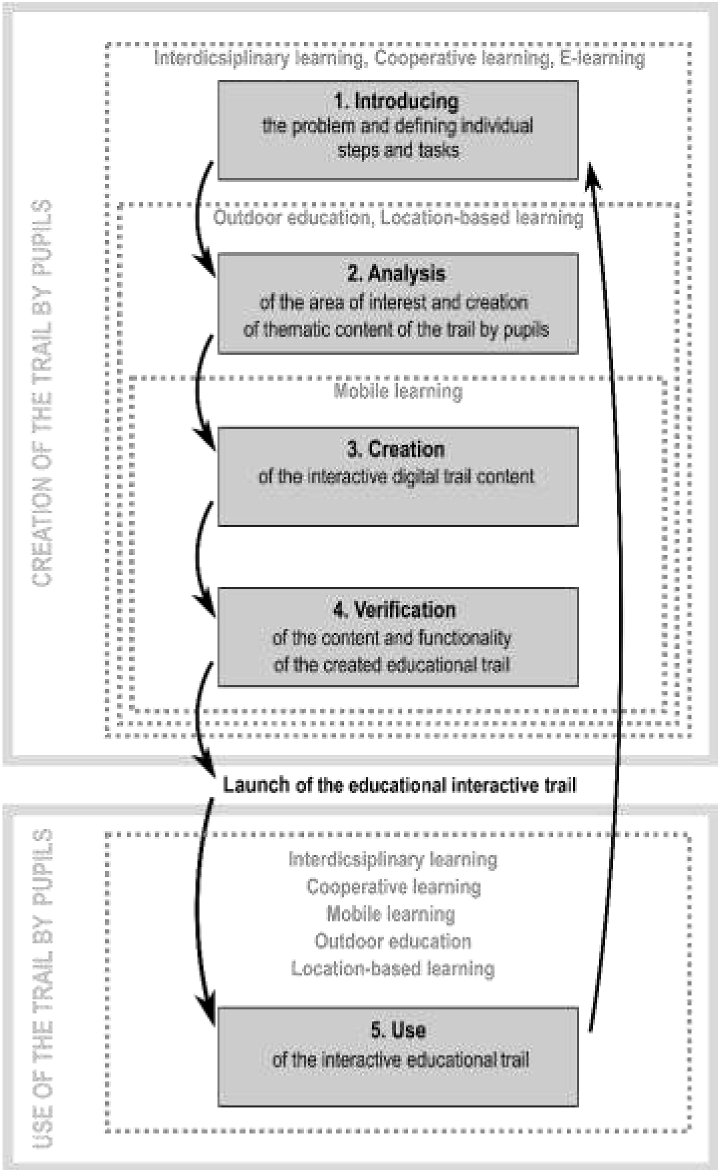

Figure 1: Proposal for teaching environmental education

4. Discussion

The idea for creating the proposal of environmental education presented in the article has been initiated in 5 basic problems, we wanted to react to and contribute to their solution:

The first problem is an inefficient system of teaching environmental education at secondary schools, what is also pointed out in the conclusions of the National Conference of EE (Enviromagazín, 2018). Our aim was to realize

EE in the spirit of Palmer & Neal (1994) who talk about three stages of education: education in (or from) environment, education about the environment and education for the environment, which has objectives related to nature conservation and sustainable development. We also tried to use the natural and cultural values of the area, which students discovered not only from the textbooks but directly in the field in order to create a positive attitude to the area of interest.

The second problem is the minimum interconnection of the content of upper secondary education´s curriculum with the natural, cultural and historical wealth of the city in which they live. In general, approximately half of the students come to the city from closer or further vicinity and they know the city only marginally and thoughtlessly. Mobile interactive educational trail created by students can in an attractive way introduce the city to other school students and can become a suitable teaching tool with usage in teaching the subjects: History, Geography, Biology, Civics and so on.

The third problem is the poor involvement of students studying tourism into a production of promotional materials for tourism support in the city of Nitra. Students could directly implement acquired knowledge and skills in the practical production of modern and innovative materials. The proposal has the potential to develop a wide range of skills for students who design and create trails. Active use of ICT develops skills associated with ICT (Rosado & Bélisle, 2006). Using interdisciplinary education, students develop interdisciplinary thinking, improve critical thinking skills, cognitive skills, and understand relationships between different disciplines (Ivanitskaya et al., 2002). In addition, cooperative learning develops discipline, analytical thinking, effective problem solving and improves classroom performance (Dressler & Keeling, 2004).

The fourth problem is a lack of attention given to the mobile phones as teaching aid in pre-graduate teacher training at universities. Teachers tend to order to turn off students´ mobile phones before the lesson starts, do not see the potential of a mobile phone as a multimedia device, which can streamline teaching process of both natural sciences and social sciences subjects as exemplified by Walker (2006), Sharples (2005), Kukulska-Hulme & Traxler (2005) and others.

The fifth problem in Slovakia is the absenting offer of up-to-date and modern, interactive materials about cities in English language that schools could provide to foreign pupils, students or for partner´s visits within available mobilities at high school or university.

5. Conclusion

Oftentimes, young people are not actively involved in improving or promoting their environment. They do not know how or they have no reason, as their relationship to the environment is not at high level. And exactly here comes the space for schools, specifically in environmental education can one acquire several skills right away.

Students learn to cooperate, being mindful and respectful while creating interactive educational trails. The classroom moves out of the school building, resulting in a more relaxed atmosphere and the promotion of a healthy lifestyle while staying in the fresh air. Mobile phone or other ICT medium are considered as a “friend” because they use them for the necessary purposes such as information retrieval, photos creation, GPS-sharing, etc. In addition to all of this, they have the opportunity to understand the interrelationship and interconnection of the same information within different subjects and gain a holistic view on the issue.

The proposal designed in this way serves to streamline and modernize the teaching process in upper secondary education, but it will also find application in the field of the development of the tourism in the city. Particular trails created in the city of Nitra by SVS students offer space for usage in the subjects History, Geography of Tourism, Biology and Practical Training in Tourism Technology in upper secondary education.

At present, in cooperation with the SVS G&T with the DEES and the Mlyňany Arboretum (SAS), a new interactive educational trail is being created in the area of arboretum, by new high school students, with help of older experienced students who participate in education as consultants. By this implementation of EE we managed not only to create functional interactive trails, but also to involve students in the creative promotion of the region, to connect them directly with their environment and to deepen their relationship with it.

Acknowledgements

This scientific article was prepared as a part of the KEGA 026UKF-4/2020 Siphonapterology modernly and illustratively – SIMONA.

References

Anderson, R. D. (2002) “Reforming science teaching: What research says about inquiry”. Journal of Science Teacher Education, 13(1), 1–12.

Bell, S. (2010) “Project-based learning for the 21st century: skills for the future”. The Clearing House: A Journal of Educational Strategies, Issues and Ideas, 83(2), 39-43.

Brown, E. et al. (2010) “Education in the Wild: Contextual and location-based mobile learning in action”. A report from the STELLAR Alpine Rendez-Vous workshop series, Nottingham, 2010.

Čapek, R. (2015) “Moderní didaktika”. 1. vyd. Praha: Grada, 2015, 624 s. ISBN 978-80-247.

Damon, W. (1984) “Peer education: The untapped potential”. Journal of Applied Developmental Psychology, 5(4), 331–343, doi:10.1016/0193-3973(84)90006-6.

Delialioglu, O., & Yildirim, Z. (2007). Students' perceptions on effective dimensions of interactive learning in a blended learning environment. Journal of Educational Technology & Society, 10(2), 133-146.

Dressler, S., & Keeling, A.E. (2004) “Benefits of cooperative education for students”. In R.K. Coll & C. Eames (Eds.), International handbook for cooperative education (pp. 217-236), Boston: World Association for Cooperative Education.

Edelson, D. C., Gordin, D. N., & Pea, R. D. (1999) “Addressing the Challenges of Inquiry-Based Learning Through Technology and Curriculum Design”. Journal of the Learning Sciences, 8(3-4), 391–450, doi:10.1080/10508406.1999.9672075.

Enviromagazín. (2018) “Závery národnej konferencie EVVO”. In: Enviromagazín, Odborno-náučný časopis o životnom prostredí 1/2018 | XXIII. Ročník [online] Ministerstvo životného prostredia Slovenskej republiky a Slovenská agentúra životného prostredia, http://www.enviromagazin.sk/enviro2018/01_enviromagazin_2018.pdf.

Ford, P. (1986) “Outdoor Education: Definition and Philosophy”.

Groenewald, T. (2004) “Towards a definition for cooperative education”. In R.K. Coll &. Eames (Eds.), International handbook for cooperative education: An international perspective of the theory, research and practice of work-integrated learning (pp. 17-25), Boston: World Association for Cooperative Education.

Hmelo-Silver, C. E. (2004) “Problem-based learning: What and how do students learn?” Educational psychology review, 16(3), 235-266.

Howe, R., Disinger, J. F. (1991) “Environmental education research news”. The Envirnnnientuliut, I I(I). 5-8.

https://www.oecd.org/pisa/pisa-2018-global-competence.htm

Ivanitskaya, L., Clark, D., Montgomery, G., Primeau, R. (2002) “Innovative Higher Education”. 27(2), 95–111. doi:10.1023/a:1021105309984.

Kolodner, J. L., Camp, P. J., Crismond, D., Fasse, B., Gray, J., Holbrook, J., et al. (2003) “Problem-based learning meets case-based reasoning in the middle-school science classroom: Putting learning by design into practice”. The Journal of the Learning Sciences, 12, 495–548.

Kukulska-Hulme, A., Traxler, J. (2005) “Mobile learning: A handbook for educators and trainers”. London: Routledge.

OECD, (2018) “Preparing our youth for an inclusive and sustainable world”. The OECD PISA global competence framework , [online] https://www.oecd.org/pisa/Handbook-PISA-2018-Global-Competence.pdf

Palmberg, I.E., Kuru, J. (2000) “Outdoor Activities as a Basis for Environmental Responsibility”. The Journal of Environmental Education, 31:4, 32-36, DOI: 10.1080/00958960009598649.

Palmer, J., Neal, P. (1994) “The handbook of environmental education”. New York : Routledge, 162 s. ISBN 0-415-09313-9.

Rosado, E., & Bélisle, C. (2006) “Analysing digital literacy frameworks. A European framework for digital literacy” (eLearning Programme 2005-2006).

Rowntree, D. (1982) “A dictionary of education”. Totowa, NJ: Barnes & Noble Books.

Sharples, M. (2005) “Learning As Conversation: Transforming Education in the Mobile Age”. In Proceedings of Conference on Seeing, Understanding, Learning in the Mobile Age (pp. 147-152), Budapest, Hungary.

Stapp, W.B., et al. (1969) “The Concept of Environmental Education”. Journal of Environmental Education, 30-31.

Tavangarian, D. (2004). Is e-Learning the Solution for Individual Learning? Electronic Journal of E-learning, 2(2), pp265-272.

The Ministry of the Environment of the Slovak Republic, (1997) “Koncepcia environmentálnej výchovy a vzdelávania v Slovenskej republike”. Dokumenty MŽP SR, Bratislava: EKOPRESS, 1997, 40 s. ISSN 1335 – 1564.

The Ministry of the Environment of the Slovak Republic, (2021) [online] https://www.minzp.sk/osveta/

The National Institute for Education, (2015) “Štátny vzdelávací program” [online] https://www.minedu.sk/data/att/7500.pdf.

Walker, K. (2006) “Introduction: Mapping the landscape of mobile learning”. In M. Sharples (Ed.), Big issues in mobile learning: Report of a workshop by the kaleidoscope network of excellence mobile learning initiative, University of Nottingham.

Wals, A. (1990) “Caretakers of the environment; a global network for teachers and students”. Journal of Environmental Education, 21(3), pp. 3-7.

Zimmerman, B. J. (2000) “Self-efficacy: An essential motive to learn”. Contemporary educational psychology, 25(1), 82-91.

Future Teachers' Attitude Toward Using Digital Technology in Instruction: Questionnaire Survey Results

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Abstract: The role of digital technology in education is more important than ever. Due to the pandemic and the integration of digital technology into various areas of human activity (the so-called Fourth Industrial Revolution or Industry 4.0), teachers are required to adapt their teaching methods and to focus on helping their students develop digital literacy, which is one of the crucial skills in today's information society. In the light of societal changes, teacher education programs need to be modified. At the Pedagogical Faculty of the University of Ostrava, every future teacher is required to take the course Information and Communication Technology in Education. In the course, students learn how to use ICT in education. They familiarize themselves with the basic types of ICT tools, different educational programs and applications, online educational tools, and how to use the Internet for educational purposes. They also learn how to use the most common tools used in schools. The goal of the course is to teach students how to use digital technology in instruction to achieve educational goals. That is the only way digital technology can be beneficial to students rather than a distraction. Aside from choosing the appropriate technology, the teacher also needs to be able to use that technology in an effective manner. Because it is the teacher who is the key element in determining the success of using digital technology in instruction. When used effectively, digital technology can improve the education process and motivate students to become more engaged. However, the inappropriate use of technology could result in far-reaching consequences. Therefore, teachers should strive to improve their digital literacy and digital skills. The modern teacher should not only be an expert in their own field and be familiar with basic pedagogical and psychological principles, but they should also have digital skills. That is the only way one can be an effective teacher. Students from different programs are likely to have not only different levels of digital literacy, but also different attitudes toward digital technology. That is why a questionnaire survey was conducted to determine students' attitude toward digital technology and their level of digital literacy. The paper centers on teacher education at the Pedagogical Faculty of the University of Ostrava, specifically on using digital technology in instruction. It also presents the results of the questionnaire survey. The results should help identify areas where student knowledge is lacking, allowing teachers to adapt their courses so that even students with limited knowledge can achieve the required level of digital skills and knowledge.

Keywords: future teacher, digital technology, education, digital competences, digital skills

1. Introduction

Willingness to learn, creativity, open-mindedness, collaboration, and big picture thinking are key to understanding the world of tomorrow. To be able to guide children on their path to knowledge, one needs to look at education from different points of view. And to be able to do that, one needs to be literate (Gramotnosti pro život, c2018-2021).

Most people view literacy as the ability to read and write, as they are the skills they need to be able to not only educate themselves, but also to understand the world around them. However, one needs to realize that reading and writing are not the only skills needed for personal development. There are three types of literacy in primary education:

- Reading literacy – the ability to understand, use, and reflect on written texts.
- Mathematical literacy – an individual's capacity to formulate, employ, and interpret mathematics in a variety of contexts, mathematical thinking, using all kinds of tools (including ICT), spatial awareness, data collection and analysis, etc.
- Digital literacy – a variety of digital competencies, from the basics of computer use to the ability to find, evaluate, and clearly communicate information on online safety and authorship.

In addition to the term literacy, one can also encounter the term functional literacy, which Palán (2020) defines as:

- Knowledge, skills, and attitudes an individual needs to participate in the socio-cultural life of society;

- Type of behavior: the ability to understand information and use it – in day-to-day situations, their personal life at work or and in their community – to achieve their goals, improve their knowledge, and realize their potential.

The aforementioned examples prove that individual literacies cannot be developed separately. It is only natural that they are developed simultaneously. Today's teachers are expected to help their students develop big picture and critical thinking and test theory in practice, allowing them to understand how knowledge and skills can be used in their day-to-day lives without having to ask the teacher, "Why are we even learning this?".

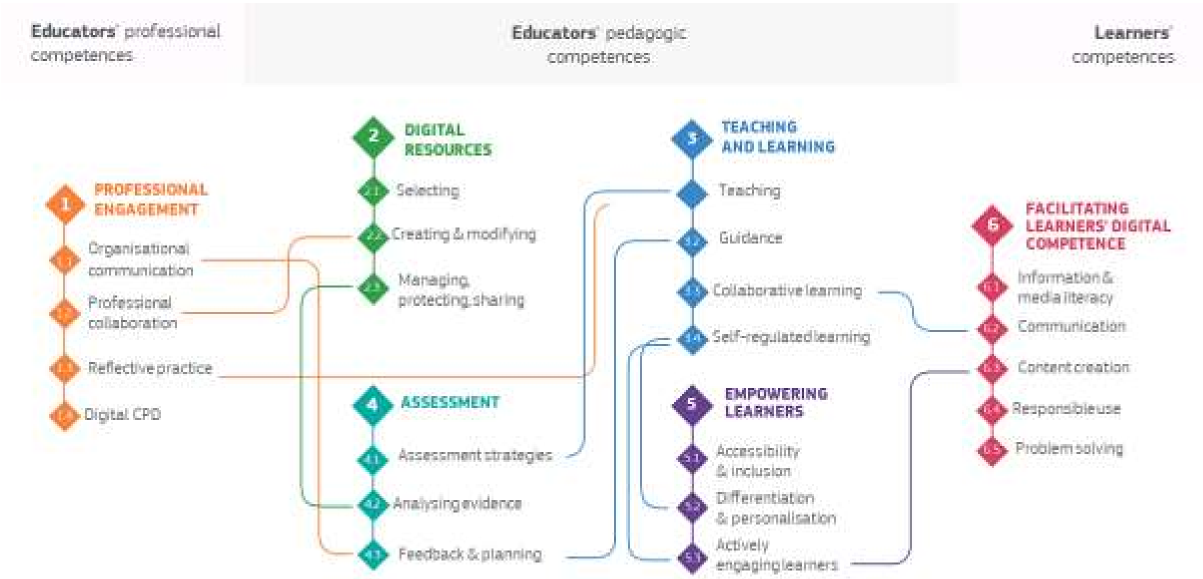

Figure 1: Relationships between competencies (Redecker, 2017)

Figure 1 shows that not only students but also teachers (both current and future) need to develop digital literacy and digital competencies. Because if there is going to be a digitally literate student, there needs to be a digitally literate teacher first. Digitally literate individuals can use digital technology in a productive, creative, safe, and ethical manner (White, 2015).

Unfortunately, there are obstacles that prevent further education of teachers and the innovation of the education process (Kampylis et al., 2019):

- Many teachers work in an environment that does not allow them to improve their teaching methods or to further educate themselves (e.g., to develop their digital competencies);
- Many teachers are convinced that the key to a successful transformation of the education process lies in incorporating the latest technology and trends into instruction (flipped classrooms, mobile technology, etc.), without considering the possible advantages of that particular technology/method;
- It is not always good when an institution/school focuses only on the so-called innovators who bring new ideas and work independently. Such an approach is not sustainable and only results in widening the gap between outstanding educators and those that are not as effective.

The latest data show that the situation regarding digital education in the EU member states is vastly different. As far as teacher preparedness is concerned, a 2018 OECD research showed that only 39% of EU teachers were ready to use digital technology in their classes, with there being differences between the individual member states (European Commission, 2020a).

The below chart (Figure 2) represents teachers' opinions on whether they need more education/training regarding incorporating digital technology into instruction. Only 18% of EU teachers reported a "high need" for further education. In Croatia, one in every four teachers felt they needed to further educate themselves in this area. In comparison with other EU countries, the Czech Republic is at the very end.

Figure 2: Percentage of teachers who need more education/training regarding incorporating ICT into instruction (European Commission, 2020b)

The COVID-19 pandemic has resulted in digital technology being used for educational purposes across the EU, and showed the need for affordable, high-quality digital content that should be easily available to learners. Creating one's own digital content is one of the competencies that educators should improve in the near future.

In an open public consultation on digital education, which occurred in the summer and fall of 2020, the participants agreed that teachers' digital skills were the most important aspect of digital education!

62 percent of the respondents (the percentage was even higher among professional educators) reported that their digital skills had improved during the pandemic, with more than 50 percent of them wanting to further improve their digital skills in the future.

Learning about and using ICT in school allows young people to better understand the digital world. Developing their digital skills can help learners understand the digital world on a scientific level. However, many European children complete their elementary education knowing virtually nothing about ICT. As of 2019, one of every five young people in Europe has not mastered basic digital skills. Moreover, less educated individuals' the level of digital skills is likely to be three times lower compared to their better-educated peers. In the future, more than 90 percent of all jobs will require at least some level of digital skills. However, as of today, 35 percent of Europeans do not possess these skills (European Commission, 2020a).

The following figure presents the different levels of digital skills and competencies:

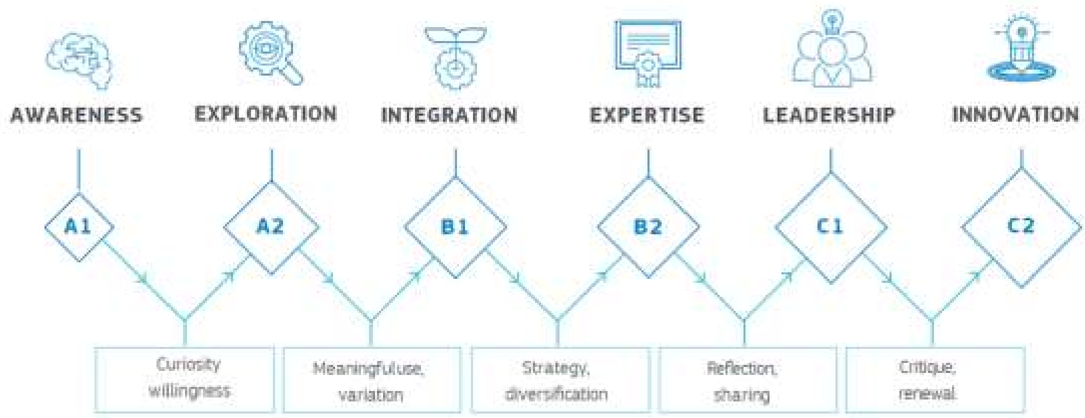

Figure 3: Digital skill levels (Redecker, 2017)

The proposed model should help teachers better understand their strengths and weaknesses by describing the different levels of digital skills.

And why exactly are digital skills so important in education? Because 43 percent of Europeans do not have basic digital skills. Because in the future, more than 90 percent of all jobs will require at least some level of digital skills. And because digital technology is part of our everyday lives and therefore should also be an integral part of education (European Commission, 2020c).

The following chapters focus on the results of a questionnaire survey that was conducted to determine students' attitude toward digital technology and its integration into the education process.

2. Methods

The questionnaire survey was conducted between September and December 2020. 488 students from the University of Ostrava's Faculty of Education, Faculty of Science and Faculty of Arts and Faculty of Education at the Constantine The Philosopher University in Nitra, Slovakia participated in the survey. All the students were studying to become primary or secondary school teachers. The questionnaire consisted of 29 questions. Aside from personal data questions, the questionnaire was divided into two parts: the student's attitude toward digital technology and the incorporation of digital technology into instruction. The questionnaire was conducted electronically and included both open-ended and closed-ended questions. The sample composition can be seen in the following table.

Table 1: Research sample

Department	**Country**	**n**		**Age**		**Bachelor studies**	**Master's studies**	**Doctoral studies**
		Female	Male	Average	SD			
Faculty of Education	CZE	262	116	23.71	7.661	376	2	0
Faculty of Science/Arts	CZE	63	22	23.25	5.185	67	17	1
Faculty of Education	SVK	16	9	26.08	11.228	11	11	3
Σ		341 (69.88 %)	147 (30.12 %)	23.75	7.528	454	30	4
		488						

3. Data analysis

The first part of the questionnaire consisted of 7 questions aimed at students' attitude toward digital technology and the level of their digital skills. The respondents reported a positive attitude toward digital technology, with the average score on a five-point scale (1-positive, 5-negative) being x = 2.16. The answers the students gave when asked to evaluate their own knowledge and skills on a five-point scale (1-excellent knowledge, 5-lack of knowledge) prove that they have not yet mastered all the skills and knowledge a teacher should possess. Based on their answers, the respondents believed they were the most skilled at text processing, creating presentations, information seeking, and email management. On the other hand, they were less confident about their skills required to create educational animations and video tutorials or create and manage websites and e-courses. The following table provides a detailed summary.

Table 2: Student self-assessment of their digital skills – basic use of digital technology

	$\bar{x}$	**Absolute frequency**					**Relative frequency [%]**				
Basic use of digital technology		**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Text processing	1.895	170	223	76	14	5	34.84	45.70	15.57	2.87	1.02
Data processing	2.670	63	158	168	75	24	12.91	32.38	34.43	15.37	4.92
Use of images	2.174	131	199	104	42	8	26.84	40.78	22.13	8.61	1.64
Use of photography	2.389	116	163	126	69	14	23.77	33.40	25.82	14.14	2.87
Sound recording and editing	3.174	46	93	147	134	68	9.43	19.06	30.12	27.46	13.93
Creating presentations	1.816	213	188	62	14	11	43.65	38.52	12.70	2.87	2.25
Creating animations	3.408	32	83	145	110	118	6.56	17.01	29.71	22.54	24.18
Creating video tutorials	3.598	39	60	115	118	156	7.99	12.30	23.57	24.18	31.97
Use of applications or educational purposes	2.613	91	150	143	65	39	18.65	30.74	29.30	13.32	7.99

Table 3: Student self-assessment of their digital skills – online environment

	$\bar{x}$	Absolute frequency					Relative frequency [%]				
Online environment		**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Information seeking	1.457	314	146	14	7	7	64.34	29.92	2.87	1.43	1.43
Email management	1.510	306	143	19	12	8	62.70	29.30	3.89	2.46	1.64
Use of cloud services	2.623	86	157	136	73	36	17.62	32.17	27.87	14.96	7.38
Creating online forms	2.891	69	134	129	93	63	14.13	27.46	26.43	19.06	12.91
Creating online documents	2.758	88	137	125	81	57	18.03	28.07	25.61	16.60	11.68
Creating online tests	3.092	56	113	136	96	87	11.48	23.16	27.87	19.67	17.83
Creating websites	3.613	35	57	129	108	159	7.17	11.68	26.43	22.13	32.58
Creating e-courses	3.777	24	50	117	117	180	4.92	10.25	23.98	23.98	36.89

The majority of respondents (n=404; 83.61 %) reported they intended to improve the aforementioned skills. The remaining respondents either stated that they were satisfied with their level of skills and knowledge (n=23; 4.71 %) or that they had yet to discover their own potential (n=61; 12.5 %).

To better understand the students' attitude toward digital technology, the authors included open-ended questions in the second part of the questionnaire (which were aimed at determining what the students like/do not like about digital technology. The most frequent answers are presented in the following table.

Table 4: Advantages/disadvantages of digital technology – the most frequent answers given by the respondents

What do you like about digital technology?	What don't you like about digital technology?
Speed	Difficulty
Makes searching for information much easier	Addiction
Availability	Unreliability
Communication	Disinformation
New possibilities	Limited social contact

The second part of the questionnaire was aimed at learning the students' opinions on the integration of digital technology into the education process. The participating future teachers have a positive attitude toward integrating digital technology into instruction (x = 1.906; 1-positive attitude, 5-negative attitude). Even though most of the respondents were studying to be elementary school teachers, it did not reflect in their answers to the question, "At which education level is digital technology used the most?". The most frequent answers were high school (n=242, 49.59 %) and university (n=142, 29.1 %), respectively. According to the respondents, digital technology was used less frequently in elementary schools (n=97, 19.88 %) and kindergartens (n=7, 1.43 %).

Teachers, whom the respondents have encountered during their lives, can be divided into two groups. Half of the respondents reported that their teachers did not use digital technology enough (n=247, 50.61 %). The other half believed that their teachers used digital technology often enough (n=227, 46.52 %). The students were also asked to evaluate their teachers' digital literacy on a five-point scale (1-excellent, 5-insufficient), with the average score being x=2.293.

The results show that future teachers intend to use digital technology in their classes – 442 respondents (90.57 %) intend to use digital technology in their classes, with the majority of respondents reporting that they are not stressed at all or only slightly stressed (n=308, 63.11 %) about using it. As far as teaching stages are concerned, the students intend to use digital technology during the motivation (n=304) and application (n=242) stages. 136 respondents selected the motivation stage as the only option out of the five presented (motivation, exposition, retention, diagnostic, and application) while 30 respondents selected all five options.

The majority of respondents would use digital technology to present the curriculum (n=428, 87.70 %), with 126 of them would use it exclusively for this purpose. The remaining respondents chose different combinations of the available options (to present the curriculum for modeling/simulation testing, to record students' grades/performance). 58 respondents chose all available options.

Future teachers would also like to use laptops (n=388) and interactive whiteboards (n=375) in their classes. The following chart presents the respondents' responses.

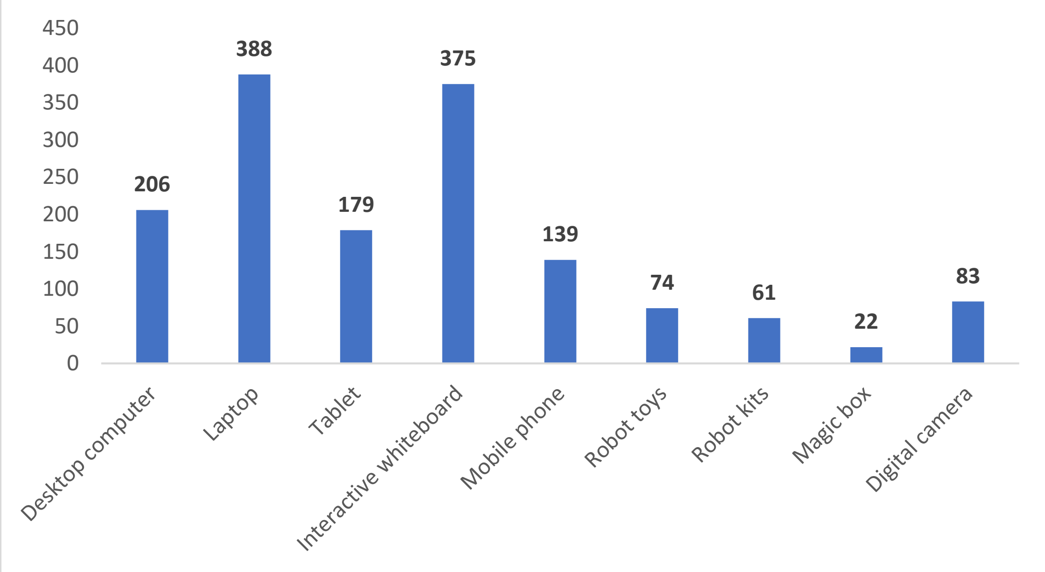

Figure 4: Considered use of digital technology by future teachers

4. Discussion

Future teachers across disciplines have a positive attitude toward digital technology, with men having a more positive attitude than women. The respondents' answers show that they have yet to master all the skills and knowledge a teacher should possess. They believe they are the most skilled at text processing or creating presentations, while being less confident about their skills required to create educational animations and video tutorials. This might have to do with the students' study plans, as they are asked to write all kinds of assignments (e.g., papers, reports, essays, and correspondence tasks) and create presentations. Other skills, which could make the teacher's job much easier and the education process more effective, are not being developed. The same applies to online tools; the respondents are the least confident about creating e-courses.

That is why more attention needs to be paid to developing future teachers' digital skills, so they are ready to use digital technology in their classes and their digital literacy is in accordance with the Digital Education Plan (2021-2027) (European Commission, 2020).

It is important that students are aware that they need to improve their skills. And what is even more important, they want to improve them. The available data show that the level of digital skills increases with educational attainment, i.e., students (future teachers) gradually develop these skills during their studies. It does not happen intentionally, however, as the authors learned by analyzing the study plans.

The second part of the questionnaire allowed the authors to answer questions regarding future teachers' willingness to use digital technology in their classes. However, because of the aforementioned reasons, it is unclear whether future teachers will be able to use digital technology properly and effectively. This notion is supported by the fact that only 30 respondents would like to use digital technology in all five teaching stages and that the majority of respondents would only use it to present the curriculum. These two findings may point to a lack of imagination and creativity on the part of future teachers. However, it may also be caused by their inexperience.

The results did not reflect the current popularity of tablets and other mobile devices. This may also be caused by the students' inexperience, i.e., they cannot incorporate them into instruction. If they chose not to use them, however, it may have been because of the study on the impact of tablets, mobile phones, and notepads on knowledge retention (Umejima et al., 2021) where tablets did not fare as well as notepads. Another study (Sung et al., 2016) argues that the effectiveness of mobile devices varies according to the subject in which they are used.

5. Conclusion

The goal of this paper was to determine students' attitude toward digital technology and its integration into the education process. A questionnaire survey was conducted to achieve that objective. The results presented in this paper show that future teachers are learning to use digital technology, specifically how to work with text and create presentations.

The available data show that the level of students' digital skills increases with educational attainment. Aside from expanding their digital knowledge and skills, future teachers also need to develop their creativity and imagination, which will help them discover new ways of using digital technology in their classes and allow young teachers across disciplines to use this technology in unusual and creative ways in all teaching stages.

The participating students will be asked to fill out the same questionnaire to determine whether their answers have changed at the end of their study.

References

European Commission. Digital Education Action Plan 2021-2027 - Resetting education and training for the digital age, Brussel, 2020a. Available at: https://ec.europa.eu/education/sites/default/files/document-library-docs/deap-communication-sept2020_en.pdf.

European Commission, Education and Training Monitor 2020, Publications Office of the European Union, Luxembourg, 2020b. ISBN 978-92-76-20443-5. Available at: doi: 10.2766/917974 NC-AJ-20-001-EN-N.

European Commission: Education & Training. SELFIE for schools. 2020c. Retrieved 2021-05-19, from https://ec.europa.eu/education/resources-and-tools/about_en

Gramotnosti.pro život: Učíme v souvislostech. (c2018-2021). Retrieved 2021-05-19, from https://gramotnosti.pro/

Kampylis, P., Hodson, D., Petkova, S., Hippe, R., Cachia, R., Sala, A., Weikert Garcia, L., Castaño Muñoz, J. and Punie, Y., SELFIE Forum – Teaching and Learning in the Digital Age, Publications Office of the European Union, Luxembourg, 2019. ISBN 978-92-76-09033-5. Available at: doi:10.2760/799301, JRC117482.

PÁLAN, Zdeněk. (2020). Funkční gramotnost [Online]. Retrieved 2021-05-19, from http://www.andromedia.cz/andragogicky-slovnik/funkcni-gramotnost

UMEJIMA, Keita, Takuya IBARAKI, Takahiro YAMAZAKI a Kuniyoshi L. SAKAI. Paper Notebooks vs. Mobile Devices: Brain Activation Differences During Memory Retrieval. Frontiers in Behavioral Neuroscience [online]. 2021, 15 [qtd. 2021-5-6]. ISSN 1662-5153. Available at: doi:10.3389/fnbeh.2021.634158

REDECKER, Christine. European Framework for the Digital Competence of Educators: DigCompEdu. Punie, Y. (ed). EUR 28775 EN. Publications Office of the European Union, Luxembourg, 2017. ISBN 978-92-79-73494-6. Available at: doi:10.2760/159770, JRC107466

SUNG, Yao-Ting, Kuo-En CHANG a Tzu-Chien LIU. The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis and research synthesis. Computers & Education [online]. 2016, 94, 252-275 [cit. 2021-5-6]. ISSN 03601315. Available at: doi:10.1016/j.compedu.2015.11.008

WHITE, Jonathan. (2015). Digital literacy skills for FE teachers. Thousand Oaks, California: SAGE/Learning Matters.

Inclusive Multimodal Designs in Language Classroom: Three Empirical Studies

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DOI: 10.34190/EEL.21.023

Abstract: Few empirical studies have tried to integrate remedial functionalities in foreign language classrooms to enable inclusive practice, combining Universal Design for Learning and Computer-assisted Language Learning. To fill this apparent dearth in research, the author set out to study the affordances of remedial functionalities used in mainstream language classrooms. In three empirical classroom studies involving three interventions, the author tested the learning affordances of three Ebook prototypes with pedagogically informed remedial scaffolds in different mainstream language classrooms with subsequent semi-structured interviews consenting interviewees (n = 32). The author aimed at verbatim transcription of interviews, annotating paralinguistic features like laughter and circumstantial information, when needed for comprehension as well as prosodic features like emphases and rising nuclear intonation. Protocols were coded iteratively in a flexible-deductive way in which major coding categories and themes, when identified, entered into a dialogue with previous research, giving rise to further iterations and identification of subthemes. The studies of this paper are the first to attempt to explore in detail how remedial meaning-comprehension scaffolds are used by individual learners from struggling levels to top performance categories of proficiency. The three interview protocols suggested that learners in general used scaffolds for assisted self-regulation and self-efficacy but also for heightened engagement in acquiring receptive and productive lexical competences. Language teachers as well instructional materials designers can use these results to inspire pedagogical and instructional designs. Today's nations across the globe need skilled labour forces speaking a foreign language and possessing 21st- century skills and therefore teaching designs that can reach out to the whole classroom to impart such skills can contribute to satisfy this need.

Keywords: universal design for learning (UDL), CALL, foreign language teaching, remedial, English as a foreign language (EFL), inclusive practice

1. Background

The present paper studies how Universal Design for Learning (UDL) and Computer-assisted Language-learning (CALL) may be crossbred to produce a learning design for language teaching which can promote inclusive practice and make use of digital multimodal functionalities. With English as the Global language and 21st century skills (see e.g. (Kivunja, 2015) also calling for communication, it is arguably more necessary than ever for English language teaching to reach out to the whole classroom.

Three serial empirical qualitative studies in Danish year-seven English-as-a-foreign-language classrooms were used to explore the affordances (Gibson, 1986b) of functionalities in Ebook prototypes which have been remedially designed in accordance with UDL guidelines (Wakefield, 2011) with special emphasis on the guideline of "providing multiple means of representation". Here, a sui-generis Ebook prototype learning design with experimental UDL-guided remedial scaffolds was used (Kasch 2019). The prototypes featured the remedial scaffolds: compendious contiguous multimodal bilingual textual and auditory glossing with pictorial support (when pedagogically feasible), text-to-speech (TTS) and a bilingual audio retelling functionality as well as a response field for reflection. The paper presents data from three studies (n = 32), the first two of which were published in Kasch (2019).

To review contemporary empirical CALL research, the database compilation ProQuest was searched for peer-reviewed documents on April 5th 2020, using the truncated search string [ab("computer-assisted language learning") AND ab ("empiric*")], which returned 56 genuine types (i.e. non-duplicates) addressing CALL research. A further similar search in Scopus using the search string [computer-assisted AND language learning AND empiric*] returned 104 types, which together with the ProQuest search produced 73 genuine types in all. No returns combined CALL and UDL research, which astounded the author.

The paper starts off by briefly introducing CALL and UDL, after which previous empirical research in UDL and CALL pertaining to the present study. Then follows a presentation of method, after which an analysis of data is presented followed a discussion and conclusion.

2. CALL

CALL covers a broad range of activities and technologies as well as research agendas. The CALL research community thus engages in materials design, studies and design of learning technologies, pedagogical theories and modes and models of instruction. A CALL activity may thus encompass pedagogically tailored computer-driven designs as well as general-purpose software and other ICT media or functionalities that may be applied in language classrooms to support (foreign or second) language instruction.

As a result, the scope of CALL is a wide and expanding field (Beatty 2010, p. 8), expanding, as it were, whenever ICT inventions and innovations emerge and provide CALL with new language teaching and learning opportunities or affordances.

3. Universal design for learning

Universal Design for Learning research began in the 80s with the advent of the MacIntosh personal computer when, based on neuroscience and neuro-pedagogy, David Herbert Rose and co-workers at Center for Applied Special Technology (CAST) developed learning materials for students with disabilities – including learning disabilities (Hall et al., 2012, pp. 2-17; Rose, 2007). Based on their neuroscientific studies and a neuropsychological research base, CAST argue that variability and difference in learners should be considered the norm (Rose and Strangman, 2007; Hall, Meyer and Rose, 2012, pp. 2–17). Thus, Rose & Strangman (2007, p. 381) argue:

> *The traditional ''one-size-fits-all'' approach to curriculum denies the vast individual differences in learning strengths, challenges, and interests. The focus of this article is a novel approach, called Universal Design for Learning, to addressing the challenge of individual learner differences.*

On this basis, CAST propose a neuropsychological learning model and analytical framework for curricular designs dividing the brain into three dynamic and interrelated kernel sets of neural networks (Hall et al., 2012, pp. 2-3):

> *”Recognition networks” corresponding to “the what of learning” – dealing with how to ”sense and assign meaning patterns” to what ”we see” and ”how to understand information, ideas and concepts”.*
>
> *”Strategic networks” relating primarily to ”executive functions” and being ”specialized” in ”generating” and ”overseeing mental and motor patterns” so as ”to plan, execute and monitor actions and skills”.*
>
> *”Affective networks” specialized in evaluating patterns and assign them emotional significance”, enabling the learner to ”engage with tasks and learning with the world around us”.*

4. CALL studies of glossing and multimodal designs

Empirically, second-order meta-reviews (“meta-meta-studies”) of the CALL empirical research field present (Plonsky & Ziegler, 2016) a number of learning effect studies; with the exception of Ziegler’s meta-study of synchronous computer-mediated communication having a learning effect size of 0.16, all meta studies present medium and above-medium effect sizes (i.e. effect sizes > 0.4). Thus, Plonsky’s and Ziegler’s meta-study (2016) points to CALL glossing having learning effects both both vocabulary acquisition - incidental as well as long-term - and reading comprehension.

Taylor’s meta-study (2013) of CALL textual glossing formats and traditional non-hyperlinked textual formats draws attention to a study that used comprehensive (though not remedial or contiguous) glossing” (p.75):

> *It seems important to inquire as to why this manner of glossing [complete CALL L1 glossing] is not more common in L2 glossing studies. Why not put the onus of learning on the L2 reader and let him or her decide which items to pay attention to and select? If the learner could control which items were glossed, perhaps such a condition would provide even more bottom-up support for L2 reading comprehension.[Brackets, mine].*

According to Taylor, semantically open-category rather than grammatical closed-category lexemes are the more apt for supporting reading comprehension but also vocabulary acquisition (Taylor 2013, p. 74) owing to the “informational value” of the former:

> *The question then arises: besides assisting text comprehension and learner motivation, can glossing (including electronic dictionary access) help the L2 learner in real time to acquire lexical items, if we consider glossing a pedagogical aid? Knight (1994) and Salem (2006) both found that the more glossing is consulted in a CALL context, the more vocabulary is learned. Besides helping the L2 learner to become more motivated, glosses may help the L2 learner actually learn lexical items through the allocation of attentional resources, since attention to lexical items may be as essential as attention to language structure (Cook, 2001). L2 learners seem to process lexical items before or instead of grammatical items (Lee & VanPatten, 1995).*

Like (Laufer and Rozovski-Roitblat, 2011, p. 395), Taylor cites Schmidt's "Noticing hypothesis" (Schmidt, 2010), but, in addition, Laufer and Rozovski-Roitblat cite Laufer and Hulstijn's (Hulstijn and Laufer, 2001) Involvement Load Hypothesis and (Canale) and Swain's Pushed Output Hypothesis (Canale and Swain, 1980) to explain why doing more with lexical items than mere reading in or outside the classroom is more efficient for learners' retention of vocabulary. Taylor, though, also uses the easy hyperlinked access to glosses afforded to explain CALL glossing's superior efficiency over traditional glossing formats regarding vocabulary acquisition.

In his meta-study (Taylor 2013, p. 74), Taylor may be seen to argue in favour of glossing texts to an unlimited extent and to reach out to and offer students a choice. Taylor has reservations, arguing the CALL glossing may impede advanced learners' attainment of receptive competences of deriving meaning from contextual clues (2013, p. 75), i.e. lexical inferencing:

> *Thus, CALL use should depend to a large extent on the goal(s) of the L2 instructor. If the goal is to achieve fairly unified comprehension of a passage for preparing the learner for a speaking or writing activity, motivational and comprehension needs can be addressed with a CALL L1 glossed text. If the classroom goal is to show how certain lexical items are used in context, CALL L1 glossing may be effective as well. If the L2 teacher's goal is to provide the learner with the skill of deriving meaning from context, perhaps providing less CALL L1 glosses may be a more logical option, especially at more advanced levels.*

A limitation in Taylor's study (2013) is foregoing multimedia glossing, which has, however, been extensively studied by (Mohsen & Balakumar, 2011) reviewing empirical studies of multimedia glossing and second-language learning effects. Of the effects found in empirical studies (Mohsen and Balakumar, pp. 140-141), glossing with picture or video plus text, multimodal glossing (text + visual) led to higher learning effects than did text alone.

Cognitive loads on working memory may have a negative impact, as studies explored by Mohsen and Balakumar (2011) point to, viz. when visuals and text are presented simultaneously rather than separately. On the other hand, in a study of four variables hypothesised to have an effect on working memory capacity, Chun & Payne (2004) found that students with a low working memory looked up more words in multimedia glossing to compensate for memory limitations.

Mohsen's and Balakumar's meta-study (2011) also compared multimodal L1 and L2 glossing, finding that L1 and L2 multimodal glossing aids retention of incidental vocabulary acquisition. In Yoshii's study of the effectiveness of L1 and L2 glosses on incidental vocabulary learning in Japanese language classrooms and pictorial glossing (Yoshii, 2006, pp. 94-95), it was thus found that multimodal access in Yoshii's (2006) study was more important than whether the language used was the native language or the target language. In sum, CALL research has identified significant learning effects in glossing, be it multimodal, monomodal, L1 or L2.

5. Studies of language learners in empirical UDL research

In UDL research, only one language classroom has been studied (Proctor et al., 2007; Strangman et al., 2008). In a Universal Literacy Environment (ULE) year-4 learners (Proctor et al. 2007, p.74) studied a US classroom of 30 students, with 16 Spanish-speaking ESL learners and 15 English-only learners in a pre-post-test design to measure comprehension and vocabulary gains. (Proctor et al. 2007) used eight Ebooks with TTS with synchronised highlighting and pre-reading supportive true Spanish cognate "Power words" (Proctor et al., p.79) with pictorial support and audio pronunciation, but no glossing. Moreover, coach avatars were used for alerting students to cognates but also for scaffolding meaning-comprehension and executive functions, identifying statistically significant comprehension and vocabulary gains for all learners. In sum, UDL remedial scaffolds apparently benefit the whole classroom.

6. Method

On this background, the present paper conducted experimental qualitative classroom studies in collaboration with participant teachers in EFL classes. The studies all involved reading activities leading up to communicative spoken and written tasks. Three serial 3-5-lesson-day studies were conducted in Danish year-seven English-as-a-foreign-language classrooms.

The learner informant variability in the first study (Protocol 1) comprised four points out of a five-point range of proficiency levels scored at the Danish national English proficiency test (i.e. the strata clearly below average, below average, average, and above average). As no clearly-below-average performers consented to being interviewed in the second study, Protocol 2 featured average and below-average, and above-average interviewees. On these grounds, the author undertook a third study of serial studies in a classroom featuring a clearly-above-average student and three clearly-below average students for robustness of sampling.

In strict conformity with Danish ethical standards, all interviewees were informed consenters, as were participant schools. School belonged to socio-economically middle-income or slightly below middle-income municipality districts. The author conducted semi-structured interviews with 32 student respondents, having translated research questions into interview guide questions in everyday language guided by Brinkmann & Kvale (2015). The author asked informant students if and how they used digital functionalities and how they felt (if they did use them) the functionalities helping them to learn English. Conducting interviews, the author used screen dumps of the functionalities discussed to aid subjects' recall. Informants were encouraged to give further experiences, comments, and viewpoints, if any.

7. Analysis

Results were obtained from an iterative coding leading up to meaning-condensation (Brinkman and Kvale, 2015) of the interview protocols. In this iterative process, categorial coding was used for theoretical redescription (Protocols 1-3) in a dialogue with the following empirical and theoretical background:

- 1. learning engagement in general, i.e. self-regulation, self-efficacy (including intrinsic motivation) (Pintrich and De Groot, 1990; Bandura, 1994; Usher and Pajares, 2008) and autotelic behaviour (flow theory) (Csikszentmihalyi, 2014) and in UDL research (see section 4.2), on the one hand,
- 2. the theory of receptive language acquisition and lexical competence, on the other, i.e. studies vocabulary acquisition and attention to input as well as multimodal effects to with learned super-additive effects of multimodal inputs (Stephens and Kaiser, 2018; Cheetham, 2019)
- 3. scaffolding textual receptive comprehension in lexical competence and vocabulary acquisition and reading research (Laufer and Rozovski-Roitblat, 2011; Laufer, 2014; Laufer and Aviad-Levitzky, 2017) (Hulstijn and Laufer, 2001; Laufer and Hulstijn, 2001; Laufer, 2014) and in CALL and UDL research (see sections 4.1-4.2) and
- 4. misaffordances and undue scaffolding (Gibson, 1986a) and the overall usage of functionalities.

No new coding categories and themes emerged after coding the third protocol, suggesting theoretical sample saturation.

7.1 Learner engagement: Self-regulated learning and intrinsic motivation

A recurrent theme in all protocols (Protocols 1-3) was how task-persistence – i.e. the student's "management and control of their effort" (Pintrich and De Groot, 1990) - was aided by the assistive functionalities. This finding seems remarkable as neither "affective networks" nor "strategic networks" played a prominent part in the scaffolds design and hence not the UDL model's cognitive components directly associated with self-regulation and self-regulated learning (cf. Hall et al. 2012, pp. 3-7).

In interview responses, self-regulated learning (SRL), self-efficacy and intrinsic motivation appeared to pave the way for increased learning engagement. The author also investigated whether multimodally scaffolded reading activities led to increased learning intake. Interview data were thus confronted with studies of lexical competence acquisition (Hulstijn and Laufer, 2001; Laufer and Hulstijn, 2001; Laufer, 2014) (Laufer and Rozovski-Roitblat, 2011). Laufer & Rozovski-Roitblat (2011, p. 395) thus argue that vocabulary learning depends on "repeated encounters with the words" and "the quality of attention that learners pay to them (or elaboration, or involvement) during a communicative or any other learning task", i.e. doing more than just reading the text once.

7.2 Learning engagement and receptive lexical competence

In the present study, learners expressed how the text-to-speech functionality (TTS) with synchronous highlighting offered bimodal access to comprehending lexis, which research into multisensory integration and language learning point to as having "a super-additive [comprehension] effect" (Cheetham, 2019). Expectedly, learners used bilingual textual glossing for meaning comprehension, but amongst users only using glossing in Danish, the Retelling functionality was used for comprehension checks, but at other times for bimodal access to meaning content. Around a third of the informants (Protocols 1-3) also expressed experienced comprehension gains from pictorial glossing, typically as comprehension checks. In this way, elaboration and involvement were the norm.

7.3 Learning engagement and productive lexical competence

The functionalities also appeared to offer affordances for working with productive lexical competence. Thus, TTS bimodal input presented apparently still other affordances (Protocol 1, 7)

For an above-average learner, the TTS functionality afforded a bimodal input useful for augmenting "partial lexical knowledge" (Henriksen, 1999) and "getting the pronunciation right". Such an affordance was also expressed by learners who used the functionality for working on pronunciation. In some responses, receptive practice co-occurred with productive reading practice, viz. with an aware attempt at filling (Schmidt, 2010) a gap "noticed" in one's lexical competence, and thus facilitating phonological "pushed output" (Canale and Swain, 1980), with learners using audio sources for pronunciation practice. Further, in a couple of cases, the response field, originally meant to scaffold task-persistence and executive functions, lent itself to working on productive lexical competence and written proficiency in general. One learner, in fact, only used the response field to work with the lexis acquired and fine-tune their written proficiency.

7.4 Learning engagement: Misaffordances and overall functionality usage

Although, learners generally expressed intrinsic motivation at having the UDL-CALL scaffolds to help them and thus scaffold self-efficacy and SRL, a few learners, however, expressed suspicion of misaffordances of the remedial learning design. Such suspected misaffordance were expressed when asked if they thought it a good idea to have all such assistive functionalities in general. Later on, when asked to clarify, their apprehension concerned reading tasks not involving speaking or writing in English, viz. that people might be tempted just to have the passage retold and one respondent even feared that an input in English would impede learning because people would not read the text and just remember the aural input. The same learner, though, reported a preference for using retelling in English for comprehension gains, only using retelling in Danish once when struggling with a particular text fragment, i.e. the learner themselves used scaffolds to engage in an "reading plus" learning behaviour.

A few learners experienced GUI (graphical user interface) issues. One learner pointed out occasional reduced audibility of sound glosses, two learners pointed out that the layout could have been more appealing, two learners found the dotted clickable underlining navigationally confusing, and four learners found that they were not given enough time to master navigation.

Even so, all learners tended to engage in viable reading practices that would go beyond mere reading comprehension. Thus, interview data coding learning-relevant use only saw two learners not using (one possible below-average "outlier" - the only informant only appearing in the last intervention - and one above-average learner using only two and a further possible outlier ENL learner not using any) a least three functionalities, and only four informants using less than four functionalities. The overall usage of functionalities is depicted in the boxplot below of the learner informant performance strata: below average, average and above average.

To construct the boxplot representations of functionality usage, annotations in interviews of all informants were scanned by the author. All functionalities that a given informant used to learn English - backed by explanations of usage - were tabled into a spreadsheet, which was subsequently converted into a dataset to be fed into R Studio to compute a boxplot diagram.

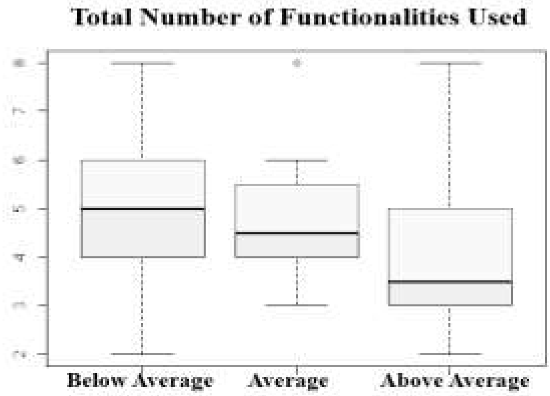

Figure 1: Box-plotted functionality usage in learner strata

The boxes in the boxplot including minimum whiskers account for 75 percent of each stratum, and here the respective strata represent functionality usage values between two and six for below-average learners, between three and five 5 for average learners, and between zero and five for above average learners. In other words, multiple functionality usage - and hence enhanced engagement and lexical competence acquisition - seems to be the norm in the observational serial studies' aggregate sample. This being a qualitative study, the quantitative representation is but one way to summarise findings. The tendencies in the data also tell a story of learning engagement, with learners tending to use minimally three and typically more functionalities.

8. Discussion

In general, interview data appear to report that the UDL-guided instructional material design is conducive to language learning and comprehension, with both glossing design and retelling sources as well as working on the response field assisting learners in self-regulating their learning. In addition to aiding comprehension, learner experiences present a wide variety of "reading plus" (cf. Laufer, 2003) affordances interacting with the scaffolds.

However, eight informants (out of 32) point to misaffordances, i.e. negative affordances, imagined, occasionally citing their own observations of other learners. In classical scaffolding theory (Wood, Bruner and Ross, 1976) and social constructivist learning practices (Vygotsky, 1978), it is vital that the "scaffolder" facilitates the learner's learning process and does not prevent them or let themselves prevent themselves from entering their "zone of proximal development". Experienced "ease of learning" as associated with intrinsic motivation or self-efficacy could give rise to suspicion of misaffordances, viz. learners engaging in intrinsically motivating behaviour at the expense of learning engagement, as ascertained in (Wood, Bruner and Ross, 1976). Here, scaffolding calls for the "tutor" to guide the learner to have a task focus and not engage in task-irrelevant activities. Therefore, when an above-average learner is so delighted by the easy access to lexical meaning, we could speculate that a higher intake could have evolved from forcing the learner out of (overly) smooth "learning flow". On the other hand, in the lens of "flow" theory, too low learning demands are associated with boredom rather than delight (Csikszentmihalyi, 2014: 239-297). When the self-same learner expresses avoiding using the retelling functionality in Danish, as it would make learning "too easy", the "autotelic behaviour" of the learner seems to engage in a sound "task engagement" rather than counterproductive (badly) self-regulated learning. More serious are misaffordances owing to regular inexpediencies in the design, found in the experiences of two learners – one with dyslexia finding the dotted lining interface a visual impediment, and one with (self-expressed) OCD-like behaviour finding contiguous glossing hard to use when they only wanted one word. With such inexpediencies, although it did not compromise the learning flow in general in the cases cited, self-regulation is at risk of being discontinued owing to (intrinsic) demotivation and negative "self-efficacy" (Pintrich and De Groot, 1990) or "learned helplessness" (Seligman and Maier, 1967).

A sample of consenting interviewees was used, which may lead to biased answers. Moreover, the interviewer participated actively in classroom teaching, giving the author access to an ecological learning environment, and personal relationships between interviewees and researcher may have influenced the way comments were made.

9. Conclusion

The findings of the study point to as affordances in the UDL-guided CALL design from what appears to be a removal of barriers to learning, scaffolds opening new entries to learning.

Investigating recognition networks UDL scaffolds, especially, i.e. “providing multiple means of representation” (Wakefield, 2011), the study found that augmented input-channel scaffolds appeared to offer both remedial and non-remedial usages helping learners to engage in as well as improve language learning in reading tasks. Affordances reported concerned both SRL in scaffolds stimulating non-struggling as well as struggling learners’ engagement but also pointed to an improved quality of learners’ attention to the “input”.

Therefore, functionality usages apparently increased not just learner participation and inclusion but also lead to a reading-plus strategy in learners (cf. Laufer & Rozovski-Roitblat, 2011). Only clearly-below average informants tended to use the remedial scaffolds for remedial, i.e. general meaning -content access and participation and only indirectly engaging in a reading-plus strategy, whereas all other informants’ use of functionalities was directly associated with a reading-plus strategy, i.e. non-remedial uses.

However, since only year-seven learners of English as Foreign Language were studied, it stands to reason that mechanisms could obtain in other language classrooms at other levels. Therefore, more research into UDL-CALL designs is advisable to have a more fine-grained understanding of long-term learner interactions behaviours as well as learner affordances in other language classrooms. Even so, UDL-CALL designs appear to offer inclusive practice potentials for all learners to acquire vital 21st century language proficiency skills.

References

Bandura, A. (1994) ‘Self-efficacy’, in Ramachaudran, V. S. (ed.) *Encyclopedia of Human Behavior*. New York: Academic Press, pp. 71–81.

Brinkman, S. and Kvale, S. (2015) *InterViews. Learning the craft of qualitative research interviewing.* 3rd edn. London: Sage.

Canale, M. and Swain, M. (1980) ‘Theoretical Bases of Communicative Approaches to Second Language Teaching and Testing’, *Applied Linguistics* , 1(1), pp. 1–47.

Cheetham, D. (2019) ‘Multi-modal language input: A learned superadditive effect’, *Applied Linguistics Review*, 10(2), pp. 179–200. doi: 10.1515/applirev-2017-0036.

Chun, D. M. and Payne, J. S. (2004) ‘What makes students click: Working memory and look-up behavior’, *System*. Elsevier Ltd, 32(4 SPEC.ISS.), pp. 481–503. doi: 10.1016/j.system.2004.09.008.

Csikszentmihalyi, M. (2014) *Flow and the Foundations of Positive Psychology*, *Flow and the Foundations of Positive Psychology*. doi: 10.1007/978-94-017-9088-8.

Gibson, J. J. (1986a) *The Ecological Approach to Visual Perception*. New York and Sussex: Psychology Press, Taylor and Francis Group.

Gibson, J. J. (1986b) ‘The Theory of Affordances’, in *The Ecological Approach to Visual Perception*, pp. 127–146.

Hall, T. E., Meyer, A. and Rose, D. H. (eds) (2012) *Universal Design for Learning in the classroom: Practical applications*, *What works for special-needs learners*. Edited by K. R. Harris and S. Graham. Wakefield MA: Guilford.

Henriksen, B. (1999) ‘Three Dimensions of Vocabulary Development’, *Studies in Second Language Acquisition*. Aarhus Universitets Biblioteker, 21(2), pp. 303–317. doi: 10.1017/s0272263199002089.

Hulstijn, J. H. and Laufer, B. (2001) ‘Some Empirical Evidence for the Involvement Load Hypothesis in Vocabulary Acquisition’, *Language Learning*. Blackwell Publishing Inc., 51(3), pp. 539–558. doi: 10.1111/0023-8333.00164.

Kasch, H. (2019) ‘Experimental Studies of the Affordances of Assistive Multimodal Learning Designs: Universal Design for Learning in Modern Language Classrooms’, *JISTE*, 23(2), pp. 93–107.

Kivunja, C. (2015) ‘Exploring the Pedagogical Meaning and Implications of the 4Cs “Super Skills” for the 21st Century through Bruner’s 5E Lenses of Knowledge Construction to Improve Pedagogies of the New Learning Paradigm’, *Creative Education*, 06(02), pp. 224–239. doi: 10.4236/ce.2015.62021.

Laufer, B. (2014) ‘Vocabulary in a second language: Selection, acquisition, and testing: A commentary on four studies for JALT vocabulary SIG’, *Vocabulary Learning and Instruction*, 3(2), pp. 38–46. doi: 10.7820/vli.v03.2.laufer.

Laufer, B. and Aviad-Levitzky, T. (2017) ‘What Type of Vocabulary Knowledge Predicts Reading Comprehension: Word Meaning Recall or Word Meaning Recognition?’, *Modern Language Journal*, 101(4), pp. 729–741. doi: 10.1111/modl.12431.

Laufer, B. and Hulstijn, J. (2001) ‘Incidental vocabulary acquisition in a second language: The construct of task-induced involvement’, *Applied Linguistics*, 22(1), pp. 1–26. doi: 10.1093/applin/22.1.1.

Laufer, B. and Rozovski-Roitblat, B. (2011) ‘Incidental vocabulary acquisition: The effects of task type, word occurrence and their combination’, *Language Teaching Research*, 15(4), pp. 391–411. doi: 10.1177/1362168811412019.

Mohsen, M. A. and Balakumar, M. (2011) 'A review of multimedia glosses and their effects on L2 vocabulary acquisition in CALL literature', *ReCALL*. Cambridge University Press. 100 Brook Hill Drive, West Nyack, NY 10994-2133., pp. 135–159. doi: 10.1017/S095834401100005X.

Pea, R. D. (2004) 'The Social and Technological Dimensions of Scaffolding and Related Theoretical Concepts for Learning, Education, and Human Activity', *The Journal of the Learning Sciences*, 13(3), pp. 423–451. doi: DOI: 10.1207/s15327809jls1303_6.

Pintrich, P. R. and De Groot, E. V. (1990) 'Motivational and Self-Regulated Learning Components of Classroom Academic Performance', *Journal of Educational Psychology*, 82(1), pp. 33–40. doi: 10.1037/0022-0663.82.1.33.

Plonsky, L. and Ziegler, N. (2016) 'The CALL-SLA Interface: Insights from a Second-Order Synthesis', *Language Learning & Technology*, 20(2), pp. 17–37. doi: URI/DOI:10125/44459.

Proctor, C. P., Dalton, B. and Grisham, D. L. (2007) 'Scaffolding English language learners and struggling readers in a universal literacy environment with embedded strategy instruction and vocabulary support', *Journal of Literacy Research*, 39(1), pp. 71–93. doi: 10.1080/10862960709336758.

Rose, D. H. and Strangman, N. (2007) 'Universal Design for Learning: Meeting the challenge of individual learning differences through a neurocognitive perspective', in *Universal Access in the Information Society*, pp. 381–391. doi: 10.1007/s10209-006-0062-8.

Schmidt, R. (2010) 'Schmidt, R. (2010). Attention, awareness, and Individual Differences in Language Learning', *CLaSIC 2010*. Edited by W. M. Chan et al. Singapore: National University of Singapore, Centre for Language Studies., pp. 721–737.

Seligman, M. E. and Maier, S. F. (1967) 'Failure To Escape Traumatic Shock', *Journal of Experimental Psychology*, 74(1), pp. 1–9. doi: 10.1037/h0024514.

Stephens, M. and Kaiser, M. R. (2018) 'A comparison of visual and audio scaffolds in L2 English reading', *Indonesian Journal of Applied Linguistics*, 8(2), pp. 380–387. doi: 10.17509/ijal.v8i2.13303.

Stockwell, G. (2007) 'A review of technology choice for teaching language skills and areas in the CALL literature', *ReCALL: Journal of Eurocall*. Waseda University, Tokyo, Japan gstock@waseda.jp; Stockwell, Glenn,1-6-1 Nishi-Waseda Shinjuku-Ku,Tokyo,Japan,Waseda University,gstock@waseda.jp: Cambridge University Press. 100 Brook Hill Drive, West Nyack, NY 10994-2133., 19(2), pp. 105–120. doi: http://dx.doi.org/10.1017/S0958344007000225.

Strangman, N. *et al.* (2008) 'New Technologies and Universal Design for Learning in the Foreign Language Classroom', in *Worlds Apart?*, pp. 164–176. doi: 10.12987/yale/9780300116304.003.0009.

Usher, E. L. and Pajares, F. (2008) 'Sources of Self-Efficacy in School : Critical Review of the Literature and Future Directions Author (s): Ellen L . Usher and Frank Pajares Source : Review of Educational Research , Vol . 78 , No . 4 (Dec ., 2008), pp . 751-796 Published by : American', *American Educational Research*, 78(4), pp. 751–796. doi: 10.3102/0034654308321456.

Villada, E. G. (2009) 'CALL Evaluation for Early Foreign Language Learning: A Review of the Literature and a Framework for Evaluation'. San Marcos: Computer Assisted Language Instruction Consortium, pp. 363–389.

Vygotsky, L. S. (1978) *Mind in Society - The Development of Higher Psychological Processes*. Edited by M. Cole et al. Cambridge, Massachusetts and London: Harvard University Press.

Wakefield, M. A. (2011) 'Universal Design for Learning Guidelines Version 2.0'. CAST. Available at: https://wvde.state.wv.us/osp/UDL/4. Guidelines 2.0.pdf.

Wood, D., Bruner, J. S. and Ross, G. (1976) 'The Role of Tutoring in Problem Solving', *Journal of Child Psychology and Psychiatry*, 17(2), pp. 89–100. doi: 10.1111/j.1469-7610.1976.tb00381.x.

Yoshii, M. (2006) 'L1 AND L2 GLOSSES : THEIR EFFECTS ON InCIDENTAL', 10(3), pp. 85–101.

Peer Observation and Evaluation of Synchronous Online Tutorials

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DOI: 10.34190/EEL.21.104

Abstract: The COVID-19 pandemic has resulted in Higher Education Establishments across the world moving a large proportion of their teaching online. This has required a rapid upskilling of academic staff who were required to learn how to use online learning environments and in particular synchronous delivery tools for the delivery of online lessons. In the process of upskilling to meet the demands of delivering lessons online, traditional teaching paradigms needed to be altered in order to fit with online delivery approaches. In order to deliver rapid online learning compromises had to be made as the online tools were used to implement traditional teaching paradigms. Concurrently new approaches for online lesson delivery were being developed which strived to make use of synchronous tools to support students in their learning. Moving forwards, it looks like online learning will constitute a significant part of future learning for many students in Higher Education. Traditional Face to Face delivery uses Peer reviewing as a means of supporting staff in the delivery of lessons across a range of interaction modes. This paper seeks to identify how supportive peer reviewing can be used to support and develop academic staff as they continue to deliver lessons online. The paper will draw on the work of Lambie and Law (2018), Law and Lambie (2020) which sought to identify best practice in running online synchronous learning events and will identify self-assessment criteria and a supportive peer review framework which will help academics assess their online synchronous delivery. The paper will discuss an evaluation approach based on a Likert type scale for evaluating the delivery of an online tutorial session and will discuss how this pro-forma could be used in the peer review process.

Keywords: peer review, quality, synchronous, online, tutorial

1. Introduction

Peer reviewing is about observing someone deliver a lesson to a specific group of students in order to determine if that lesson is of an appropriate quality. (Haiter,2013) There are several reasons for either wanting or needing to carry out this activity. Peer observation of teaching is a well established approach in a range of educational settings and is central to the development of trainee teachers and has also established a place in higher education. The primary reason the authors have for investigating this activity is to help establish a good set of criteria that a practitioner can use in order to reflect as part of their own evaluation of their teaching and how advice can be provided to colleagues engaging in this role. Wajnry (,2012) identifies an observable task as a “focused activity to work on while observing a lesson in progress” Further Wajnry (2012) identifies a similar list of tasks focusing on the activities being performed and how the activities are carried out. So, in order to carry out observation both observer and observe need to know what the criteria are.

The recent move to deliver teaching in Higher Education using a predominantly online model has resulted in a sudden need for Higher Education teachers to upskill in order to use the online medium. While this was a response to a Global crisis caused by COVID-19, as some countries start to recover there is much discussion on how students should be supported and what the new model of interaction should be in a post COVID world. Teaching at a distance has some advantages in terms of utilising staff and accommodation (Wells,2017), (Strengths and Weaknesses of Online Learning, 2021), (Seven Benefits of a Virtual Classroom, 2021). Staff no longer need to be in a face-to-face situation to deliver some forms of teaching. It is true to say that not all subjects naturally lend themselves to online delivery, but for those that do there are many opportunities to delivery some form of teaching in a more flexible manner. Social isolation is a possible problem for some students as well as identified by (Wells,2017). So how can best practice be established locally within a subject area in order to help colleagues deliver a good quality of supportive teaching online. Peer Observation of Teaching online (POTOL) offers one way to help establish good practice.

A fundamental question asks what is good practice in online delivery? This paper will review what is good practice and ask how peer review of teaching online (POTOL) can be used in a supportive way to help those teaching in higher education to deliver good quality online lessons. The use of POTOL is one way to share good practice once it has been established what that is. This paper will focus on good practice regarding online Tutorial delivery where there is an expectation that students and the pedagogue will need to communicate in order to discuss a specific topic in a higher education context (Lambie and Law,2015), (Modes of Delivery,2021). In a traditional face to face tutorial students either work through a set of questions provided by the Tutor with intervention from the Tutor if a difficulty arises or they discuss the answers that they have already prepared (in a flipped classroom sort of setup). Lambie and Law (2015,2016,2018) discuss the differences between face to face and online Tutorial provision and the lack of aural and visual cues that are apparent in the face-to-face world. This makes it much more difficult for the Tutor when running an online Tutorial. Hence a new set of criteria need to be identified to engage in Peer review activities in an online world.

Note that student evaluation questionnaires are not a satisfactory way of evaluating the quality of teaching being delivered (Johnson, 2000). However, if Peer review is a regular process, then there is scope for building a discussion of student feedback into the review process. Morgan (2003) discusses how those being taught can contribute to the peer review process in terms of what characteristics they would like to see a trainee teacher exhibit. There is scope for extrapolating the characteristics identified into higher education. So, respect for pupils as learners and instilling a sense of discipline in the classroom translate to respecting students as learners from diverse backgrounds and showing interest and enthusiasm in the work being produced.

Peer review can be applied at different times and for different reasons. This paper seeks to review how Peer review can be used to support those delivering synchronous sessions in the online world and to help them to develop skills in relation to using online tools either as a direct replacement for face to face sessions or as an alternative to face to face sessions for students studying at a distance and unable to physically attend face to face sessions. In order to do this the authors have used their experience of working in a team teaching situation to identify criteria that can be used in a peer review/self-evaluation situation and to use that to develop a pro-forma that can be used to identify criteria to measure Tutor experience in some way. Team Teaching in the online world is discussed in the literature review and is identified as being a very desirable practice in online delivery in order to handle potentially high workloads.

The research question that was formulated is asking “What role can peer observation of teaching play in disseminating good practice in online Tutorial delivery”. This topic came out of a discussion during the question and answer session of a previous conference where the authors’ were asked how they disseminated good practice among colleagues. On reflection after the presentation the authors felt that developing a peer review strategy was one way to contribute to disseminating good practice.

2. Literature review

Peer Observation of Teaching can be used for several reasons depending on the reason for carrying it out. In Gosling’s (2002) investigation of the term “peer” he suggests that a peer can be departmental, interdepartmental or from a learning/teaching specialist department, however, this definition includes the peers “status” within the organisation. This apparent status can play its part within the observation process. Regarding observation, Gosling (2002) asks the question “what is, and what is not, observable?” as the current focus of peer observation is on “performance”. Interestingly, Gosling (2002) notes that there is a difference between what the observer has seen and what has been noticed, advocating that observers “interpret” what they’ve seen and that this can be influenced by the observer's own experience and proficiency level. Moving forward it is important to identify what it is that we would like to observe in an online situation and how observations can be recorded in a productive supportive and way.

Gossling (2002) identifies 3 specific Models of Peer Observation of Teaching: evaluation, development and peer review. The focus of this paper is on the Peer Review model of teaching staff observing teaching staff in order to provide a safe environment in which to discuss the teaching activity and to encourage mutual reflection. Kenny et al (2013) found that although the process is time consuming peer observation across different disciplines provided exposure to alternative approaches that could be used in the observers own subject area. So, there is scope for taking a multidisciplinary approach to the POT/POTOL activity.

A study by Weller (2009) identifies an important research question associated with peer review is the role played by “pedagogic jargon”. Respondents to her study identified the validity and importance of engaging in critical discussion but found the use of pedagogical jargon by the observer created a disjoint with their “real” experiences preferring that the discussion use "non-technical language" (Weller, 2009). Bearing this in mind, it would seem prudent to remove, as much as possible, the technical language of both pedagogy and online teaching to facilitate a less daunting environment for practitioners.

Moving online provides several opportunities in terms of peer review activities. For example, recording of an online Tutorial can be readily achieved by most synchronous tools such as Microsoft Teams, Adobe Connect and Collaborate Ultra. This paper is based on live reviewing of an online Tutorial session rather than on a recording.

2.1 Teaching approach

Tigelaar et al. (2004) suggest that the higher the level of activity a student finds themself in during their learning experience infers that the teaching has a greater focus on being student centred. Online teaching is no exception and should aim to engage and encourage student participation. Lambie and Law (2015,2016, 2018) identify that students will not always want to engage verbally in an online session and the pedagogue needs to be aware of this. Law and Lambie (2020) outlines some ideas that would allow students to participate in a non-verbal way to an online session. Approaches such as ordering code snippets, filling in words in written paragraphs and using multiple choice type questions all contribute to the online experience.

Tigelaar et al. (2004) postulate there is a "positive" relationship "between student-focused teaching and students' learning outcomes." In their study, Tigelaar et al. (2004) observe a relationship between the way that lecturers perceive the target of learning and their teaching technique; implying those that perceive "knowledge as given" tend to embrace a "teacher-focused" teaching technique and those that perceive "knowledge as being constructed" tend to embrace a "student-focused" teaching technique (Tigelaar et al., 2004).

A constructivist approach to teaching requires a move from teacher focus to student focus fulfilling the constructivist belief of the learner actively constructing knowledge with the learner being involved, in control and deriving consequential understanding from their personal experiences (Tigelaar et al., 2004).

A previous study of academics' beliefs about teaching and learning by Samuelowicz and Bain (2001) established intrinsic divergence in the approaches of teaching-centred and learning-centred techniques to learning and teaching. Their research leads to the development of a seven orientation framework of teaching and learning, which is used to describe a continuum where teaching progressively evolves toward student-centred learning Tigelaar et al., (2004).

Table 1: Orientations to teaching and learning Samuelowicz and Bain (2001)

Teaching-centred orientations	Learning-centred orientations
Imparting information	Helping students develop expertise
Transmitting structured knowledge	Preventing misunderstandings
Providing and facilitating understanding	Negotiating understanding
	Encouraging knowledge creation

McKenzie, Pelliccione and Parker (2008) state "Peer review of learning and teaching in blended learning environments is complex.". The complexity depends on the blend and therefore how much direct input the teacher has to the teaching situation. Further, Alexander and McKenzie (1998, cited in McKenzie, Pelliccione and Parker, 2008) extol the virtues of e-learning technologies and how they can provide students with an augmented learning experience. Again, the level of direct involvement of the teacher in the learning will vary depending on how the material will be used. A great deal of higher education follows a blended learning approach (Modes of delivery, 2021), with a Tutorial based activity being part of that blend.

Reeves, Herrington and Oliver (2004, cited in McKenzie, Pelliccione and Parker, 2008) indicate that there is minimal evidence to suggest a universal improvement of student learning. Some researchers (Cuban (2001, cited in McKenzie, Pelliccione and Parker, 2008) and Naidu (2003, cited in McKenzie, Pelliccione and Parker, 2008)) assert the cause for this lack of improvement is firmly due to reproducing provision accessible via face-to-face instruction. McKenzie, Pelliccione and Parker (2008) further support this claim indicating that an abundance of time has been expended producing identical material in a variety of distribution types ceding that access to material is required but that the material provided is not adequate for the style of learning which requires an alteration in students' perception of subject matter or the formation of new ideas.

The pedagogical approach used is therefore important in the delivery of learning and will influence the style of observation that will be used. Attention therefore needs to focus on what can be observed in a particular pedagogical approach which in this paper is the online tutorial.

2.2 Identifying observables

What should be observed in a POT situation? As a starting point we can use the criteria identified by an Education Department when reviewing trainee teacher performance. (Dept. of Education University of Strathclyde, 2021) identify the following "observables" that are used as part of review of a trainee teacher.

The headings include:

- resources
- support
- pedagogies used
- organisation and management
- student voice
- the use of ICT to support online learning

The first 5 points are all factors that would be of interest in the delivery of an online activity such as a Tutorial. The sixth point is specifically about the use of a tool to help deliver the online session. As we will see later in this paper the authors have used the first 5 points in order to focus on observables that can be used as part of a POTOL situation the results of which could be used as part of a peer review/peer support session after the observation has been completed. Morgan (2003) identifies similar criteria which came from student observers. The student observers included role modelling and behaviour management as well, which are interesting additions even in the online world.

In order to establish a good practice baseline when delivering synchronous online delivery those delivering these activities need to draw on the topics in this and similar lists in order to provide the basis for a peer observation experience. A primary objective is quality establishment and then enhancement for the individual delivering the lesson rather than simple quality assurance. There is an underlying question - "Is the pedagogue good or bad and what is the level of goodness or badness being demonstrated" In a supportive environment the aim is to help the pedagogue to improve regardless of the level of goodness or badness.

Ali (2007) establishes a 6 stage process for a reflective observational programme. Importantly one stage in this process is to prepare the person being observed for the activity indicating that this is an important activity in its own right. Interestingly Ali (2007) also produces a sample observational checklist which includes a specific entry for enthusiasm and motivation.

ICT is now a central resource in face to face teaching through use of tools such as PowerPoint, internet resources, videos etc. In the developed world classrooms are equipped with computers, ceiling mounted projectors along with internet connections and Wi-Fi. Tool use in online learning needs to be a separate item. Lambie 2018 discussed the changes over a 25 year period from chalk and talk approaches to the role that virtual reality may play in education when students need to ask for help and concluded that the technology revolution was an essential driver in modern education. Where would we be in the COVID landscape without the internet and the plethora of tools that have helped everyone including those in the education world to communicate with each other. One significant downside of the COVID situation is that the inequalities in society have been magnified and the lack of educational opportunity for those with no or poor internet connectivity have been apparent.

Moving forward into the online world in the 21st century still requires compromises. The compromises that have to be reached must also be reflected in the way that a Peer review process is conducted for teaching situations such as Tutorials in the online world.

2.3 Peer reviewing in the online world - what is the different?

In the online world the classroom has moved into the virtual world and the activities and expectations need to be handled with this in mind. Many Higher Education establishments already have a peer review process (POT) in place for example Peer observation of teaching policy (2016), Peer observation of teaching process (2021), (Hater, 2013). This is in accordance with Quality Assurance Agency requirements in the United Kingdom. Some institutions have attempted to adapt their policy for online learning (Peer observation of teaching process,2021). However, the pro-formas used as an observation of E-teaching do not really give any hint of what is being observed in the online teaching situation. The authors therefore believe that there is scope for providing some specific criteria to help both the observer and the teacher being observed particularly in the non-speaking communication area. Not everything is possible in the virtual world. The visual and aural nuances that are evident when standing in front of a class in a Tutorial situation are missing in the online world and the way that a Tutor is observed when handling that class needs to change as well to accommodate this. Lambie and Law (2016) identified this as something that needs to be considered when developing a lesson plan for an online class and (Law and Lambie, 2020) discussed some strategies that can be adopted when students are reluctant to speak during an online lesson. It is these strategies that the authors are suggesting could be factored into the online observation session.

2.4 Team teaching approaches in the online world

Team teaching cannot be underestimated in the online world because of the need for the pedagogue to multitask to handle the multiple communication sources available to students participating in an online session such as a Tutorial. In a classroom situation students shouting out answers or asking questions is discouraged and in most situation students will be reticent to do this. However, in the online world with the opportunity to utilise chat facilities the Tutor may be overwhelmed with students asking individual questions. This is where a small team of two Tutors can be deployed to hand the situation with one Tutor controlling the flow of the lesson and the other Tutor handling questions as they come in via the chat facility. This is a particularly good approach with large groups of greater than 20 students.

2.5 Small group teaching approaches

Small group teaching situations such as Tutorials are key to supporting student learning in the face to face situation. Opportunities for students to produce answers to subject related questions and to be able to discuss the questions and answers with their peers and a Tutor is an important part of their education. Most higher educational programmes will have a tutorial in some form or other as part of the programme delivery of a specific module. Typically, tutorials are organised in groups of up to 20 so there are opportunities to discuss subject related topics both formally and informally in a session. Move this sort of activity online and the dynamics of the activity immediately change.

2.6 Literature review conclusion

It is clear from looking at work done in this area there are competing objectives in carrying out Peer review depending on who is instigating the activity. The benefits verses the work involved in peer review is a balance that needs to be calculated. Nevertheless, there are positive benefits from “sharing” experiences of POT and there is a need to extend this into the online world. In order to do this, there is some work to be done to identify and discuss appropriate criteria that can be the basis for a Peer observation session online and a discussion afterwards.

3. Identifying peer review criteria

POT can be valuable for several reasons. Firstly, for those new to delivering online activities there is the opportunity to observe a colleague delivering a lesson online (a sort of reverse POT). This provides an opportunity to view in practice specific approaches to online support. The observer has an opportunity to view:

- how the pace of the lesson is controlled

- how visual aids are used to focused on specific points
- how students are encouraged to interact (with each other and with the pedagogue in charge of the lesson)

This activity in the first instance is in the 'development model' as defined by Gosling (2002). There is the tacit assumption here that the approach being observed has merit in providing a good example of how to conduct a session. Lambie and Law (2018), Law and Lambie (2020) identified criteria which could be used to identify good practice in the delivery of synchronous online activities as you would expect to carry out in a Face to Face situation. Crossing over into the online world requires the use of a Tool in order to achieve some form of communication and a rethink of how the session is going to be conducted. There is a tendency for the online tool to dictate the style of delivery rather than thinking through a particular pedagogical approach and how this would work with the tool. Lemmer (2013) pointed out that "pedagogical goals" should be a central consideration when utilising Technology and not the other way round. University learning and teaching units tend to focus on providing the procedural training for online tools. There is therefore scope for providing some support in terms of consideration of the pedagogical approach the Tutor wants to use and looking at how the tool can be used to support this. Further, Lemmer (2013) indicated that a problem solving approach was appropriate in the online world because it focuses students on analysing the problem being presented. Figure 1 from (Lambie and Law 2018) is an attempt to show that there is a spectrum of approaches that could be utilised but an active approach that encourages students to engage in problem solving exercises which try to reinforce ideas they have already discovered as part of their flipped classroom activities is very important. Ideally the Tutor(s) delivering the session want to be working in the top right corner of Figure 1 using approaches outlined in Law and Lambie (2020). If an active problem solving approach is appropriate, then this should be reflected in the criteria used as part of a POTOL strategy.

3.1 Self evaluation/obervation pro-forma

To capitalise on previous work which attempted to identify appropriate strategies for delivering online Tutorials a Pro-forma based on this work has been developed. This is an attempt to provide the pedagogues' running online sessions with a means of evaluating their activities. The focus here is on criteria for an interactive session in which students are keen to participate and are provided with opportunities to participate. The criteria for the pro-forma came from previous work carried out by the authors and from discussions of how team teaching situations have worked.

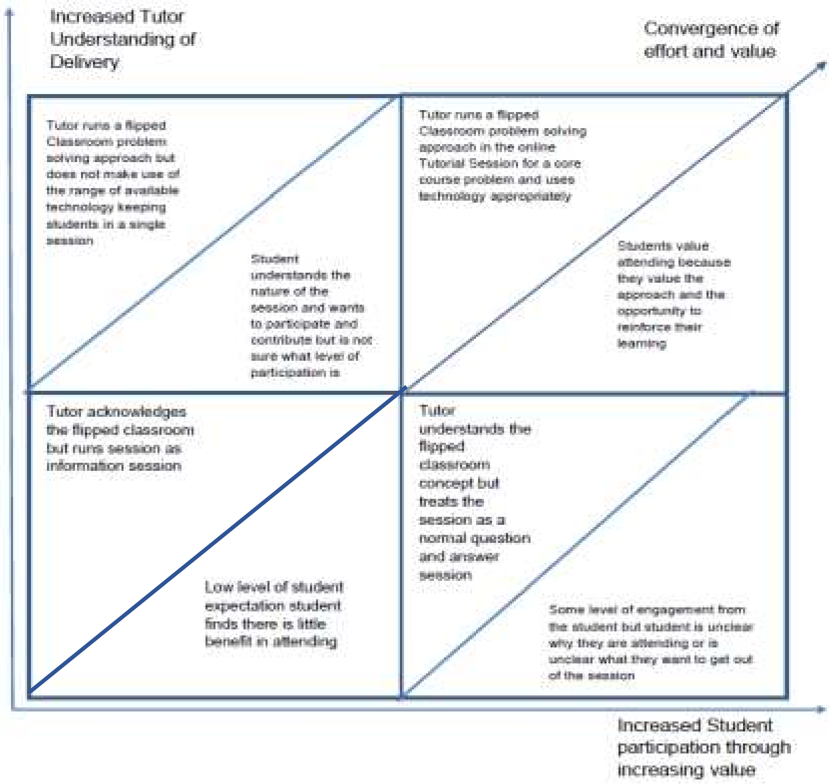

Figure 1: Tutor understanding of delivery process verses student participation

The pro-forma is based on a Likert scale and identifies five specific criteria that can be observed. The criterion are:

- Clarity of visual instructions on screen in relation to the advertised topic
- Distinct/defined points for student participation
- Range of interactions provided and manner of usage
- Session Pacing and opportunities for questions/dealing with problems
- Use of Team Teaching to share workload
- Appropriate summary of skills covered/developed.

The evaluation also acknowledges that the online session (just like the face to face session) has distinct parts and seeks to include these as distinct parts of the evaluation.

Some examples of the questions included in the POTOL pro-forma are shown below.

Table 2: Sample pro-forma questions

	Agree Strongly	Agree	Neither agree nor Disagree	Disagree	Disagree Strongly
Sample question from category Clarity of Visual Instructions. Students were directed to Sound/video set up instructions at the start of the session					
Sample question from category Range of Interaction Provided Students were making use of the chat facility to communicate with the Tutor to ask questions.					
Sample question from category Range of interactions provided Session flowed well with clear transitions from one part to the next.					
Sample Question from Category Use of Team teaching to share workload Staff handovers for each section worked well with each with each section clearly signposted.					
Sample Question from category Appropriate Summary of Skills covered/developed. Main points/technologies/ideas/techniques were summarised.					

The authors believe there is a tendency to think that the work that is carried out in face to face sessions is in some way perfect and that online support is in some way inferior. As indicated in Lambie and Law (2015,2016, 2018) the Tutor must work much harder and needs to be better prepared for an online session. This acknowledgement needs to be part of the POTOL observation. As Lambie and Law (2015) point out there is a lack of visual and aural cues in the online world and this makes the work of the Tutor much harder.

The authors recognise that generally an idealised online session consists of:

- Setup phase (Checking sound/video settings and establishing the protocol for interaction in the session)
- Participation phase (Active participation is the key here either through direct speech or using the chat facility)
- Review/Evaluation (Discusses the ground covered and may be used to set the scene for a forthcoming assessment)

Broadly speaking the authors believe the setup phase is an opportunity to put students at ease and to provide an opportunity to check some aspects of the tools being used such as . - Direct speaking, use of the chat facility etc. There is still the age old problem with some participants arriving late. The Participation phase will require some instructions and should allow students to contribute either individually or collectively in small groups. It is always helpful to have a review of the main points covered and to pause to allow for any questions that may have arisen as a result of the sessions. Tutors have to work hard not to turn the session into a mini lecture.

Urmani-Khan (2009), Venkatesh (2003) discuss the role of acceptance of technology in online learning, Lambie and Law (2016) point out that while students can demonstrate regular usage of technology through social media applications this is not a predictor of a good level of participation in a learning activity such as an online Tutorial. This reluctance to participate should be taken into account and should not be used in a negative context when reviewing a Tutor or team of Tutors when delivering online. Instead, the "metrics" should be focused on the level of opportunity that the Tutor provides the student with in terms of being able to participate. Non spoken means such as short online quizzes or opportunities to complete sentences or calculations can be provided and these approaches can offer just as valid experiences for the student in the online world.

3.2 Use of the pro-forma in online POTOL

The intention when developing the pro-forma was to identify criteria that could be used to evaluate an online session and to provide opportunities for discussion about how to engage with students in an online situation. The authors believe that encouraging engagement even in a non-spoken way is the key to a successful online session.

The pro-forma also has potential to be used by colleagues looking to evaluate their online delivery and would allow them to observe others to get an idea of what can be done using a particular synchronous delivery tool. This may be of particular use to those who are new to online delivery.

4. Conclusion

So far, the pro-form has only been used by the authors in their own delivery, mostly in some form of team teaching situation where each author was responsible for conducting a specific part of the session. The observations obtained and discussed indicate that lessons have a good flow with an appropriate amount of ground being covered but that there is scope to provide more opportunities for students to discuss the problems among themselves. This could involve activities such as creating breakout rooms where sub groups of students could discuss specific course/module related problems.

Length of session is a factor that affects how the three identified phases in the online session pan out. The authors have a certain amount of control over the timings but deliver a mixture of session lengths from 1 to 2 hours in duration. The sweet spot is around the 1.5 hour mark for both student and Tutor concentration.

Frequency of observation is an important consideration. The authors believe that this should be carried out at least once per session/semester with twice being better and three times being optimal. The magic number three was settled on because (near the beginning, in the middle and towards the end of the semester session) it reflects different points in the delivery of a module which may influence what is being covered in the Tutorial and why. Three observation session is quite a lot but can be spread out over an academic session to allow staff time to reflect on their experiences and try out a range of activities with different classes. Over a period of time say 1-3 years there should be scope for individual Tutors developing a range of skills and feeling comfortable sharing thee experiences with colleagues.

References

Ali, S. (2007) 'Reflective teacher Observation Model for In-Service Teacher Trainees', English teaching Forum, v45 n1 p16-25

Blackmore, J. (2005) 'A critical evaluation of peer review via teaching observation within higher education', International Journal of Educational Management Vol 19 No 3 pp218-232.

Bovill, C. (2011) 'Peer Observation of Teaching Guidelines', Academic Development Unit of the Learning and Teaching Centre at the University of Glasgow.

Dept of Education, University of Strathclyde (2021), 'Criteria for trainee teacher assessment in face to face teaching situations'

Goodfellow, R., 2014. Students' attitudes to Face-to-face and Online (Elluminate) Tutorials: 2012J Tutorials Survey – report on findings.

Gosling, D. (2002), Models of Peer Observation of Teaching, August, LTSN Generic Centre Learning and Teaching Support Network, York.

'Guide to Peer Observation of Teaching' (2017) University of Edinburgh [Online]. Available at http://www.docs.hss.ed.ac.uk/iad/Learning_teaching/Academic_teaching/Resources/Peer_Observation/Peer_Observation_of_Teaching_A4.pdf Accessed(6th June 2021)

Haiter, C. (2013) 'Peer Observation and review of Teaching and Learning', University of Canterbury [Online]. Available at https://www.canterbury.ac.uk/learning-and-teaching-enhancement/docs/Peer-Observation-and-Review-Guide-for-Staff.docx (Accessed 7th June 2021)

Johnson, r. (2000) 'The Authority of the Student Evaluation Questionnaire' Teaching in Higher Education 5(4) 4190434

Kenny et al. (2013) 'In their shoes: exploring a modified approach to peer observation of teaching in a university setting, Innovations in Education and teaching International, 51:2 218-219

Lambie, I., Law, R. (2015) 'The 21st Century Tutorial' In Proceedings of the 14th European Conference on E-Learning, University of Hertfordshire Hatfield, UK pp 299-304.

Lambie, I., Law, R. (2016) 'Using the E-Learning Acceptance Model (ELAM) to identify good practice in the provision of online tutorials**.**', In Proceedings of the 15th European Conference on E-Learning, Charles University, Prague. pp 299-304.

Lambie, I and Law, R. (2017) "Factors affecting Student attendance at online Tutorials in TU100 My Digital Life" , paper presented at European Conference on E-Learning (ECEL), Porto, 26th-27th October

Lambie, I and Law, R. (2018) "Tutor Perception of Delivery Mechanisms for Online Tutorials" paper presented at European Conference on E-Learning (ECEL), Athens 1st -2nd November

Lambie, I (2018) A review of Pedagogical Support for Online Learning in the 21st Century "Please State the Nature of the Educational Emergency!" paper presented at European Conference on E-Learning (ECEL), Athens 1st -2nd November

Law, R and Lambie, I (2020) "Encouraging Student Participation in Online Tutorials: A Tutor's perspective. *In* Proceedings of the 2020 ACM Conference on Innovation and Technology in Computer Science Education (ITiCSE '20). Association for Computing Machinery, New York, NY, USA, 525–526. DOI: https://doi.org/10.1145/3341525.3393991

(Lambie and Law, 2020) 'Teaching online during a pandemic – pedagogical skills transfer from face to face support to online synchronous provision' paper presented at European Conference on E-Learning (ECEL), Berlin 28th-30th October

'Modes of Delivery', (2021) University of Leicester – Leicester Learning Institute. [Online]. Available at https://www2.le.ac.uk/offices/lli/designing-your-course/modes-of-delivery (Accessed 8th May,2021)

Morgan, J. (2011) 'Students Training teachers', in Czerniaswski, G and Kidd, W. (eds) The Student Voice handbook: Bridging the Academic/Practitioner Divide, The Emerald Publishing Group

'Peer Observation of Teaching Process', (2021) University of Leicester – Leicester Learning Institute. [Online]. Available at https://www2.le.ac.uk/offices/lli/developing-learning-and-teaching/enhance/peer-observation-of-teaching-1/peer-observation-of-teaching-process (Accessed 13th of July 2021)

'Peer Observation of Teaching Policy', (2016) University of Sussex. [Online]. Available at http://www.sussex.ac.uk/adqe/documents#P (Accessed 5th of May 2021)

'Strengths and Weaknesses of Online Learning' (2021) The University of Illinois at Springfield [Online]. Available at https://www.uis.edu/ion/resources/tutorials/online-education-overview/strengths-and-weaknesses/ (Accessed 5th March, 2021)

'Seven Benefits of a Virtual Classroom' (2021) Walden University. [Online] Available at https://www.waldenu.edu/programs/resource/seven-benefits-of-a-virtual-classroom (Accessed 12th March 2021)

Swinglehurst, D et al (2008) 'Peer observation of teaching in the online environment: an action research approach', Journal of computer assisted learning, 2008-10, Vol, 24 (5) p. 383-393

Umrani-Khan, F. & Iyer, S., 2009. ELAM: a Model for Acceptance and use of e-Learning by Teachers and Students. In *Proceedings from the 4 th International Conference on e-Learning, Bombay, Mumbai, India*. pp. 475–485.

Tigelaar, D et al. (2004) 'The development and validation of a framework for teaching competencies in higher education', Higher Education Vol 48 253-268

Venkatesh, V. et al., 2003. User Acceptance of Information Technology: Toward a Unified View. *MIS Q.*, 27(3), pp.425–478.

Wajnryb, R. (2012) 'Classroom Observation Tasks A resource book for language teachers and trainers, Cambridge United Kingdom, Cambridge University Press.

Weller, S. (2009) 'What does "Peer" mean in Teaching Observation for the Development of Higher Education Lecturers ', International Journal of teaching and Learning in Higher Education, Vol 21 Number 1 25-35.

Wells, D (2017) 'An Open University Student's Positives and Negatives' [Online] Available at https://survivingtheou.com/an-open-university-students-positives-and-negatives/ (Accessed 5th May 2021)

Woodcock, S., Sisco, A. & Eady, M., 2015. The Learning Experience: Training Teachers Using Online Synchronous Environments. *Journal of Educational Research*, 5(1), pp.21–34.

Self-Paced Learning in Virtual Worlds: Opportunities of an Immersive Learning Environment

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DOI: 10.34190/EEL.21.053

Abstract: Digitalisation in education is inevitable and must be driven forward even more consistently. Accordingly, the current COVID 19 pandemic further underlines and accelerates this necessity. Instead of persistently philosophising about infrastructure and learning platforms, teachers and students are suddenly confronted directly with digital teaching and e-learning. Among technologies for digitalization there is one with a huge potential in the course of digitalisation in education, namely Virtual Reality (VR). VR can be applied as a powerful and multifunctional tool for accessing problems usually considered as hard to taggle. For education, VR can create a connection between abstract theory and real-world scenarios and makes the presentation of facts and applications tangible for students. In addition to a theoretical and literature-based consideration of VR in the concepts of e-learning and blended learning, this paper presents the integration of learning content based on VR through the LMS platform OPAL and discusses the achieved results. Linking to this, an additional chapter will discuss the promotion of the learning process through an immersive learning environment, i.e., what opportunities and challenges arise. The idea and implementation of a virtual research lab modelled based on the physical Industry 4.0 research lab by Professor Christoph Laroque and his Team Industry Analytics is intended to highlight the possibilities and potential of an immersive environment and provide an outlook for future work. This paper addresses the questions to what extent and in which context an immersive learning environment can be more effective than traditional face-to-face learning environments in courses and seminars. Furthermore, challenges and difficulties regarding the use of immersive learning environments from the projects experience will be described. Thoughts and ideas on how these challenges and difficulties can be overcome sum up the considerations within this paper.

Keywords: virtual reality, immersive learning environment, learning concepts, simulation-based learning

1. Introduction

Education is becoming more digital, global, and multimedia. Mobile screens and instant access to the internet almost anywhere in the world are transforming informal and formal learning. Accordingly, new worlds are increasingly unfolding through the Internet, which is used quite naturally for learning purposes, not necessarily as a replacement for traditional face-to-face learning environments in courses and seminars, but in combination with and as an addition to traditional methods (Kerres et al, 2016).

The range of socio-demographic characteristics, but also prior knowledge, motivation to learn, learning habits and learning locations inevitably lead to heterogeneity among learners and make a rigid system with fixed times, places and learning objectives useless. The challenge is to motivate and actively involve all parts of society in education (Vester, 1975). Because of this, digitalisation in education is inevitable and must be driven forward even more consistently. The current COVID 19 Pandemic further underlines the need behind it. Instead of persistently philosophising about infrastructure and learning platforms, teachers and students are suddenly confronted directly with digital teaching and e-learning.

One technology that has a huge potential in the course of digitalisation in education is VR, which can be used as a powerful and multifunctional tool. Within education, virtual reality is used to create a computer-based environment that simulates the physical presence of the learner or optionally of objects in an artificial learning environment and creates a realistic, three-dimensional, sensory experience. The movement is gesture-controlled or haptic. When using virtual reality in teaching, the focus is on putting the learner at the centre and encouraging them to become active themselves (Craig and Georgieva, 2018). Experiences that can be simulated realistically and in real time in an immersive learning environment help the learner to actively acquire knowledge instead of practising "learning" in the sense of "being taught" (Lee and Hu-Au, 2017). Due to this virtual reality can create a connection between abstract theory and real-world scenarios and make theoretically and abstractly presented facts and application scenarios tangible for students.

In addition to a theoretical and literature-based consideration of VR in the concepts of e-learning and blended learning, this paper presents the integration of learning content based on VR through the LMS platform OPAL and discusses the achieved results. Linking to this, an additional chapter will discuss the promotion of the learning process through an immersive learning environment, i.e., what opportunities and challenges arise with an immersive learning environment. The idea and implementation of a virtual research lab modelled on the physical Industry 4.0 research lab by Professor Christoph Laroque and team Industry Analytics is intended to highlight the possibilities and potential of an immersive environment and provide an outlook for future work.

As a result of the above-mentioned preliminary considerations and the structure of this paper, several open questions arise in connection with the above-mentioned research project and the associated problem of a virtual learning environment. Even though the use of new technologies always conceals an immense potential and, consequently, an opportunity for current conditions, it also always brings with it a certain challenge.

Due to this this paper addresses the questions to what extent and in which context an immersive learning environment can be more effective than traditional face-to-face learning environments in courses and seminars. Furthermore, challenges and difficulties regarding the use of immersive learning environments from the projects experience will be described. Thoughts and ideas on how these challenges and difficulties can be overcome sum up the considerations within this paper.

2. Virtual reality in concepts of e-learning and blended learning

Virtual reality (VR) is a simulated, computer-generated, three-dimensional world in which users can immerse themselves through the use of so-called head-mounted displays (HMDs). The goal of such an artificially generated reality is naturally the strongest possible immersion and a realistic imitation of the appearance and behaviour of objects, e.g., simulation of gravity and causal correlations (Kind et al, 2019; Christou, 2010). In VR, there are usually forms of interaction, even if it is only in the sense of physical movement through the virtual world. To interact with objects, special input devices are needed in addition to the video or VR glasses, such as a special controller, a 3D mouse, a data glove (Bendel, 2018) or room-sized 3D displays that are also called as Cave Automatic Virtual Environments or briefly CAVEs (Pellas et al, 2021).

From a technical point of view, the functioning of VR or a VR system can be described as followed: The behaviour of the user in the form of a human being – e.g., movement, pressure, sounds and other analogue data – is recorded via different input sensors and converted into digital signals. Subsequently, these signals are transmitted to the computer centre and combined with stored image information and thus 3D data. This union can equally be understood as sensor fusion (Dörner et al 2013).

Finally, the world simulation is responsible for the representation of this captured information in the form of events and transfers them to the virtual environment. Due to necessary calculations and given buffer times, certain latencies, which in this case are referred to as simulation latencies, may occur. The generated image information is passed on to the output devices because of a rendering process. Output devices can be understood here as both auditory and haptic displays, e.g., speakers, screens, motion platforms or haptic feedback through special controllers or data gloves (Dörner et al, 2013).

The implied multi-sensory interaction that becomes possible in such an artificially generated (and safe) environment provides a solid basis for learning. In context of e-learning and blended learning concepts, such multi-sensory interaction (especially the resulting realistic experience of different scenarios) can be used to support learning processes and increase the resulting learning success.

Following Bauer et al (2021), e-learning can generally be understood as the use of electronic media and information and communication technologies (ICT) in education. Another definition is given by Arnold et al (2013): The term "e-learning" is used to describe a multifaceted objective and organisational arrangement of electronic or digital media for learning, virtual classroom and "blended learning". These definitions emphasise mainly the technological aspects of e-learning. Bermejo (2005), on the other hand, focuses more on the communication and interaction aspects, concretising e-learning as learning using ICT with pedagogical interactions and the exchange of information between students and teachers. Such pedagogical interaction can by no means only be between students and teachers. According to Anderson (2003), three forms of interaction can be distinguished: student and teacher, student and student, and student and content. Thus, meaningful formal learning is supported if one of the three forms of interaction takes place at a high level. In his view, the remaining two forms of interaction can even be absent altogether without deteriorating the learning process and the resulting learning success. Following on from this, Kollmann (2018) finally describe e-learning as a use of ICT to support students to improve their learning process.

As Arnold et al (2013) almost casually describe the term blended learning as a form of e-learning in their explanation of e-learning, the two forms differ decisively from each other regarding the teaching and learning methodology behind them. There are quite a few who associate the term e-learning with an alternative to conventional face-to-face learning environments, the use of which is not tied to a specific location, a specific time of day or the availability and presence of a teacher. According to Kerres (2002), however, the positive aspects of the use of digital media in education can come to fruition above all when they are not used as such an alternative but are combined with forms of conventional face-to-face presence courses and seminars in a didactically justified manner. Following on from this, Friesen (2012) concretises the characteristics of blended learning as a range of possibilities that arise from the combination of the Internet and digital media with conventional forms of teaching that require the physical presence of teachers and students.

In concepts of e-learning and blended learning, VR can promote active participation and self-directed learning of students through a high level of interactivity with the LMS platform and due to this, as mentioned in the introduction, can act as a powerful and multifunctional tool, and significantly improve the learning process and the resulting learning success (e.g., Rathner et al, 2019). The general impact of such an active learning process is discussed by Betihavas et al (2016) and Freeman et al (2014), among others. Marsh et al (2008), for example, show that VR can help in the repetition of previously (conventionally) taught topics to achieve a deep and lasting understanding of knowledge in the corresponding subject areas.

Göbel and Sonntag (2017) suggest that the use of immersive learning environments in teaching is almost self-evident. According to them, one's own interactive experimentation and experience are usually preferable to purely recording observation, which is often found in conventional methods of learning and technologies. The development of VR technology – in the form of HMDs – over the years has also changed the situation permanently. VR technology today is flexible and more cost-effective than it was years ago and can therefore be used with larger numbers of students. The HTW Dresden, for example, has been using immersive learning environments in its everyday teaching since 2016.

Some existing use cases, such as an application for learning manual welding (Göbel and Sonntag, 2017) or the STIHL chainsaw simulator (imsimity GmbH, 2020), show that immersive learning environments can in principle have a great added value in the field of education, but that in some cases there is a lack of seamless integration in line with the variety of possibilities – for example, with regard to e-learning and blended learning.

3. Self-Paced learning in virtual worlds

The research project described below coordinated and supervised by Professor Christoph Laroque presents the integration of learning content based on VR through the LMS platform OPAL. Subsequently, the results achieved are discussed.

3.1 Description of the research project

The above introduction highlights a need for research and development for digital services around creating individual and flexible education and training offers using VR technology. The aim of the research project was to offer VR-based learning content via the LMS platform OPAL, whereby the technical requirements of the LMS platform OPAL were analysed and then adapted and expanded according to the required requirements. The virtual environment should be able to be used by the learners without having to provide a large part of the required infrastructure and the associated resources on the hardware side. In addition, the creation of VR-based content based on a corresponding didactic concept was part of the project. For this objective, a total of five work packages were formulated, which are described below and evaluated in detail according to the course of the project regarding the target and actual status and presented in a concrete work concept (Figure 1).

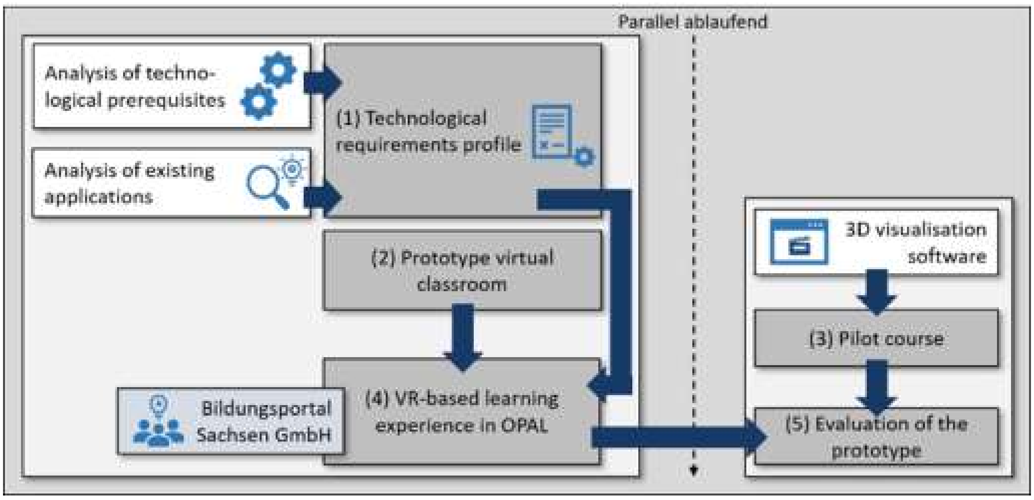

Figure 1: Work concept according to the formulated work packages

Work package I comprises the analysis of technological prerequisites for the use of VR and defines technological requirements for the implementation of a user-friendly interface for VR teaching scenarios. The current version of the LMS OPAL must meet these requirements in order to serve as a suitable platform. The requirements are divided in the areas of technology/hardware, interfaces, graphical user interface and browser plug-in. In addition, data transfer rate and computing power required for VR use must be secured on the server side (OPAL).

Afterwards, an overall architecture was formalised so that a technical prototype of the approach could be established. A basic concept for the construction of the "VR classroom" was developed and implemented. An application scenario from the area of production planning and control was implemented as a pilot course; software research was carried out to create VR environments using 3D visualisation software. For the evaluation, the HTC Vive and other VR end devices were provided by the applicants. The pilot course replicated a production application scenario, where learners could apply production planning and control approaches in a practical and real-time manner. Students can distinguish between different tasks within the learning environment and learn about simulated and manual interventions and their consequences in complex systems.

The prototype of the VR-classroom involves the creation of a web-based user interface, which will be made available to all VR-based learning contents. The result was the integration of VR-based learning content in OPAL.

Finally, student feedback was obtained by a first evaluation of the created course. In the sense of agile project development, the prototype available up to that point was adopted during the project duration regarding susceptibility to errors, speed, stability, and other quality features. The results of the evaluation were collected and analysed by the research team; they allow an assessment of the quality of the LMS platform and the course.

3.2 Presentation and discussion of the results

The declared objective of the research project was the creation of a prototype and the development of a virtual learning space for appropriate use in teaching, which was integrated into the LMS platform OPAL at the end of the project term. This will enable all universities in Saxony to use the project results and provide concrete support for creating and integrating their own VR-based (learning) content. Adaptation to further application scenarios in the various domains within the framework of individual research and teaching activities is explicitly desired and is to be made possible by building up a community around the area of virtual reality – in general and specifically regarding use in teaching and research – through the additional implementation of a forum module.

The work concept formulated in advance, including the resulting work packages, was successfully realised. For individual obstacles, an (in some cases alternative) solution approaches could be found within the project duration. The evaluation of the virtual classroom accompanying the project nevertheless made it clear that too many hardware resources – in the form of main memory capacity – are required for loading and displaying (extensive) 3D visualisation and the associated interaction. This cannot yet be assumed by students in this form – in this case, at least 16 GB of RAM – and limits the presentation of VR-based (learning) content (partially or completely).

Following a final evaluation of the developed virtual classroom, it can be stated that students have a fundamentally positive attitude towards the use of VR-based (learning) content. Accordingly, students can imagine such an application above all in technical areas, such as construction, to "better understand components and groups", or factory planning, to "implement learned knowledge and jointly check the learned theories in their own factories". In addition, you consider the use of virtual learning environments to be equally useful in medicine or in the field of marketing, but at the same time, in the current time of the Covid 19 pandemic, you presuppose a corresponding hygiene concept regarding a possible joint use of the hardware in classroom teaching, regardless of the respective fields of application.

4. Promoting the learning process through an immersive learning environment

Advancing digitalisation is changing all areas of society. Accordingly, alongside existing approaches to designing learning environments and supporting students, new technologies are gradually making their way into everyday life in education. In the current situation of the Covid 19 pandemic, the questions of how learning should work nowadays, and which approaches to designing learning environments can gradually take a (temporary) predominant position come into even sharper focus (GfdB, 2020).

Since abstract representations of learning content continue to dominate, e.g., in textbooks or based on blackboard images, the learning process is impaired because students are faced with the challenge of understanding correlations and incorporating them into their mental model. According to Rapp (2007), mental models are internal representations of information and experiences from the outside world.

In the context of the new technologies mentioned, which are gradually entering the everyday life in education, a technology such as VR can be seen as having huge potential, being a powerful and multifunctional tool. There has been much discussion on how an immersive learning environment can become a promising method of learning (e.g., Merchant et al, 2014; Radianti et al, 2020). In the following, the opportunity as well as the challenge of such an immersive learning environment regarding promoting the learning process will be highlighted followed by a presentation of the idea and implementation of a virtual research lab.

4.1 Opportunity and challenge

Immersive learning environments offer promising opportunities for engaging and recipient-oriented presentation of learning content (Albus et al, 2021), whereby, e.g., a well-designed immersive learning environment can help to maintain students' attention and prevent procrastination through the need for continuous interaction (Ripken and Sacher, 2020). Several studies have found that the use of innovative methods of learning and new technologies, such as VR, have a positive impact on student motivation, interest, and effort (Parong and Mayer 2018; Jensen and Konradsen, 2018; Makransky et al, 2019).

According to Aguirrezabal and Gomez (2020), a student's learning success depends largely on his or her ability to process abstract information and reduce it to the essential core statements. An immersive learning environment can help students to recognise and understand patterns, e.g., regarding physical processes or chemical reactions, by making unimaginable as well as incomprehensible structures visible. The learning experience in an immersive learning environment offers the advantage of adapting the presentation of information to students and providing information through multiple channels. As a result, education can gradually move away from primarily verbal instruction and focus on a visual learning experience (Aguirrezabal and Gomez, 2020; Ripken and Sacher, 2020). In addition, immersive learning environments can enable demonstrations and excursions that are not feasible in this form in a school or university setting because, for example, they require a complex technical set-up, are not feasible, are too dangerous or are just too expensive (e.g., Wilkerson-Jerde et al, 2015; Lammi, 2020).

In an immersive learning environment, according to Ripken and Sacher (2020), students can, for example, see complex structures of a cell in space and view them (almost) without restriction, or recreate the architecture of buildings from long ago. Students can immerse themselves in an artificially generated reality and interact with the environment in various ways, which actively involves them in the learning process, as the immersive learning environments dynamically react to the movements and behaviour of the students and, for example, through the use of controllers, haptic feedback is returned to the students (Christou, 2010; Chen 2016; Rathner et al, 2019). The resulting learning experience is thus not based on listening and writing as in conventional methods of learning, but on real experience and experimentation (Lammi, 2020). The complexity of a real system can be viewed in a nuanced way, thus simplifying the communication of multi-layered contexts. In contrast to the real world, the degree of interconnectedness of different facts can be influenced (almost) without restriction.

The potential of immersive learning environments in education is extraordinary and yet no miracles should be expected, as the selection of the VR-based learning content itself and its concrete use regarding the resulting learning successes can be attributed a decisive importance. Accordingly, studies from the medical field show that the advantages of an immersive learning environment also depend, for example, on the time allotted for a learning task or the extent of possible interactivity (e.g., Stephan et al, 2017; Maresky et al, 2019). At the same time, teachers play a decisive role, immersive learning environments cannot replace face-to-face teaching, but rather offer a useful supplement (Allcoat et al, 2021).

Furthermore, technical aspects play a special role; an insufficient graphic representation and a lack of dynamics can impair the learning experience. The more realistic the graphics are to be displayed; the more computing time is required for rendering (Christou, 2010). While older VR systems required high-end computer support, current VR systems such as the HTC Vive or the Oculus Rift can already be operated with a single desktop computer. In addition, with the Oculus Go and the two generations of the Oculus Quest, for example, there are stand-alone solutions on the market that allow immersion in a virtual world without further effort and have the corresponding computing power.

4.2 A virtual research lab

In cooperation with universities and industrial partners, the Team Industry Analytics carries out cooperative research projects. Solutions and innovations are researched to optimise decision making for manufacturing processes and increase the system performance. One focus is on conducting data analyses and developing data-based models for process improvement. In addition, the Team Industry Analytics deals with the creation of innovative applications of simulations in the context of manufacturing companies. An excellently equipped Industry 4.0 lab also offers the opportunity to implement innovative technologies and to realistically recreate company-related application scenarios from the areas of production and logistics and to use this as a starting point for new research topics. The idea and implementation of a virtual research lab described below (Figure 2) results from the previously described project and is intended to depict the research focus and use cases of the Team Industry Analytics in an immersive environment. As a WebGL application, the virtual research lab can be accessed via the Industry Analytics website (www.industry-analytics.de) by clicking on "VLAB" and will be continuously upgraded.

Figure 2: Overview of the virtual research lab

The virtual research lab is intended to depict the research focus and use cases in an immersive environment and give external audiences - especially in view of the Covid 19 pandemic - an insight into the day-to-day work of Industry Analytics. Accordingly, the existing use cases from the physical Industry 4.0 research lab are gradually being transferred to the virtual environment and integrated in the best possible way. As a result, the diverse design options of the 3D visualisation software Unity3D sometimes create even more realistic replicas of company-related application scenarios from the areas of production and logistics, and an immersive environment offers (almost) infinite spaces in this respect.

In the implementation and design of the virtual research lab, the aim is to provide the user with a comprehensive and user-friendly experience in the immersive environment, both with and without HMD. Accordingly, the WebGL application is primarily designed for use with mouse and keyboard, while a local application on the computer makes the experience and interaction in the immersive environment with HMD and corresponding controllers as interactive as possible using the SteamVR asset and various scripts.

The current equipment of the virtual research laboratory includes a set-up concerning a calculation according to a simulation-based management, a presentation and corresponding linking of ongoing as well as completed research projects (selection) optionally with posters as well as information materials and/or demo set-ups (Figure 3), various links to relevant internet presences of Professor Christoph Laroque and Industry Analytics, various data visualisations such as dashboards and a graph visualisation (Figure 4), a set-up concerning the teaching activities of Professor Christoph Laroque at the University of Applied Sciences Zwickau as well as smaller and larger set-ups for testing the numerous possibilities in an immersive environment. One of these set-ups shows, for example, machines that produce batteries with the logo of Industry Analytics based on a simulation model "Lead Acid Battery Production" using a 3D Lego model that depicts the individual components such as anodes and cathodes.

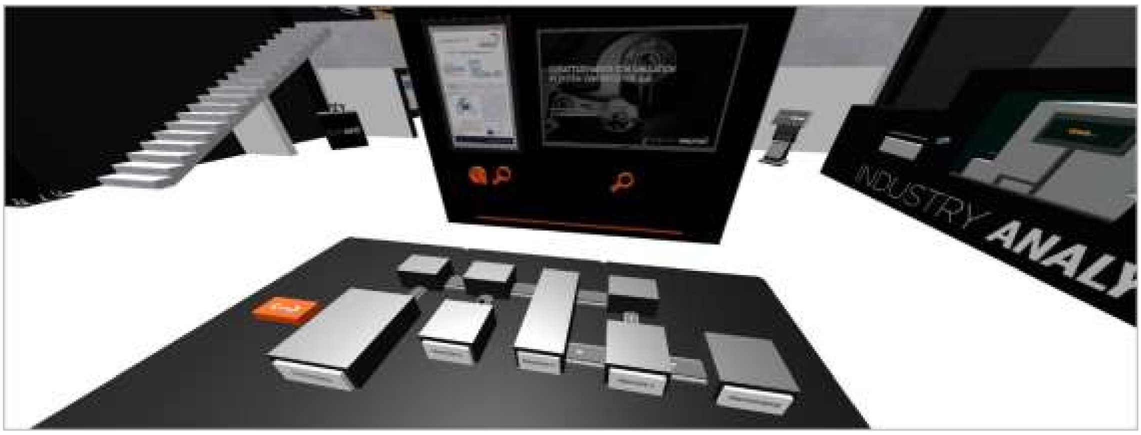

Figure 3: Set-up and representation for an understanding of a discrete-event (backward) simulation

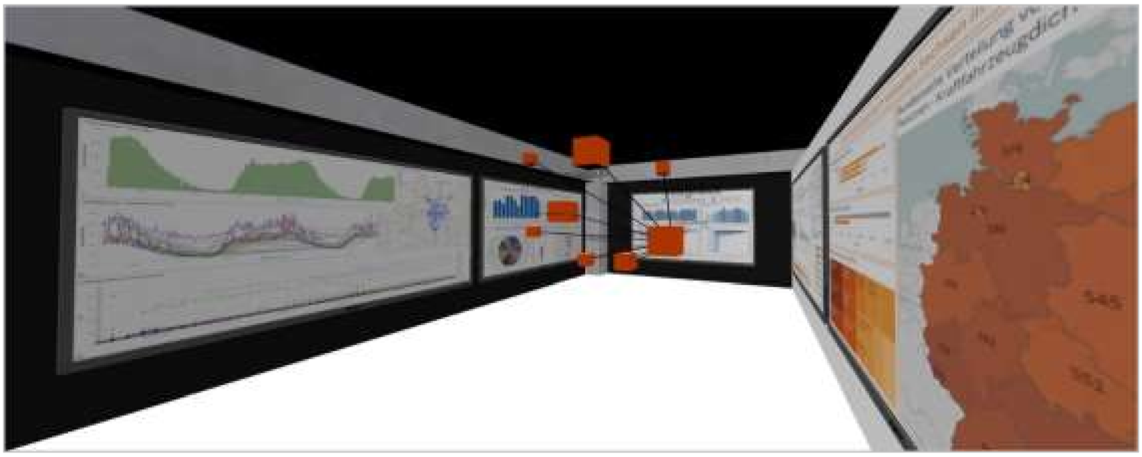

Figure 4: Presentation of dashboards and a graph visualisation

5. Conclusion and outlook

The potential of immersive learning environments in education is extraordinary and yet no miracles should be expected. The scope for design within immersive environments can be seen as almost infinite and, provided a few key points are observed, offers the possibility of enabling experiential learning according to different learning styles. Accordingly, teachers must be trained in the use and creation of immersive learning environments and motivated to actively use them as a method of learning. If all participants understand the possibility of an immersive learning environment as a meaningful supplement instead of an either-or compared to face-to-face teaching, then this is the right approach.

The experiences from the research project described in this paper and the subsequent idea and implementation of a virtual research lab are to be further developed in the future. Accordingly, use cases by and with students are to be successively transferred and integrated into the immersive environment. The virtual research lab is also to be used as an illustrative example in teaching, for example by explaining how a discrete-event (backward) simulation works using the set-up in the immersive environment.

References

Aguirrezabal, P. and Gomez, J. (2020) "Immersive Technologies and Their Application in Education", in: *Boosting Virtual Reality in Learning*, Green Paper, Enter Network, Graz, pp. 29-30.

Albus, P., et al. (2021) "Signaling in virtual reality influences learning outcome and cognitive load", in: *Computer & Education*, Vol. 166 (11):104154.

Allcoat, D., et al. (2021) "Education in the Digital Age: Learning Experience in Virtual and Mixed Realities", in: *Journal of Educational Computing Research*, 0(0), pp. 1-22.

Anderson, T. (2003) "Getting the mix right again: An updated and theoretical rationale for interaction", in: *International Review of Research in Open and Distance Learning*, 4(2), pp. 9–14.

Arnold, P., et al. (2013) "Handbuch E-Learning – Lehren und Lernen mit digitalen Medien", 3rd edition, Bertelsmann Verlag, Bielefeld.

Bauer, T., et al. (2021) „The Making of a Joint E-Learning Platform for Remote Sensing Education: Experiences and Lessons Learned", in: *Remote Sensing*, 13 (9): 1718.

Bendel, O. (2018) „Was ist ‚Virtuelle Realität'?", [online], Wirtschaftslexikon Gabler, https://wirtschaftslexikon.gabler.de/definition/virtuelle-realitaet-54243/version-277293.

Bermejo, S. (2005) „Cooperative electronic learning in virtual laboratories through forums", in: *IEEE Transactions on Education*, 48(1), pp. 140-149.

Betihavas, V., et al. (2016) "The evidence for 'flipping out': A systematic review of the flipped classroom in nursing education", in: *Nurse Education Today*, 38, pp. 15-21.

Chen, Y.-L. (2016) "The effects of virtual reality learning environment on student cognitive and linguistic development", in: *The Asia-Pacific Education Researcher*, 25(4), pp. 637–646.

Christou, C. (2010) „Virtual Reality in Education", in: Tzanavari, A. and Tsapatsoulis, N. (eds.), *Affective, Interactive and Cognitive Methods for E-Learning Design: Creating an Optimal Education Experience*, 1st edition, IGI Global, pp. 228-243.

Craig, E. and Georgieva, M. (2018) "From VR and AR to Our XR Future: Transforming Higher Education", [online], Educase Review, https://er.educause.edu/blogs/2018/8/from-vr-and-ar-to-our-xr-future-transforming-higher-education%20.

Freeman, S., et al. (2014) "Active learning increases student performance in science, engineering, and mathematic", in: *Proceedings of the National Academy of Sciences of the United States of America*, 111(23), pp. 8410-8415.

Friesen, N. (2012) "Report: Defining Blended Learning", [online], Norm Friesen, https://www.normfriesen.info/papers/Defining_Blended_Learning_NF.pdf.

GfdB (2020) "Lernen im 21.Jahrhundert – Schule im Wandel", [online], Gesellschaft für digitale Bildung, https://www.gfdb.de/schule-neu-denken.

Göbel, G. and Sonntag, R. (2017) „Erfahrungen zur Nutzung von Mixed und Virtual Reality im Lehralltag an der HTW Dresden", in: Köhler, T., et al. (eds.), *Wissensgemeinschaften in Wirtschaft, Wissenschaft und öffentlicher Verwaltung*, Proceedings of 20th Conference GeNeMe, Dresden, pp. 280-291.

Graham C.R. (2006) "Blended Learning Systems: Definition, Current Trends, and Future Directions", in: Bonk, C. J. and Graham, C. R. (eds.), *Handbook of Blended Learning: Global Perspectives, Local Designs*, Pfeiffer Publishing, San Francisco, pp. 3-21.

Imsimity GmbH (2020) "Effizientes Distanzlernen in Forst, Feuerwehr und Rettung durch virtu-ellen Motorsägen-Simulator möglich", [online], imsimity – immersive simulation & mixed reality, https://imsimity.de/wp-content/uploads/2021/01/210122_PM_VRsaegensimulator_corona-aktion_imsimity-D_bz.pdf.

Jensen, L. and Konradsen, F. (2018) "A review of the use of virtual reality head-mounted displays in education and training", in: *Education and Information Technologies*, 23(4), pp. 1515–1529.

Kerres, M. (2002) „Online- und Präsenzelemente in Lernarrangements kombinieren", in: Hohenstein, A. and Wilbers, K. (eds.), *Handbuch E-Learning – Expertenwissen aus Wissenschaft und Praxis*, Deutscher Wirtschaftsdienst, Köln, pp. 1-20.

Kerres, M., Hölterhof, T. and Rehm, M. (2016) „Lebenslanges Lernen im Kontext sozialer Medien: Chancen für formelles und informelles Lernen", in: Münk, D. and Walter, M. (eds.), *Lebenslanges Lernen im sozialstrukturellen Wandel - Herausforderungen, Bedingungen, Entwicklungsperspektiven*, Springer VS, Wiesbaden, pp. 141-170.

Kind, S., et al. (2019) „Virtual and augmented reality", [online], Office of Technology Assessment at the German Bundestag, http://www.tab-beim-bundestag.de/en/pdf/publications/tab-fokus/TAB-Fokus-019.pdf.

Kollmann, T. (2018) "E-Learning", [online], Wirtschaftslexikon Gabler, https://wirtschaftslexikon.gabler.de/definition/e-learning-34033/version-257548.

Lammi, H. (2020) „Higher Education Needs to Lead on Immersive Learning", in: *Boosting Virtual Reality in Learning*, Green Paper, Enter Network, Graz, pp. 27-28.

Lee, J. and Hu-Au, E. (2017) "Virtual reality in education: a tool for learning in the experience age", in: *International Journal "Innovation in Education"*, Vol. 4, No. 4, pp. 215-226.

Makransky, G., et al. (2019) "Adding immersive virtual reality to a science lab simulation causes more presence but less learning", in: *Learning and Instruction*, 60, pp. 225–236.

Maresky, H. S., et al. (2019) "Virtual reality and cardiac anatomy: Exploring immersive three-dimensional cardiac imaging, a pilot study in undergraduate medical anatomy education", in: *Clinical Anatomy*, 32(2), pp. 238-243.

Marsh, K. R., et al. (2008) "Medical Student Retention of Embryonic Development: Impact of the Dimensions Added by Multimedia Tutorials", in: *Anatomical Sciences Education*, 1(6), pp. 252-257.

Merchant, Z., et al. (2014) „Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis", in: *Computers & Education*, Vol. 70, pp. 29-40.

Parong, J. and Mayer, R. E. (2018) "Learning science in immersive virtual reality", in: *Journal of Educational Psychology*, 110(6), pp. 785–797.

Pellas, N., et al. (2021) "Immersive Virtual Reality in K-12 and Higher Education: A systematic review of the last decade scientific literature", in: Virtual Reality, https://doi.org/10.1007/s10055-020-00489-9.

Radianti, J., et al. (2020) "A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda", in: *Computers & Education*, Vol. 147:103778.

Rathner, J., et al. (2019) „Virtual Reality in Higher Education", in*: International Journal of Innovation in Science and Mathematics Education*, 27(8), pp. 69-80.

Ripken, C. and Sacher O. (2020) "VR in Higher Education", in: *Boosting Virtual Reality in Learning*, Green Paper, Enter Network, Graz, pp. 35-36.

Stepan, K., et al. (2017) "Immersive virtual reality as a teaching tool for neuroanatomy", in: *International Forum Of Allergy & Rhinology*, 7(10), pp. 1006-1013.

Vester, F. (1975) "Denken, Lernen, Vergessen: Was geht in unserem Kopf vor, wie lernt das Gehirn, und wann lässt es uns im Stich?", dtv Wissen, München.

Wilkerson-Jerde, M. H., et al. (2015) "Exploring Shifts in Middle School Learners' Modeling Activity While Generating Drawings, Animations, and Computational Simulations of Molecular Diffusion", in: *Journal of Science Education and Technology*, 24, pp. 396–415.

IT as a Career Choice for Girls: Breaking the (Self-Imposed) Glass Ceiling

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DOI: 10.34190/EEL.21.022

Abstract: The lack of workforce in IT is a global phenomenon. According to Informatics Europe, the lower numbers of females studying IT at universities are evident in all Europe (in Master studies, the leader is Estonia with 38%, while in Bachelor studies the level is even lower - the top country is Romania with 30%). Awareness and training programs are offered for increasingly younger people (examples include the Hour of Code, or the ProgeTiiger in Estonia) and they bring in many young talents, but they tend to be predominantly male. IT-related competitions (including robotics, programming, and cybersecurity) pull in much more young men than women (as seen at e.g. World/EuroSkills, Robotex, European Cyber Security Challenge, and various olympiads). How and when girls should be reached to introduce IT careers is a big question with no clear answer so far. It has been suggested that the most crucial career choices are made either in late basic school or secondary school - but is it true? We have carried out four surveys in Estonia during the 2020/2021 academic year, three of which involved students - the CyberCracker survey for Grades 4-6, and the combined CyberPin (Grades 1-6) / CyberDrill (Grades 7-12, also involving a separate study for teachers). The total number of participants exceeded 22000, showing the difference of interests by gender already from Grades 3-4. The actual IT skills and problem-solving capabilities start to differ at Grades 5-6, and by the 7th, girls have fallen about 20% behind boys. Moreover, in readiness to study IT in one's leisure time and seeing one's future in IT, boys are ahead for 35-40%. In the article, we will study the results and propose solutions for schools to avoid girls being left behind in IT. We also suggest some national activities that should already start in primary school. For the discussion, we will look at whether, how much, and how is it ethical to influence the career choices of young people at an early age - at the same time recognizing that if this is not done, the proportions will grow worse still, as the dominant mentality still seems to uniformly direct boys towards robotics and girls towards dancing.

Keywords: pedagogy, teacher training, digital literacy, informatics strategies, gender challenges

1. Background

This article's goal is to discuss the challenges of becoming an active information society builder from an early age (mostly middle school) - we focus on additional IT education possibilities in cybersecurity. The need to get more diversity and talents into the IT sector is linked to the need to have more and better students take interest in IT and cybersecurity as their career choice. We do note that the same problems occur in almost all countries of the European Union, but also elsewhere - there is a general lack of interest in studying natural subjects such as Physics and Mathematics. In this study we try to look at the gender distribution of this problem – whether we need a special approach to include more female students, and if yes, then in which age groups. The need to discuss the challenge stems from the gender-based initiatives that have emerged in recent years. Approaches and understandings of these issues vary – while some question the effectiveness of attempts to guide students' interests, others demand special treatment for some groups (e.g. gender-based quotas).

Europe is expected to have 350 000 vacant jobs in Computer Science (CS) by 2022; in the US, the same number is said to be 209 000 (Ashford, 2017). Both Education 2030 OECD (OECD, 2018) and the World Economic Forum (Whiting, 2020) pointed out the need for new kinds of skills including complex problem solving, critical thinking, creativity, and managing people. These skills are a vital part of future success in a digital society. Most entrepreneurs do not care about the gender of the recruit - instead, they want dutifulness, problem-solving capability, professional skills, independent work abilities, and an overall passion for the field (Jaccheri, 2020). The problem has been outlined by the business sector as well, claiming difficulties in finding and hiring female IT specialists. On average, almost 50% of European companies trying to hire ICT personnel have not been able to find them (Eurostat 2018). There is a big unused pool of workforce in women: in 2018, about 78% of people working in the IT sector in Estonia were men. Approximately 17% of people working in the IT sector in the EU are female (Eurostat, 2019).

Joining the talent pool can be hard - aspiring students need to develop themselves in their chosen field, yet only little sustainable training is provided for them, and there are only a few initiatives that also do not reach everyone. There is a lack of deeper research addressing youth, females, and other disadvantaged groups in various other ways - the problem in CS is evident both in the EU and the US. At the same time report on Absent Voices: Missing Female Perspectives in CEE, produced by GLOBSEC with the support of the Open Society Foundations, points out gender equality and female participation challenges in the public and private spheres in Central Europe regarding topics like: Future of Europe, Defence & Security, Economy & Global Order, Digital Future and Sustainability (Globsec, 2021).

Learning/training models for CS usually involve policies and frameworks from the industry and government, such as the National Institute of Standards and Technology (NIST) in the US, ISO standards, guidelines from ISACA, ENISA, SANS, etc; in addition, several handbooks have been written on these issues. From an academic point of view, we can base our research on Rogers' Protection Motivation Theory (1997), Moura and Systems (2012) "Internet Bad Neighborhoods", Concerns-Based Adoption Model (Hall, 1974; Anderson, 1997) and Da Veiga Security (2010) Culture theory, Technology acceptance model/unified theory of acceptance and use of technology (Lee, 2003), etc.

1.1 Formal education

In 2017, Informatic Europe published an overview of the current situation in Informatics education titled "Informatics Education in Europe: Are We All In The Same Boat?" (Vahrenhold, 2017) describing how differently are the EU countries approaching the IT education challenge - and digital safety and cybersecurity are only mentioned in the context of GDPR and privacy.

On the EU level, the main document to consider is the Digital Competency model (Vuorikari, 2016). It consists of 5 main categories: Information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving. The safety category is divided into protecting a) devices, b) personal data and privacy, c) health and well-being, and d) environment. This model is widely implemented in most EU-s countries as the baseline of IT competencies for EU citizens. ICT is part of students' everyday life, especially during the current ongoing COVID-19 pandemic. Students use ICT for both study and pleasure: search for information, study online, draft research documents and presentations, etc.

Estonia has been using the current Informatics-related curricula since 2012 - divided into "cross-cutting topics and social courses (basic school, gymnasium, special Informatics courses) and has implemented the DigComp model for students and teachers. In 2017-2019, the country also developed materials for a cybersecurity curriculum for grades 1-6(9) (curriculum, materials) and 10-12 (curriculum, materials). All these materials and curricula are available for anyone to use (at Estonian curricula portal and at the Estonian Informatics Teachers Association website), but they are currently not mandatory to be implemented. This means that every school can pick topics and choose methods to implement (from extracurricular activities to actual IT lessons). The main topics tend to focus on being a good e-citizen, e.g. the grades 1-6 need to know and behave safely with networked smart devices and computers, manage their identities safely in various information systems and services, understand risks in social interaction online, mental and health issues as well as basic problem-solving regarding digital safety. While this age group was provided with examples and materials for two courses of digital hygiene, the curriculum for the next group, grades 7-9 grade curriculum was not widely adopted and is under development again (as of 2021). For this age group, the number of topics included has made their further safety education rather marginal - the main topics are GDPR, privacy, and security, but the practical part - developing a safe networking project - is optional.

1.2 Non-formal education

Non-formal education in Informatics usually focuses on coding and robotics (for instance, Hour of Code or FirstLegoLeague, Informatics Olympics, or even the DigiGirls movement); Estonian examples include Robotex, Unicorn Squad, etc.

As our study relates to cybersecurity education, we will have a look at what is currently happening in this area:

- On the global scale, there are many Capture the Flag -type of competitions (CTFs) everywhere with various topics and skill levels. In the US, the main events for youth are the Cyber Patriot with several different training modules (Ethics, Online Safety, Computer Basics, and Virtual Machines, CS Principles, Windows and Linux Security and Tools) and the Sans CyberStart (also present in the UK) with three levels of exercises – an example can be found here. In Asia, the Brainhack series of workshops and CTFs (application development, AI and cybersecurity, overall awareness of digital realms). Association and Progressive Communications and others have developed a set of materials titled CyberWomen, with modules dealing diverse issues such as trust, privacy, relationship with technology, digital security basics, safe online and safer mobiles, anonymity, encryption, online violence, sexting, problem-solving.
- In the EU, one of the biggest youth competitions is called European Cyber Security Challenge where 20+ EU countries and ENISA work as a consortium to develop and host a competition for talented students aged 14–26 once a year. Their curriculum (ECSC, 2020) identifies topics such as Crypto, Network, OS, Human factors as well different domains (Web, Mobile, IoT, Hardware, Privacy, PKI) and approaches (Reconnaissance, Crypto, Operations Security, Forensics and Malware analysis).

In Estonia, the digital safety information portal Safer Internet EE (funded by the EU Commission) offers guidance on secure online behavior, online disinformation, and digital safety lesson development. Additional resources include CyberPin, CyberCracker, CyberDrill, CyberSpike (funded by the Ministry of Defense). A CyberDrill side project is a self-learning exercise portal that stores assignments from past CTF contests.

2. Methods

The studies discussed here are based on the Estonian CyberSecurity strategy (2019), the EU Digital Competence Framework 2.0 (2017), Estonian National Curricula for basic school (2017), and secondary school as well as the Informatics (2017) and Cyber Security (2019) curricula. We have also analyzed PISA Estonian results (2019) and Educational Ministry guidelines for distance learning (2020).

Our surveys in Estonia during the 2020/2021 academic year included three involving students - the CyberCracker survey for grades 4-6 and the combined CyberPin (Grades 1-6) and CyberDrill (Grades 7-12). The total number of participants exceeded 22000, with 80% of the participants studying in Estonian and 20% Russian language. In addition, the fourth study targeted the teachers supervising the CyberDrill to include the school view - how (if at all) do they help girls to get into IT. The studies were carried out via Google Forms using the Likert scale and open-ended questions about 3 topics: generic background information, regular school studies, and extracurricular activities.

Table 1: Composition, studies, focus group, and times

Name	Grades	Participants	Time
CyberPin testing and survey	1-6	6062	February-March, 2021
CyberCracker study	4-9	13 136	October-November, 2020
CyberDrill testing and study	7-12	3188	October-November, 2020
CyberDrill teachers' study	7-12 teachers	50	January-February, 2021

The full results of the studies together with methods and suggestions are published in the reports for Estonian wider audience and stakeholders on the www.kyberpahkel.ee website.

3. Results

3.1 Younger age group (Grades 1-6)

We carried out two partially overlapping studies (CyberPin and CyberCracker) involving younger students (Grades 4-6). The results of the former suggest that the attitude among girls towards IT starts to change from Grades 3-4 onwards - but it is not related to access to formal lessons of Informatics, the differences seem to come from extracurricular technology-related activities instead. Indifference towards iT increases notably during this stage, and by the end of Grade 6, 48% of the girls claim to be not interested in IT. Yet in terms of technical skills also addressed by the study, the actual difference with boys surfaced with some delay, in Grades 5-6. We note that the difference was in specific skills, there was no difference in tasks demanding logic, attention, or discipline.

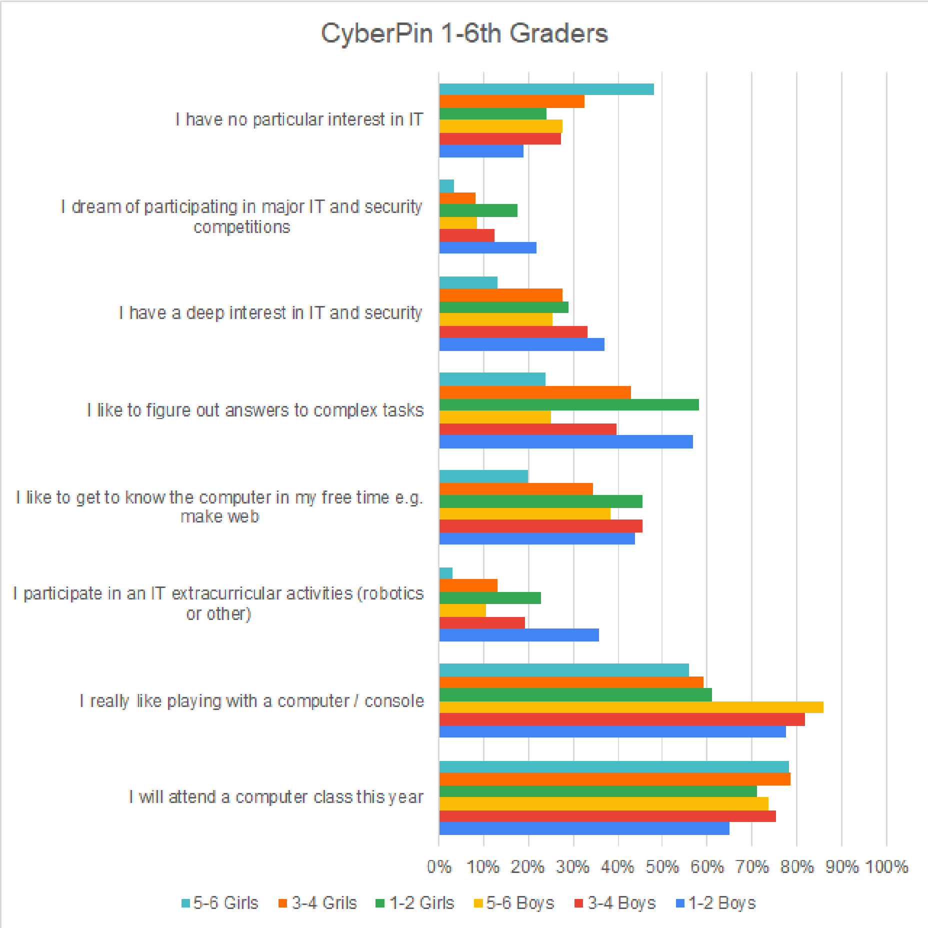

Figure 1: CyberPin, 1-6th graders

The CyberCracker study reached similar conclusions, showing that girls participate about 35-50% less in IT-related extracurricular activities or possess experience with new technologies such as drones, sensors, or VR glasses, they also participate 33% less in IT-related competitions or other events. The differences increase from 35% in Grades 4-5 to 50% in Grades 8-9. At the same time, there is no difference in attending Informatics lessons (and it remained so during the pandemic-induced distance learning period). The CyberCracker study also points out the 10% difference in confidence and self-image related to more advanced technical operations involving computers and smartphones. At the same time, there is no difference in handling more social tasks such as sharing content online, searching for information, or reporting inappropriate behavior.

3.2 Older age group (Grades 7-12)

The results of CyberDrill suggest that for this age group, overall participation in IT-related extracurricular activities is not that high and most of the actual IT education comes via the official lessons of Informatics. Just as in the previous study, there is no gender difference in the more social IT skills, but technical skills do differ. While this study suggests that technical skills start to get more traction among girls in the later stages of secondary school, this study addressed students who were chosen to participate in a cybersecurity competition. Therefore, the difference may still be larger on average.

The difference in practical IT problem solving capabilities is around 25% - 66-80% of the boys suggest that they can get a malfunctioning computer or smartphone working again, while only 55-70% of girls would say the same. Moreover, in more demanding scenarios like malware, online attacks, or even more complicated problems with office software, the confidence of girls trails behind boys by 50%. Again, in more social tasks (countering illegal content, but also contacting a tech support service) there is no difference.

When asked about their interest in cybersecurity topics in their leisure time, reading websites or books is at similar levels. However, boys are about 33% more likely to watch thematic videos and lectures online, follow an online community or channel, discuss the topics with friends, enroll in a thematic e-course, or take part in a competition or hackathon.

Talking about their plans for the future, 71% of boys and only 52% of girls envision an IT career for themselves. More specifically, 16% of boys would prefer to work in customer support, 19% in cybersecurity, 23% as an analyst, 28% as a manager, 30% in design or other creative craft, 34% as an engineer or researcher, 42% as a software developer, and 60% as an ordinary user. For girls, the same figures are 7% as an analyst, 8% as a manager, 11% in cybersecurity, 11% as an engineer, 13% as a developer, 15% in support, 24% in creative crafts, and 57% as an ordinary user.

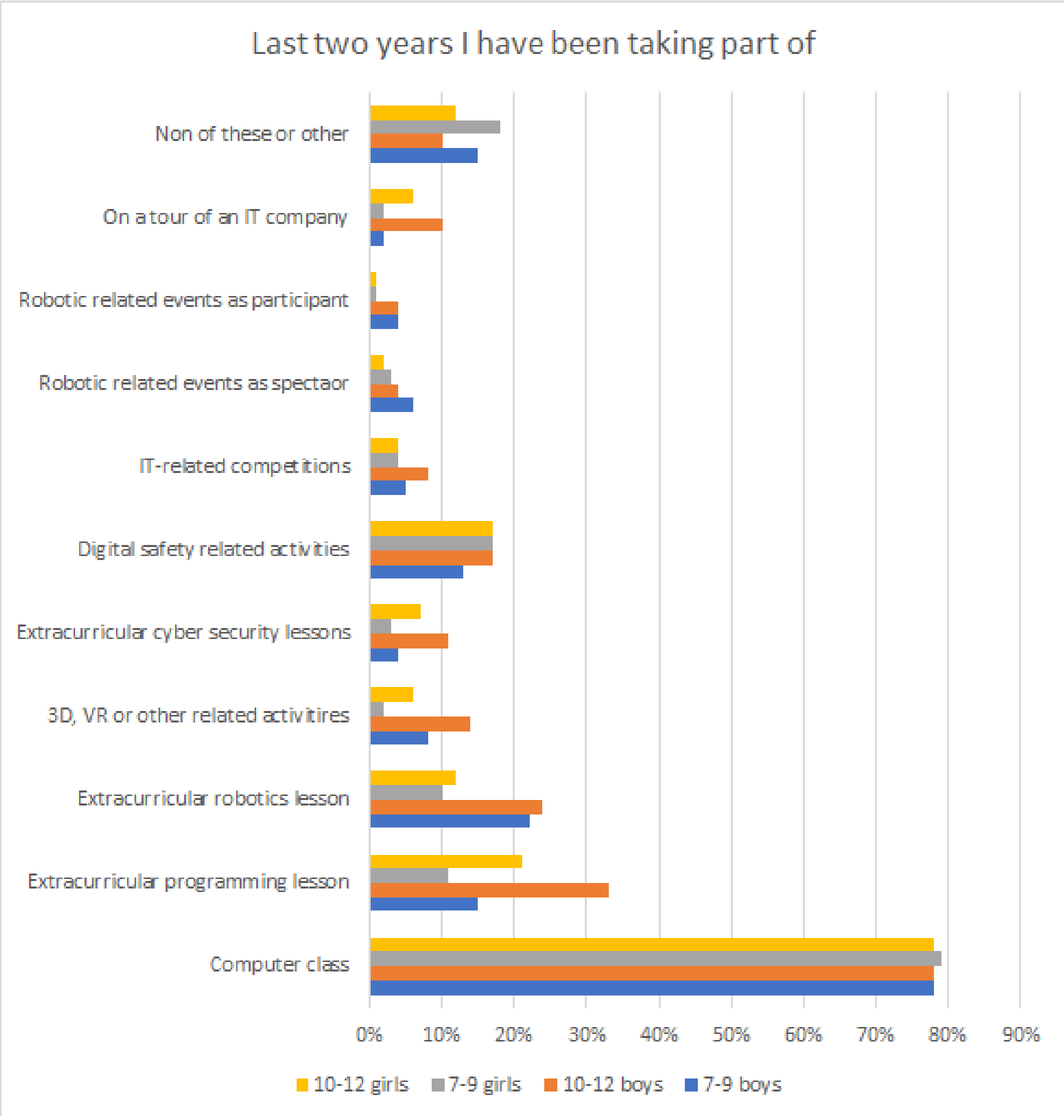

Figure 2: CyberDrill, 7-12th graders

3.3 Teachers

This study involved 50 institutions where 84% of the students took part in the CyberDrill competition, meaning that the sample was somewhat biased towards more 'digitally active' schools (as opposed to the national average). 80% of the schools had chosen to include cybersecurity topics and 60% pay attention to raising security awareness, which gives an optimistic perspective - yet we suggest that on average, the situation is not that positive.

Among the participating schools, 30% offer Informatics to all students and 62% to a selection; 80% offer robotics as an elective, 40% offer extracurricular activities in IT, and 44% organizes IT-related events; 80% participate in cybersecurity contests, and 58% in other kinds of IT competitions.

Among the participants, cybersecurity and digital safety are mostly taught within a more generic IT-related extracurricular activity (74%), 14% even have chosen it as the focus. 26% of the respondents claim that all teachers should teach it (among other knowledge), yet for 18% it is just a competition topic with no specific preparation. Again: while cybersecurity and digital safety are taught in all the participating schools, this is not the national average (in many places, it is taught in a rudimentary manner or not at all).

Concerning the topics taught, the most common ones are safe online behavior and the basics of safe computer use (including very basic troubleshooting). About half of the respondents have included the use of mobile devices. Advanced topics like network security, auditing one's security, or more advanced troubleshooting are typically only taught to the elect (and predominantly in vocational education).

While most schools are interested in the matter (all involved parties tend to have interest in it, and there are online communities to offer support), the main challenges are still the lack of time and money (teachers are overloaded and not motivated to take on additional tasks, the curriculum is packed with no slots available, some teachers lack relevant knowledge, and keeping up students' motivation can be difficult when topics get more demanding and there will be no actual events to test the knowledge). Russian-language schools also have more problems with equipment and materials. But most importantly, almost no participating schools took any dedicated steps to promote the inclusion of girls in IT-related activities.

In the next five years, most schools will likely recognize the importance of cybersecurity topics. They are interested in membership in related communities but are reluctant to see cybersecurity as a dedicated subject and towards the special treatment of some students (be it extra activities for talented students, or stronger inclusion of girls). While this can be at least partially explained with lack of funds, there seem to be also some attitudes that could change.

4. Discussion

Studies show that in Estonian schools, girls' interest in IT is only supported within the official Informatics lessons. Some other activities where girls seem to participate in Grades 4-5 would disappear later on - the reasons are many, from competing interests and extracurricular activities to public expectations (whether girls are welcomed into IT clubs and competitions, also whether parents support their IT interest the same way they would support boys) to lack of time (in Grades 7-9, the curriculum is demanding and students have got less time for hobbies; there is also another connection to public opinion which seems to value formal results/grades over the ones in non-formal education, especially for girls). Looking at the gender distribution at the CyberCracker and CyberDrill, there are 50% fewer girls than boys among the participants, and the girls' results trail 25% behind the boys of the same age.

Rather than the actual skills which may be difficult to measure, we can look at the readiness and confidence of students to take on specific tasks. The confidence in one's IT skills has a clear gender gap in all age groups, but it is especially evident in older age groups - while it is around 15% in Grade 4, it goes up to 31% by Grade 9. The gap is the larger, the more technically demanding the task is deemed to be.

Estonian Ministry of Social Affairs commissioned a research in 2020, which stated that girls are less interested in and see fewer career choices in ICT than boys (Kantar Emor, 2020). The study suggested that most of it is socially constructed and influenced by gender stereotypes, and the stereotypical understanding of ICT sector is that it is a male-oriented field. Similar statements (e.g. claiming that social sciences are poorer career choices than natural/hard sciences) can be heard all over the social stratum, from homes to the Parliament. The 'boys to engineering, girls to social professions' starts already from home – notably, the expectations of Estonian- and Russian-speaking families tend to differ as well. We suggest that gender differences in IT skills are not that much gender based as such, but rather stem from outside expectations leading to differences in exposure. For instance, if a teacher facing an IT problem would never ask a girl to solve it, girls will learn to dismiss the field altogether.

Yet, the problem is not in stereotypes and social pressure only - the study shows that girls do make less effort to master the technology, and, when facing obstacles, tend to give up more easily. As a result, the current Estonian gender distribution among university students (according to the data collected by the national enrollment information system SAIS) is 25/75 in generic IT curricula and 10/90 in cybersecurity programs.

Previous research has attempted to find ways to increase the interest of girls in the ICT subjects, as well as encourage girls to choose a career in ICT. Efforts considered popular are programming clubs for girls and special events targeting girls (Lang, 2015), role models in the ICT sectors (Gorbacheva, 2014), and educating parents to increase their digital skills. Research has shown that most useful are long-term and consistent efforts which are targeted at girls in different levels of education (Guzdial, 2014).

Therefore, a possible solution could be to develop gender-specific support mechanisms (for both genders - there are areas where boys face stereotypes as well, also in IT) for middle school (Grades 4-5). We note that while there are initiatives like Unicorn Squad and Digigirls that help girls to get deeper into technology, similar initiatives could also be established for boys to cover more socially oriented aspects of IT (especially networking, online communication, and communities). At the same time, the way how these programs teach students is not gender-specific – similar encouragement would also help any beginner (especially older learners or those who transfer to IT from other careers).

We, therefore, suggest the following:

- to decrease the digital gender gap, both awareness-raising and technical support programs in Grades 4-12 could help;
- schools could try to find ways to introduce IT to young people outside the formal lessons (contests, festivals, visiting lectures/talks, etc);
- the school should have a support person for cybersecurity (instead of splitting the role between different subjects).
- spread the idea of IT/ cyber being not only technically (i.e. programming) oriented;
- include non-technical aspects to cyber competitions (e.g. social engineering);
- find and introduce role models for girls in cybersecurity;
- promote approaches that do not reveal gender: online education or extracurricular activities;
- involve girls (and schools) from outside big cities;
- involve parents (of both girls and boys).

As far as schools and teachers are concerned, this study did not explain that girls should be taught differently because they were female. Therefore, it is not possible to recommend teaching girls in a different way, using different methodologies example focusing on more social aspects of technology or giving them possibility to get pass with lower precedence. Rather, it is a question of creating opportunities, involvement. In this respect, teachers and schools have a very important role to play, to offer to all students, including those who, do not show overwhelming interest as they want to know first what it is all about, before investing their future to IT - who politely listen before acting, read manuals and discuss the issues first or read the rules of the game before acting out. But this does not mean that in the education the materials should be developed differently. We need to state that out as there are now practical movements, that state that girls should have different kind of IT programs or teaching materials. Also, that comes to Estonian situation perhaps it should be pointed out that in Estonia, however, "IT" is still going strong and the general lack of interest that may have been eminent in central Europe, does not exist here. The biggest issue at the same time, that is not part of this study, is how the teaching quality has changed from understanding the issues and subject to punching and copied snippets pasting, you will no longer be able to create a complete application yourself. The whole see "framework and script" paradigm development (Angular, React, Ruby on Rails, etc., etc.) is a good example.

It is also important to show that IT / cyber is related to all areas of society, regardless of if one wants to become e.g an influencer, an astrophysicist, a hairdresser, or a politician - connections to IT are everywhere. Also, one should see their career in a longer perspective: will that 'cool job' still be available and desirable in 3-5 years when I graduate? During the Soviet era, there was a constant lack of seamstresses, carpenters and many other professions which have undergone significant changes since. Rather, it is a moral question whether a society should just follow every business fad or encourage young people to take up whatever profession they feel being called to. Nevertheless, it pays to demonstrate that all (or at least a very large majority of) disciplines are in fact IT-related.

Other points for future research include how is it possible to influence young minds without automatically deciding things for them; the challenge for academic institutions how to develop talents to meet the more strategic needs of the society rather than current shorter trends (e.g. choice of programming languages); how to utilize Open Learning Materials (OER) in a wider scale (especially when combined with formal certificates).

5. Conclusion

The problem of gender imbalance in IT has many facets. Changing social stereotypes takes time, but for now, schools should at least strive to lessen the self-imposed glass ceiling by offering more variable extracurricular activities and encouraging students to participate in a uniform, gender-blind manner. The same applies to the official IT/Informatics curriculum where more socially oriented topics should be introduced (e.g. cybersecurity includes a strong social component). As seen from our studies, these steps are necessary from the 3rd or 4th grade upwards.

Acknowledgements

The authors gratefully acknowledge the financial support of the Estonian Ministry of Defense project Cyber Olympic and Connecting Europe Facility of the European Union project Safer Internet Centre in Estonia.

References

Anderson, S. E. (1997). Understanding teacher change: Revisiting the concerns based adoption model. Curriculum inquiry, 27(3), 331-367.

Ashford, W. (2017) "Europe faces shortage of 350,000 cyber security professionals by 2022", [online] Computer Weekly, https://www.computerweekly.com/news/450420193/Europe-faces-shortage-of-350000-cyber-security-professionals-by-2022

Da Veiga, A., & Eloff, J. H. (2010). A framework and assessment instrument for information security culture. Computers & Security, 29(2), 196-207.

ECSC, 2020, Competition Cybersecurity Curriculum, [online], European Cyber Security Challenge portal, https://ecsc.eu/about

Educational Ministry guidelines for distance learning (2020) [online] Organizing distance learning, Republic of Estonia Ministry of Science and Education https://www.hm.ee/sites/default/files/distantsoppe_korralduse_juhis.pdf

Estonian CyberSecurity strategy (2019) [online], Republic of Estonia Ministry of Economic Affairs and Communications https://www.mkm.ee/sites/default/files/kyberturvalisuse_strateegia_2022_eng.pdf

Estonian National CyberSecurity Curricula for secondary school (2019) [online] https://1drv.ms/w/s!AuRLzcD9FVl7ywlqPX-J4ewoLgly

Estonian National Informatics Curricula for basic school (2017) [online] HARNO procurement for materials for Informatics https://riigihanked.riik.ee/rhr-web/#/procurement/728628/documents?group=B

Eurostat (2018) ICT specialists - statistics on hard-to-fill vacancies in enterprises, [online] Eurostat, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=ICT_specialists_-_statistics_on_hard-to-fill_vacancies_in_enterprises

Eurostat (2019) ICT specialists in employment, [online] Eurostat, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=ICT_specialists_in_employment#ICT_specialists_by_sex

Globsec (2021) CEEHer Report: Absent Voices: Missing Female Perspective in CEE [online] https://www.globsec.org/publications/ceeher-report-absent-voices-missing-female-perspective-in-cee

Gorbacheva, E., Craig, A., Beekhuyzen, J. and Coldwell-Neilson, J., 2014. ICT interventions for girls: Factors influencing ICT career intentions. Australasian Journal of Information Systems, 18(3).

Guzdial, M., Ericson, B., McKlin, T. and Engelman, S., 2014. Georgia computes! An intervention in a US state, with formal and informal education in a policy context. ACM Transactions on Computing Education (TOCE), 14(2), pp.1-29.

Hall, G. E. (1974). The Concerns-Based Adoption Model: A Developmental Conceptualization of the Adoption Process Within Educational Institutions.

Jaccheri, L., Pereira, C., & Fast, S. (2020, September). Gender Issues in Computer Science: Lessons Learnt and Reflections for the Future. In 2020 22nd International Symposium on Symbolic and Numeric Algorithms for Scientific Computing (SYNASC) (pp. 9-16). IEEE.

Kantar Emor (2020) Klaasseinad ja klaaslagi Eesti IKT-s: müksud naiste osakaalu suurendamiseks IKT valdkonnas hariduses ja tööturul [online] Republic of Estonia Ministry of Social Affairs https://www.sm.ee/sites/default/files/klaaslagi_ja_klaasseinad_eesti_ikt-s_vahearuanne_2020_kantaremor.pdf

Lang, C., Fisher, J., Craig, A. and Forgasz, H., 2015. Outreach programmes to attract girls into computing: how the best laid plans can sometimes fail. Computer Science Education, 25(3), pp.257-275.

Lee, Y., Kozar, K. A., & Larsen, K. R. (2003). The technology acceptance model: Past, present, and future. Communications of the Association for information systems, 12(1), 50.
Moura, G. C., Sadre, R., Sperotto, A., & Pras, A. (2012, April). Internet bad neighborhoods aggregation. In 2012 IEEE Network Operations and Management Symposium (pp. 343-350). IEEE.
OECD (2018) The future of education and skills Education 2030 https://www.oecd.org/education/2030-project/about/documents/E2030%20Position%20Paper%20(05.04.2018).pdf
Rogers, R. W., & Prentice-Dunn, S. (1997). Protection motivation theory.
Tire, G. (2019) Pisa 2018 Eesti tulemused, [online], Republic of Estonia Ministry of Science and Education https://www.hm.ee/sites/default/files/pisa_2018-19_raportweb.pdfPISA Estonian results
Vahrenhold, J., Caspersen, M., Berry, G., Gal-Ezer, J., Kölling, M., McGettrick, A., ... & Westermeier, M. (2017). Informatics Education in Europe: Are We All In The Same Boat?.
Vuorikari, R., Punie, Y., Gomez, S. C., & Van Den Brande, G. (2016). DigComp 2.0: The digital competence framework for citizens. Update phase 1: The conceptual reference model (No. JRC101254). Joint Research Centre (Seville site).
Withing, K. (2020) "These are the top 10 job skills of tomorrow – and how long it takes to learn them", [online] World Economic Forum, https://www.weforum.org/agenda/2020/10/top-10-work-skills-of-tomorrow-how-long-it-takes-to-learn-them/

Factors Impeding South African Libraries, Archives and Museums From Collaborating for Digitisation Purposes

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DOI: 10.34190/EEL.21.095

Abstract: Academics can argue that without digitisation, e-learning cannot take place. This study aimed to determine the factors that prevent South African Libraries, Archives and Museums (LAMs) from collaborating to digitise their collections. The study aimed to fill a gap identified in another study, which unfolded that even though LAMs in South Africa understood the benefits of collaboration for digitisation purposes, these collaborations were not occurring. As such, the study's objectives were "to determine the factors impeding South African LAMs collaboration, and to determine what LAMs should do to overcome impediments to collaboration". To fulfil these objectives, a literature review was utilised together with non-standardised, semi-structured interviews. The study's sample size included 21 participants stationed at 16 different LAMs in South Africa. Following transcription, ATLAS.ti assisted with analysing the data collected. Some of the findings were that even though the ground staff is open to collaboration, there are various impediments to collaborating with other institutions. One impediment was the lack of buy-in from upper management. Another impediment being the lack of collaboration due to the shortage of staff found in South African LAMs, which leads to the overworking of staff and not having the time to collaborate. In adding to the value of the study, it was also essential to determine what LAMs could do to overcome the identified barriers to collaboration. This paper can thus be utilised to help raise awareness of the hindrances to collaboration for digitisation purposes. Additionally, the study identifies ways to overcome some of these hindrances and foster more collaborations between South African LAMs for digitisation purposes. Conducting this study was essential, as these three institutions are houses of indigenous knowledge. Hence, the digitisation of their collections is critical for facilitating e-learning for the public space.

Keywords: digitisation, e-learning, collaboration, LAMs, impediments

1. Introduction

The importance of digitisation for e-learning is that it increases the accessibility of knowledge (Chitambo, Mabe & Potgieter, 2015), which in developing countries is especially crucial. However, digitisation projects are expensive and require a skilled and dedicated workforce (Mabe & Potgieter, 2021). As such, Libraries, Archives and Museums (LAMs) in South Africa need to embark on partnerships for digitisation purposes. Collaboration is essential as it helps deal with issues related to money; it also allows for skills and technology infrastructure to be shared (Allen & Bishoff, 2015). Collaboration will enable organisations to be sustainable (Riley-Huff et al, 2016). Digitisation allows LAMs to collaborate by allowing them to avail shared services to the public (Wakimoto & Bruce, 2015). South African LAMs can enjoy the benefits established in the literature below if they choose to collaborate.

In most cases, organisations do not know what they need for successful collaboration to occur and be sustained (Hardwick, Anderson & Cruickshank, 2013). The irony is that collaboration creates an opportunity for organisations to access new knowledge (Grillitsch & Nilsson, 2015). Factors that influence the failure of collaborations include the following: a lack of adequate and open communication; ineffective transfer of skills; organisations not being complementary to one another; and a lack of trust (Darabi & Clark, 2012). For partnerships to be successful, it is crucial for the parties involved to trust each other and be committed to mutual goals (Pomponi, Fratocchi & Tafuri, 2015). These were all internationally identified factors. As such, this study aimed to determine the factors that prevent South African LAMs collaboration for the digitisation of their collections.

To address the research question, "what are the factors impeding South African LAMs collaboration to help each other with the execution and completion of their digitisation projects? The authors interviewed twenty-one participants from sixteen different LAMs using semi-structured interviews. With the help of both literature and the study's findings, the authors developed recommendations to highlight the impediments to collaboration and ways in which these impediments can be overcome.

2. Literature review

This section focuses on literature relevant to digitisation for e-learning and collaboration for digitisation purposes.

2.1 Digitisation facilitating e-learning

Digital technologies have altered the education and learning landscape. For example, digitisation has moved students from reading physical books to reading virtual books (Mangen & van der Weel, 2016). With support from government funding, new technologies have increased online provision, such as video conferencing, chat boards, and learning on-demand tools such as Blackboard (Glover, Myers & Collins, 2018). These digital technologies are why universities can use creative methods and research to enhance the quality of education (Kulish et al, 2020). People are increasingly utilising digital devices for content creation, including young children (Sintonen, 2020). Thus, children may no longer need to learn how to write by hand because of digital devices (Mangen & van der Weel, 2016). The digitisation of school learning content also helps this.

Huang (2015) considers digitisation the facilitator for the modernisation of education (Huang, 2015). However, having realistic goals for digitisation projects is key (Darabi & Clark, 2012), in that it may not be possible to digitise every textbook. Digitisation is also a long-term process (Huang, 2015). Digitisation is a tool that can preserve unique cultural collections for future generations to popularise the utilisation of new technologies in education (Lajbenšperger. Šegan & Sanja, 2013); to facilitate lifelong learning; and to increase opportunities for international collaboration that allow for the sharing of knowledge resources (Lin & Yen, 2012). Digitising educational material means that the material will be accessible to more people located in more places (Hill & Lawton, 2018; Chitambo, Mabe & Potgieter, 2015). Increasing access to the material will create new material leading to innovative ideas (Chitambo, Mabe & Potgieter, 2015).

2.2 LAMs working together

In the mid-2000s, Hedegaard, Hellum and Topholm (2005) and Hedegaard (2004) realised an increase in LAMs' interest in working together. During the same period, Yakel (2005) also highlighted the essentiality for cultural experts, researchers, visitors, and the public to collaborate for records preservation purposes. In Norway, the main missions for LAMs were to display the various cultural differences present in their country and improve communities by making the services and functions of these institutions available to people, both in isolation and in a collaborative manner (Hindal & Wyller, 2004). Additionally, Hedegaard (2004) provided that LAMs from various countries increasingly collaborated on several projects. With LAMs being cultural heritage establishments, they exist for similar reasons, if not the same reasons (Allen & Bishoff, 2015). With the resurgent attraction toward LAMs, clear communication between employees of the institutions has become more critical (Wakimoto & Bruce, 2015). Collaborations allow for such things as access to more skills, money, and strategy development for digital preservation (Allen & Bishoff, 2015).

Duff et al (2013) provide examples, which they regard as the standard, of such collaborations existing in countries such as America and New Zealand. Robinson (2015:12) also found this kind of collaboration materialising in Australia, while Tedd (2011) pointed to another similar example of successful collaboration in Wales. Yarrow, Clubb, and Draper (2008) provide an example of collaboration in South Africa between the Kimberley Africana Library, the De Beers Archives, and the McGregor Museums. These institutions collaborate by sharing knowledge and online service delivery platforms and having joint workshops covering topics such as cutting-edge paper and book restoration.

2.3 Benefits of collaboration for digitisation

The advantages of collaboration include sharing costs and reducing the dangers of being innovative (digitisation), more specifically financially (Dodgson, 1994). Another benefit of enabling digitisation through collaboration is providing easy access to material that was previously difficult to access (Kinsey Today, 2012; Verheusen, 2008). Adding to that, digitisation allows for the effective preservation of collections (Mapulanga, 2013). Digitisation is also helpful in conserving old material, allowing the utilisation of material for much longer than it would have in its physical state (Tîrziman, 2013). This then justifies organisational investments in digitisation technologies (Liebetrau & Mitchell, 2010).

2.4 Hindrances to collaboration

This section discusses elements that hinder collaboration from taking place.

2.4.1 Trust and commitment

Interdependence, commitment, trust, and interchange are all features found in relationships (Kottila & Rönni, 2008). Should a partnership be void of trust and commitment, it becomes easy for it to fall apart due to, for example, other opportunities arising which might steer organisations away from grinding out difficulties with partners they are not committed to or do not trust (Darabi & Clark, 2012). Hardwick et al (2013) stress that partners that do not trust each other cannot have a good relationship. Distrust impedes conquering the tension amid the sharing of knowledge and fortification (Hardwick et al, 2013). As such, it will be necessary for LAMs working together in South Africa to trust each other for successful collaborations for digitisation purposes to occur.

2.4.2 Organisational culture

Suppiah and Sandhu (2011) consider organisational culture a genuine hindrance to creating knowledge-sharing channels. Organisational culture refers to an automatic way an organisation deals with the challenges it faces internally and externally. Organisations share these tools with newly appointed workers as the correct methods to alleviate those challenges (Al-Alawi, Al-Marzooqi & Mohammed, 2007). An organisation's culture that does not encourage collaboration will negatively affect knowledge sharing (Islam, Jasimuddin & Hasan, 2015). Without an organisational culture that supports knowledge sharing, employees will keep the knowledge to themselves, as they believe it will give them an advantage over their colleagues (Suppiah & Sandhu, 2011). In contrast, a culture that purports knowledge sharing will allow the seamless distribution of knowledge among employees in an organisation (Islam et al, 2015). This type of culture can help facilitate collaborations for digitisation purposes where South African LAMs are concerned.

2.4.3 Geography

The distance between institutions can negatively influence the decision to collaborate, as it demands complex logistics. Logistics refer to the process of scheduling, implementing and managing the flow of, in terms of this study, collections from one institution (LAMs) to another (Heaslip & Barber, 2016). Distance comes with a cost (Eden & Miller, 2004), meaning that the movement of material to be digitised from one partner's workspace to another's requires finances. The logistics involved in digitisation projects are complex, as seen in the collaborative digitisation project between the Austrian National Library and Google, where over 600,000 historical books had to be digitised (Kaiser, 2012). As such, to cut costs and avoid geographical location being a hindrance, it is essential for LAMs in South Africa to consider proximity when looking to collaborate.

2.4.4 Additional hindrances

Ocholla (2008) identifies more hindrances to collaboration: cost, time, exclusivity and inclusivity, political policies and communication. Communication is an essential factor when it comes to collaborations. Not communicating will place strain on any partnership (Kottila & Rönni, 2008). An additional hindrance to collaboration is organisations competing against one another (Polenske, 2004), thereby preventing any talks regarding collaboration between LAMs. Competition not only affects institutions deciding to collaborate, but it can also dictate whom institutions decide to collaborate with (Ners, 2017). Even though South African LAMs could face all the challenges discussed here, it is important to remember that none of them is insurmountable, as discussed in section 4.

3. Research methodology

This section discusses the design and methodological choices that govern this study.

3.1 Research problem

Collaboration offers advantages where digitisation is concerned. As such, LAMs in South Africa need to embark on partnerships for digitisation purposes. For this reason, this paper aims to investigate the reasons preventing collaboration between LAMs in South Africa, mainly because collaboration is essential as it helps deal with issues related to money. Collaboration also allows for skills and technology infrastructure to be shared (Allen & Bishoff, 2015).

3.2 Aim of research

To determine the factors that prevent South African Libraries, Archives and Museums (LAMs) from collaborating to digitise their collections.

3.3 Objectives:

- To determine the reasons South African LAMs are not collaborating.
- To determine what LAMs should do to overcome impediments to collaboration for digitisation purposes.

3.4 Discussion of research design and research methodology

Interpretivism was utilised as the study focused on LAMs in South Africa. Biedenbach and Müller (2011) provided that interpretivism is a tool that enables researchers to understand perspectives on phenomena. In this paper, subjective and constructed meanings associated with collaboration for digitisation purposes are studied. A single-method, qualitative approach was identified as the most suitable for this study, using semi-structured interviews. The authors applied inductive reasoning because of the investigative traits of the study. Chitambo, Mabe and Potgieter (2016) put forward that induction looks to examine phenomena within the context that they occur. To investigate the phenomena from different points of view, it was essential that multiple cases be investigated (16 cases). Gustafsson (2017) provides that gathering data from various organisations allows for comprehending the differences and similarities in the cases studied. Twenty-one participants from sixteen different institutions participated in the interviews. The authors strategically selected the twenty-one participants. Strategically selecting the participants warranted the usage of purposive sampling (Bryman & Bell, 2011). This was because participants had to hold special knowledge regarding both digitisation and collaboration. Semi-structured interviews were the data collection method selected. These interviews enable participants to share the most critical and confidential facts about organisations (Qu & Dumay, 2011). In terms of this study, facts regarding policies around digitisation and collaboration. The data was analysed using thematic analysis, and with the help of ATLAS.ti, data were categorised into themes (Ibrahim, 2012). ATLAS.ti is only a tool that helps with analysis and does not analyse data (Friese, 2014). The authors created codes on the application.

4. Results and discussion

This section provides the findings of the study

4.1 Factors that impede LAMs in South Africa from collaborating for digitisation

Even though collaboration for digitisation brings numerous benefits (access to more funds and skills (Allen & Bishoff, 2015:61) and provides shared services and resources (Wakimoto & Bruce, 2015:183)), there are a few reported cases of LAMs collaborating in South Africa. This made it essential to investigate the reasons LAMs in South Africa are not collaborating more.

4.1.1 The time factor

Over 50% of the participants indicated not having enough time on their schedule was one of the key hindrances to collaboration. The lack of time available frustrated the participants, as they are willing and wish to collaborate. However, work pressure, as well as time constraints, prevent them from doing so. Shampa and Sashi (2014) provided that this is true and stated that digitisation is both labour intensive and time-consuming. Additionally, four of these participants provided that digitisation is not a project that one can rush, it requires a lot of time as the work never gets less, but only increases, and it does not end.

4.1.2 The absence of communication

Over 50% of the participants provided that a lack of communication is one of the main obstacles to collaboration. As argued by four of these participants, the problem is that people usually never know what digitisation tools others have and, as a result, will not know whom to turn to. Concerning these statements, Ocholla (2008) provides that a lack of communication does hinder collaboration. Another participant stated that they were left frustrated because LAM staff do not meet enough to share experiences, projects, and initiatives. The participant believed the absence of an informal platform to share knowledge was more likely to hinder collaboration and not a lack of willingness to work with others.

4.1.3 Absence of buy-in

A lack of buy-in is a crucial factor. One participant stated that some institutions do not regard collaborating with other institutions as a work-related activity and, therefore, do not support it. Another participant shared a similar testimony asserting that getting permission to attend seminars or conferences is a strenuous process in their institution. An additional four participants complained that the lack of buy-in from their institution and government negatively influenced collaboration efforts. As a word of advice, Fitsimmons (2009) informed people that to get buy-in from relevant people, they must present the benefits the organisation will reap from participating in certain activities. This is what the workers at LAMs in South Africa need to do, indicate the benefits of collaboration for digitisation purposes.

4.1.4 Personalities, organisational culture, and structure

Four participants claimed that some individuals have agendas that create barriers to collaboration. Another participant shared that institutions have internal priorities, preventing staff from looking outward and working with others. Ocholla (2008) explained that the exclusiveness of institutions prevents collaborations from occurring. Seven participants pointed to people having different personalities in institutions as being an additional hindrance to collaboration. Two participants argued that not everyone in an institution is a willing sharer. This is touched on by Ocholla (2008), who presented that some people and institutions are not willing to share. A participant believed that this was because people wanted to have an advantage over colleagues.

4.1.5 Shortage of staff

Over 50% of the participants referred to their institution as being short of staff. In reality, institutions generally suffer from a shortage of staff (Fourie & Meyer, 2016). In elaborating on this matter, a participant suggested that many LAMs being short-staffed leave people willing to collaborate with no time to do so. Two other participants reported that their institutions had no one focusing on digitisation, and they, as a result, had to leave their duties and turn to digitising collections.

4.2 Ways to overcome hindrances to collaboration for digitisation

Below are suggestions for dealing with impediments to collaboration.

4.2.1 Knowledge and comprehension

A participant proposed that for collaboration to be realised as necessary, it is imperative that institutions first become aware of the essentiality of digitisation. According to Manžuch (2009), institutions cannot replace digitisation, especially for managing archives. Muir (2003) further states that digitisation is an important field where preservation is concerned. Another prominent issue raised by a participant was that those who worked with digitisation needed to study laws related to collaboration for digitisation, such as copyright laws. The participant elaborated that with understanding these laws, digitisers will steer the digitisation environment in a beneficial direction. These views indicate that some challenges remain because of ignorance and that it is possible to develop solutions should digitisers become more knowledgeable about these matters – this knowledge can be imparted on staff through training.

4.2.2 Obtaining buy-in

It is pertinent that leaders buy into projects (Mallon, 2017). One participant proposed for digitisation to be "sold as a package" by listing all its value-adds. The value-adds of digitisation include: it is a tool for preservation; it allows for collections to be audited simultaneously to the digitisation – evaluation audit (checking for authenticity) and conservation audit (ensuring that collections have been conserved appropriately) – which enables you to save time. One participant argued that a benefit of digitisation is that it brings educational value by creating platforms of easy access to information. By highlighting the benefits of a project, one can get buy-in from those in power (Fitsimmons, 2009) to carry out a digitisation project in a collaborative manner. One participant contended that institutions would encourage workers to "make time for it" by making collaboration a priority.

5. Conclusions

The two key findings of the study are that there is both a lack of time and a shortage of staff working in LAMs, which make it difficult for workers to collaborate on digitisation initiatives. Not having enough staff also forces workers to overwork, leaving them no time to collaborate or think outside their daily work functions. Time is a significant factor for digitisation as it is a labour-intensive project and demands much focus and time. The study found that the absence of communication and the lack of buy-in from management are vital hindrances. Some institutions do not regard collaborating with other institutions as a work-related activity, and as such, do not support it. In overcoming these barriers to collaboration for digitisation, it was determined that institutions first need to become aware of the essentiality of digitisation. In that way, those in power within the studied LAMs will buy into digitisation projects. By highlighting the benefits of collaboration for digitisation, one can get buy-in from those in power. Another prominent issue identified was that those working with digitisation need to study the legislation related to collaboration for digitisation, such as copyright laws. Understanding these laws will allow digitisers to steer the digitisation environment in the direction that would benefit them. The authors recommend conducting further research focusing on determining the steps the South African government is taking in supporting digitisation projects and collaboration for digitisation purposes. The aim would be to determine whether policies or policy proposals are in place.

References

Al-Alawi, A.I., Al-Marzooqi, N.Y. and Mohammed, Y.F. (2007) "Organisational culture and knowledge sharing: Critical success factors", *Journal of knowledge management*, Vol 11, No. 2, pp 22-42.

Allen, N. and Bishoff, L. (2015) "Collaborative digitisation: Libraries and museums working together", *Advances in librarianship*, Vol 26, pp 43-81.

Biedenbach, T. and Müller, R. (2011) "Paradigms in project management research: Examples from 15 years of irnop conferences", *International journal of managing projects in business*, Vol 4, No. 1, pp 82-104.

Bryman, A. and Bell, E. (2011) *Business research methods*, Oxford university press, United Kingdom.

Chitambo, I., Mabe, K. and Potgieter, A. (2016) "The role of digitisation in knowledge and content management", Paper read at 16th European Conference on Knowledge Management, Ulster, Northern Ireland, September.

Darabi, F. and Clark, M. (2012) "Developing business school/SMEs collaboration: The role of trust", *International journal of entrepreneurial behavior & research*, Vol 18, No. 4, pp 477-493.

Dodgson, M. (1994) *Technological collaboration in industry: Strategy, policy, and internalisation in innovation*, Routledge, London.

Duff, W.M., Carter, J., Cherry, J.M., Macneil, H. and Howarth, L.C. (2013) "From coexistence to convergence: Studying partnerships and collaboration among libraries, archives and museums", *Information research*, Vol 18, No. 3, pp 1-26.

Eden, L. and Miller, S.R. (2004) "Distance matters: Liability of foreignness, institutional distance and ownership strategy", *Advances in international management*, Vol 16, pp 187-221.

Fitsimmons, G. (2009) "Resource management: People - gaining buy-in", *The bottom line*, Vol 22, No. 1, pp 21-23.

Fourie, I. and Meyer, A. (2016) "Role of libraries in developing an informed and educated nation", *Library hi tech*, Vol 34, No. 3, 422-432.

Friese, S. (2014) *Qualitative data analysis with atlas.ti*, Sage publications, London.

Glover, H., Myers, F. and Collins, H. (2018) "Academic identities and the digital self? A cross cultural study of digitisation in higher education teaching", Paper read at IADIS International Conference on e-Learning, Madrid, Spain, July.

Grillitsch, M. and Nilsson, M. (2015) "Innovation in peripheral regions: Do collaborations compensate for a lack of local knowledge spillovers?", *The annals of regional science*, Vol 54, No. 1, pp 299-321.

Gustafsson, J. (2017) "Single case studies vs. multiple case studies: A comparative study", [online], www.diva-portal.org/smash/get/diva2:1064378/FULLTEXT01.pdf.

Hardwick, J., Anderson, A.R. and Cruickshank, D. (2013) "Trust formation processes in innovative collaborations: Networking as knowledge building practices", *European journal of innovation management*, Vol 16, No. 1, pp 4-21.

Heaslip, G.E. and Barber, E. (2016) "Improving civil-military coordination in humanitarian logistics. The challenge", *Irish journal of management*, Vol 35, No. 2, 143-158.

Hedegaard, R. (2004) "The benefits of archives, libraries and museums working together: A Danish case of shared databases", *New library world*, Vol 105, No. 7/8, pp 290-296.

Hedegaard, R., Hellum, A. and Topholm, J. (2005) "NOKS: A searchable cultural and historical database from Denmark - An ALM project (archive-library-museum)", *Library hi tech news*, Vol 22, No. 2, pp 19-20.

Hill, C. and Lawton, W. (2018) "Universities, the digital divide and global inequality", *Journal of higher education policy and management*, Vol 40, No. 6, pp 598-610.

Hindal, S. and Wyller, E.H. (2004) "The Norwegian archive, library and museum authority – our role in a society based on knowledge and culture", *Library review*, Vol 53, No. 4, pp 207-212.

Huang, Q. (2015) "Digital transformation of education publishing in China", *Publishing research quarterly*, Vol 31, No. 4, pp 258-263.

Ibrahim, A.M. (2012) "Thematic analysis: A critical review of its process and evaluation", *West east journal of social sciences*, Vol 1, No. 1, pp 39-47.

Islam, M.Z., Jasimuddin, S.M. and Hasan, I. (2015) "Organisational culture, structure, technology infrastructure and knowledge sharing: Empirical evidence from MNCs based in Malaysia", *VINE*, Vol 45, No. 1, pp 67-88.

Kaiser, M. (2012) "Putting 600,000 books online: The large-scale digitisation partnership between the Austrian National Library and Google", *Liber quarterly*, Vol 21, No. 2, pp 213-225.

Kinsey today. (2012) "Preservation and access through the new digitisation lab", [online] https://web.b.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=3&sid=569f3316-222a-4b81-beb0-93ff6dee3efe%40sessionmgr103.

Kottila, M. and Rönni, P. (2008) "Collaboration and trust in two organic food chains", *British food journal*, Vol 110, No. 4/5, pp 376-394.

Kulish, A., Radul, V., Haleta, Y., Filonenko, O. and Karikh, I. (2020) "The newest digital technologies in education and the prospects of their implementation in Ukraine", *Propósitos y Representaciones*, Vol. 8, No. 2, pp 1-13.

Lajbenšperger, M., Šegan, M. and Sanja, R. (2013) "The use of the modern technology in educational work: user study for digitisation of cultural heritage", *Journal of education, culture & society*, Vol 2, pp 71-78.

Liebetrau, P. and Mitchell, J. (2010) *Managing digital collections: A collaborative initiative on the South African framework*, National research foundation knowledge management and evaluation information resources and services, Pretoria.

Lin, Simon C.; Yen, E. (2012) "An introduction to Taiwan e-learning and digital archives program (TELDAP)", *International journal of humanities & arts computing: A journal of digital humanities*, Vol 6, No. 1/2, pp 1-7.

Mabe, K. and Potgieter, A. (2021) "Collaboration between libraries, archives and museums in South Africa", *South African journal of information management*, Vol 23, No. 1, pp 1-8.

Mallon, M.R. (2017) "Getting buy-in: Financial stakeholders' commitment to strategic transformation", *Management research: Journal of the Iberoamerican academy of management*, Vol 15, No. 2, pp 227-243.

Mangen, A. and van der Weel, A. (2016) "The evolution of reading in the age of digitisation: an integrative framework for reading research", *Literacy*, Vol 50, No. 3, pp 116-124.

Manžuch, Z. (2009) "Monitoring digitisation: Lessons from previous experiences", *Journal of documentation*, Vol 65, No. 5, pp 768-796.

Mapulanga, P. (2013) "Digitising library resources and building digital repositories in the University of Malawi libraries", *The electronic library*, Vol 31, No. 5, pp 635-647.

Muir, A. (2003) "Copyright and licensing issues for digital preservation and possible solutions" [online], www.elpub.scix.net/data/works/att/0315.content.pdf.

Ners, D. (2017) "Coalitional games, excessive competition and a lack of trust: An experimental approach", *Economics and sociology*, Vol 10, No. 2, pp 227-238.

Ocholla, D.N. (2008) "The current status and challenges of collaboration in library and information studies (LIS) education and training in Africa", *New library world*, Vol 109, No. 9/10, pp 466-479.

Polenske, K.R. (2004) "Competition, collaboration and cooperation: An uneasy triangle in networks of firms and regions", *Regional studies*, Vol 38, No. 9, pp 1029-1043.

Pomponi, F., Fratocchi, L. and Tafuri, S.R. (2015) "Trust development and horizontal collaboration in logistics: A theory based evolutionary framework", *Supply chain management: An international journal*, Vol 20, No. 1, pp 83-97.

Qu, S.Q. and Dumay, J. (2011) "The qualitative research interview", *Qualitative research in accounting and management*, Vol 8, No. 3, pp 238-264.

Riley-Huff, D.A., Herrera, K., Ivey, S. and Harry, T. (2016) "Crowdfunding in libraries, archives and museums", *The bottom line*, Vol 29, No. 2, pp 67-85.

Robinson, H. (2015) *Knowledge utopias: An epistemological perspective on the convergence of museums, libraries and archives*", University of Sydney, Sydney.

Shampa P. and Sashi P.S. (2014) "Digitisation initiatives and special libraries in India", *The electronic library*, Vol 32, No. 2, pp 221-238.

Sintonen, S. (2020) "From an experimental paper to a playful screen: How the essence of materiality modulates the process of creation", *British journal of educational technology*, Vol 51, No. 4, pp 1322-1333.

Suppiah, V. and Sandhu, M.S. (2011) "Organisational culture's influence on tacit knowledge-sharing behavior", *Journal of knowledge management*, Vol 15, No. 3, pp 462-477.

Tedd, L.A. (2011) "People's collection Wales: Online access to the heritage of Wales from museums, archives and libraries", *Program*, Vol 45, No. 3, pp 333-345.

Tîrziman, E. (2013) "An experience of preservation and evaluation of documentary heritage through digitisation: "Manuscriptorium" project", *Infotheca*, Vol 14, No. 1, pp 7-14.

Verheusen, A (2008) "Mass digitisation by libraries: Issues concerning organisation, quality and efficiency", *Liber quarterly*, Vol 18, No. 1, pp 28-38.

Wakimoto, D.K. and Bruce, C.S. (2015) "Experiencing archives at universities archivists, librarians, understanding, and collaboration", *Reference services review*, Vol 43, No. 2, pp 182-198.

Yakel, E. (2005) "Choices and challenges cross-cutting themes in archives and museums", *OCLC systems and services: International digital library perspectives*, Vol 21, No. 1, pp 13-17.

Yarrow, A., Clubb, C. and Draper, J. (2008) *Public Libraries, Archives and Museums: Trends in Collaboration and Cooperation*, *IFLA Professional Reports* 108, IFLA, The Hague.

Features of e-Learning in the System of Studying Social Responsibility of Students

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DOI: 10.34190/EEL.21.125

Abstract: The article discusses the features of e-Learning in the system of studying the social responsibility of students in the framework of the scientific project IRN No. AR09058126 "Social responsibility of students in the conditions of professional training in universities of Western Kazakhstan", funded by the Committee of Science of the Ministry of Education and Science of the Republic of Kazakhstan since 2021. Scientific works on corporate social responsibility contributed to the development of this research (F.Rosati, R.Costa, A.Calabrese, J.Lee, M.Cho, etc.). Of scientific and methodological value is the work of S. L. Davis, L. M. Rives, and S. Ruiz-de-Maya on the need to develop a concept of social responsibility that includes behaviour of the individual as a modern citizen. The study of J. C. R. Sousa, E. S. Siqueira, E. Binotto, L. H. N. Nobre on the perception of the subjects of the educational process of social responsibility, depending on the degree of discussion and the level of socialization of students, is significant. C.Roofe believes that the problem of social responsibility is not given much attention, which leads to a constant decline in the moral and spiritual component of education in the country. The testing tool included one author's questionnaire, revealing the degree of awareness, personal attitude of teachers to the problem of the lack of social responsibility of students. The questionnaire "Ideas about social responsibility" was validated by specialists of the Biostatistics sector. The sample consisted of 103 respondents in random order, regardless of the age and teaching experience of the participants, as well as the academic disciplines taught. Next questions - 1, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15 when rounding, we gave the value of Alpha-Cronbach-0.7 (Alpha-Cronbach: 660927 and Standardized. Alpha: 669767), which corresponds to the required norm and confirms the validity and reliability. The features of e-Learning allow us to adjust our activities in a timely manner to achieve the goals set in the system of studying the social responsibility of students. We believe that e-Learning contributes to the personal development of students, thereby optimizing their process of developing social responsibility.

Keywords: university student, distance learning, e-Learning, responsible education, personal social responsibility, social responsibility of students

1. Introduction

Modern society is developing dynamically, constantly involving the person himself in its mechanisms, presenting new requirements to him. Responsibility, as a separate significant universal category, manifests itself in all spheres of life of a modern person and acts in turn as one of the criteria for assessing the nature of the relationship and interaction of one person with other members of society, as well as all types of results and consequences of their activities in relation to the interests of society. Therefore, at the moment, the goal of modern education is to guarantee the receipt of quality education for the full and effective life of people.

University students are the future leaders of the state, therefore, their way of thinking and behaviour determines the framework for sustainable development of the country. That is why the mission of a modern national university is to form the value system of students through responsible education. Our universities need ideas and tools for the implementation of corporate social responsibility and personal social responsibility of students through high-quality educational programmes, improvement of internal corporate culture, effective interaction with alumni, partners, employers.

The relevance of the problem of scientific research is due to the general state of the elaboration of the issue of social responsibility in the domestic and foreign scientific space and the very degree of importance of responsibility for a full harmonious social life of people in the modern world. Research interest in the study of social responsibility is caused by the logic of the development of holistic socio-psychological knowledge (G.M. Andreeva, A.A. Bodalev, B.F. Lomov), further expansion of scientific research in the field of psychology and pedagogy of higher education, which comprehensively approach the study of age, personal and social maturity of a person (A.A. Bodalev, A.A. Dergach, I.A. Zimnyaya, E.A. Klimov, B.C. Mukhina, V.D. Shadrikov, etc.), as well as the needs of society interested in the development of social responsibility of the individual, social institutions, business and government.

Social responsibility as an urgent problem of forming a full healthy personality of a citizen is considered by us as an aspect of responsible education. Therefore, we are conducting a targeted comprehensive study of the social responsibility of students in universities within the framework of the scientific project IRN No. AR09058126 "Social responsibility of students in the context of vocational training in universities of Western Kazakhstan", funded by the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan since the beginning of 2021. This publication presents the results of the theoretical part of the research since at the initial stage it assumes scientific and theoretical substantiation of the relevance of the research problem.

It is well known that in modern science education in recent years, more and more attention is paid to the relationship between knowledge and issues of social importance. In world practice, socio-scientific issues (SSI) - complex, often contradictory issues related to the development of science and technology, and the development of society as a whole - are widely recognized as an important area of the educational programme that contributes to improving the academic and scientific literacy of students. Thus, scientists L. Chen and S. Xiao determined that whilst modern teachers partially understand the principles of teaching based on sociological issues; they lack clear strategies in solving various problems; including collaboration between stakeholders necessary to support teaching practice (Chen et al, 2021). Therefore, these revealed facts are very important to take into account, first of all, for leaders and specialists in the field of educational policy, as well as for teachers of all levels of the education system, who are faced with joint SSI training.

The process of technologization of modern education is also gaining relevance, which leads to an increase in the social responsibility of students in new IT realities. At the same time, innovations - technologies, methods, new forms and methods of independent work focused on independence and creativity play a special role in this process (Knissarina et al, 2018). Thus, in foreign scientific literature, the concept of "Technology-Enhanced Learning" (TEL) is increasingly used. According to H. Beetham, R. Sharp, technologized learning is learning using technologies, including information and communication technologies (ICT), virtual reality, the Internet, mobile technologies, etc. (Beetham, et al, 2019). The design of active learning in technologically rich contexts depends on the theory of learning activities, which underlies the development of a model of practice for the design of technologized learning.

Therefore, the purpose of this scientific work is to highlight the features of the implementation of e-Learning in a personality-oriented aspect in the system of studying the social responsibility of university students.

2. Literature review

Scientific and theoretical analysis of the literature showed the existence of several theoretical and methodological approaches to the definition of the concepts of "responsibility" and "social responsibility". Thus, even the philosophers of the ancient world began to consider the category of responsibility: the ancient Chinese thinker Confucius singled out this concept as an initial one, contributing to the establishment of order in the process of analyzing the relationship between society and the individual; the ancient philosophers Plato and Aristotle first found the relationship between responsibility and free will/choice.

From the point of view of the Marxist concept, according to T. Hobbes, J. Locke, “responsibility” proceeds from the relationship between freedom and necessity, the interaction between the individual and society. M.A. Markova, S.I. Popova, A.F. Shishkina, E.A. Anufrieva considered responsibility as inextricably linked with organization and discipline. Kant made an attempt to study the content of the concept of responsibility on the basis of the idea of the dignity of the human person.

In modern scientific works of domestic and foreign scientists, we already receive sufficient information about the depth and degree of study of various aspects of this research problem. So, A.A. Amvrozov, V.S. Barulina, S.L.

Serebryakova in her works define social responsibility when analyzing the subjective and objective in the social development of all mankind.

V.N. Ivanov, A.M. Omarov, V.M. Shepel and other scientists have identified the mechanisms of the formation of the individual's social responsibility in the study of the work collective as a factor in the all-round development of the individual. L.M. Arkhangelsky, A.A. Guseinov, S.F. Anisimov devoted his scientific works to the study of the moral responsibility of the individual. B.S. Yakovlev, N.I. Fokina, N.A. Minkin considered in sufficient detail various directions and means of educating the social responsibility of the younger generation.

Scientific views of B.P. Shubnyakova, E.M. Penkov on the issues of responsibility in connection with the need and freedom in the life of a citizen are interesting. L.N. Kogan, G.E. Arefieva, A.K. Udelov highlight social responsibility in the development of the theory of social activity.

Many scientists, such as A. R. Kornilov, A. R. Lavrentiev, S. N. Kozhevnikov, V. M. Lazarev, D. A. Lipinsky, G. Yu. Prokopovich, O. V. Shcherbakova, O. S. Ioffe, A.V. Dulov, M. A. Krasnov, B. L. Nazarov, E. V. Chernykh, K. A. Novikov, V. A. Rybakov, A. S. Bulatov, D. B. Bobrova, M. I. Braginsky, etc., were engaged in the study of legal responsibility in the aspect of encouragement or punishment by the state.

Works on the disclosure of social and pedagogical aspects of educating social responsibility in the younger generation are of significance for our research (I.Yu. Novichkova, A.S. Gayazov, E.S. Kazakov, M.V. Nikolaev, G.Ya. Grevtsova, V. N. Lukin, S. P. Akunina, I. M. Duranova, M. M. Plotkina, T. P. Skrebtsova, M. O. Antonova and others).

The results of the study of social responsibility as a factor in determining interpersonal relationships in society are also interesting (B. G. Afanasyev, A. P. Burenko, A. I. Orekhovsky, A. F. Plakhotnoy, V. I. Speransky, S. V. Karpukhin, etc.).

A review of foreign literature showed a sufficient number of research papers on corporate social responsibility issues (Rosati et al, 2018; Lee et al, 2019). Research work has its place and significant importance in the aspect of a new understanding of socially responsible consumption, highlighting the crucial role of people's personal values (Lee et al, 2019).

The scientific and methodological value for our research is represented by the following work "Personal social responsibility: development and verification of the scale" by scientists-educators S.L. Davis, M.R. Longinos, R.M. Salvador. In their opinion, despite the tendency in psychological and social science towards responsible consumption on the part of the individual, no research has analyzed responsible behaviour as a multidimensional construct in areas not related to consumption, such as paying taxes, educating children and recycling. Therefore, it is necessary to develop the concept of personal social responsibility (PSR), which includes human behaviour in general, in addition to consumption. This study is developing a robust and reliable scale for measuring PSR, a concept that includes individual behaviour from the perspective of a person as a citizen (Davis et al, 2021).

The work of J. C. R. Sousa, E. S. Siqueira, E. Binotto, and L. H. N. Nobre on" University Social Responsibility: Perspectives and Achievements", which analyzed the perception of professors, students, administrative staff, and academic directors of social responsibility at four Rio Grande do Norte (RN) universities in Brazil, is also of general significance. The study found difficulties in assessing social responsibility due to the lack of discussion, poor socialization of students and discussion of the obtained data (Sousa et al, 2021).

According to C. Roofe, in the context of the important role of standardized tests and assessments of academic performance in the education system in Jamaica, the problem of social responsibility is not given special attention, which has led to a constant decline in the moral and spiritual component of education in the country (Roofe, 2018).

It should be noted that this study is one of the first, since the early 1990s, in which social responsibility is seen as a key component of teacher training, particularly in Jamaica. But we also believe that there is now a need to fill such gaps in the study of social responsibility in research on teacher education in general.

The specificity of our research is primarily due to the need to study the social responsibility of a student's personality in modern society from an integrative point of view at the intersection of philosophy, sociology, psychology and pedagogy.

3. Methods

Since the object of our research is to highlight the features of e-Learning in the personality-oriented aspect in the system of studying the social responsibility of students, it is necessary to clarify the meaning and content of the very concept of e-Learning. Also, recently, one of the developing educational technologies is distance learning, in full based on information and communication technologies. The ability to gather the learning audience at a distance, regardless of spatial and temporal boundaries, is undoubtedly the main advantage of distance learning.

In contrast to distance learning, e-Learning or online learning has become very popular and even necessary, which involves direct communication between the student and the teacher using modern Internet technologies.

According to the definition given by UNESCO experts, e-Learning is learning using the Internet and multimedia. This means that students participate in online lectures, online classes (Practical classes, Independent work of the student under the supervision of the teacher), online seminars, that is, all interaction with the university and teachers takes place online, via the Internet. And classes in the "e-Learning" mode are defined as " the process of educational interaction in real time (video conferencing, via messaging over the Internet, negotiations via telephone) (Academic Policy, 2020).

The tool that we had to test included one questionnaire, the purpose of which is to identify the degree of awareness, personal attitude to the problem of social responsibility of students and, accordingly, the level of quality of work on the development of the desired personal characteristics in them. The questionnaire "Views on social responsibility" for the university's teaching staff (UTS) was specially developed by a research group in Russian as part of an ongoing scientific project in 2021.

Professional translation of the questionnaire questions from the Russian into the Kazakh language was carried out by specialists of the Department of Documentation Management of the WKMOMU and was officially confirmed at the discussion of the University Terminology Committee on such translations.

The author's questionnaire "Views on social responsibility" has passed the procedure of confirmation of validation by a specialist in the Biostatistics sector of WKMOMU. In total, 103 respondents from among the teaching staff of different departments of the university were interviewed using the online service GoogleForms. The results of the following questions from the presented 15 questions of the questionnaire (1, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15) when rounded off gave the value of Alpha-Cronbach - 0.7 (Alpha-Cronbach: 660927 and Standardization. Alpha: 669767), which corresponds to the required norm. Documents have been submitted for obtaining the conclusion of the Local Ethics Commission.

To the question "What forms of training are the most effective in gaining knowledge?" the following answers were offered: a) lectures; b) conversations; c) business games; d) discussions; e) others. What is distinctive is that only a small number of respondents in the “others” option indicated the types and forms of online classes as the most effective. From this, we concluded that our teachers do not yet realize the value and benefits of e-Learning. Perhaps many teachers did not have time to use and test interactive types of work online? Or they are not sufficiently aware of the available opportunities of Internet applications and e-Learning in general, that is, this indicates a low level of competence and skills of teachers in the field of IT technologies.

On the 14th question on the definition of "the leading factors affecting the successful formation and development of social responsibility of students" out of 100% of the surveyed teaching staff chose: 44% - "the content of the educational process"; 37% - “the nature of educational work at the university and in the family”; 11% - “internal psychological characteristics of the personality; 7% - “specificity of leisure and cultural events”. We believe that the respondents' preferences in choosing the dominant factor are quite predictable and justified since the final expected learning outcomes depend on the educational content, which is the essence and specifics of the learning process.

To the question " Who has the main role in the formation and development of social responsibility of students?» the following was determined: 39% of respondents chose "family"; 28% of respondents chose "teachers"; 22% - "university management"; 11% - "the student himself". These results demonstrate the liberal attitude of the respondents-teachers to the very process of developing students' social responsibility since they believe that the main role in this belongs to the family, style, and examples of upbringing, values, and traditions.

4. Results and discussion

An analysis of the data leads us to the conclusion that, in general, teachers are quite aware of the issue of student social responsibility, are competent enough in choosing effective methods and forms of development of the studied personality quality, but they do not have specific knowledge and clear guidelines for the purposeful professional development of social responsibility in their students. Therefore, we agree with the results of a study by our foreign colleague that teachers have a common understanding of social responsibility: "they felt that they were prepared for this role through meetings on a special curriculum, were not properly prepared for their role, and social responsibility demanded first and foremost, faith in an idea before it can be taught" (Roofe, 2018).

In the educational process, pedagogical interest is also the interconnection of creativity with the formed cultural and social experience of the individual, the direct connection of which is also confirmed as a result of our practical experience in the development of social responsibility in students in the framework of the study of the discipline "Psychology" in the 1st year of the specialty "General Medicine". Thus, R. Sharif's determination of a causal relationship (correlation) between acculturation and creativity through statistical modelling is considered consistent and scientifically sound. Since the attributes of acculturation that generate creativity are the multicultural learning experience, the individualistic type of culture, homogeneous cultural dyads, and the strategy of acculturation of biculturalism. Therefore, acculturation, in addition to its well-founded connection with creativity, is a positive and significant predictor of innovation (Sharif, 2019).

In our opinion, the increased participation of various social factors in higher education has led to efforts to expand access to higher education. There is no doubt that social factors play an important role in academic performance., Shweta Mishra, taking into account the role of social factors, in her research analyzes the academic performance of students in terms of social network, social capital and social support, with particular attention to underrepresented groups in higher education. It turns out that networks of students, including their families, ethnicity, religion, friends, and teachers, play a critical role in academic success. (Mishra, 2020).

Of course, a logical consequence of the intensive development of digital technologies in all areas of activity is the growing interest of researchers in building digital citizenship (DC) in various disciplinary fields. Despite the growing interdisciplinary interest in this problem, there is a lack of authoritative research papers in this area, or interdisciplinary DC research is insufficient in terms of the significance of the results obtained. Thus, half of the peer-reviewed articles on digital citizenship are published in educational journals, and the basic constructs of digital competence and online participation are underdeveloped everywhere (Chen, et al, 2021). We believe that it is necessary to expand the subject areas of study and use of e-Learning tools to obtain the necessary information and knowledge in the study of various scientific problematic issues.

What features of online learning have we already noticed and identified for ourselves? The results of observation of teachers during the educational process in the "e-learning" mode during the quarantine associated with the 2020-2021 pandemic: lack of accounting for labour regulation and assessment of distance learning teachers, lack of understanding of the teacher role in the conditions of Distance Learning (DL), insufficient level of pedagogical competence of teachers in the implementation of distance learning, lack of necessary ICT resources, etc.

Considering the problem of clarifying the teaching role in e-Learning, it should be noted that many teachers perceived DL as a process of transmitting e-learning materials via the Internet. However, this is a misconception, since learners need guidance from educators, since "pedagogy places the responsibility on the teacher for guiding the learner on the path to a specific and productive goal" (Beetham, et al, 2019). Thus, the distance learning format in the e-Learning mode at our university is defined as "the process of interactive cooperation of participants in the educational process with each other and with the learning environment through a variety of multimedia technologies" (Academic Policy, 2020).

The main psychological feature of online learning in a technologized format of educational activity is the content of education itself. In this regard, only the educational activities of students and the results of their activities are important for the entire educational process (Kalinin, 2015). It became necessary to choose an effective design for active learning in the personality-oriented aspect of modern education since now there is an intensive technologization of the educational process (ICT, distance learning, virtual reality, the Internet, mobile technologies, etc.). We have clarified the very concept of "learning activity" in terms of its technologization - "the specific interaction of learners with other people through special tools and results-oriented resources" (Beetham et al, 2019). It also defined such important concepts as "learning environment" - "features of the physical and virtual environment, instrumental resources and products, data in context" and "learning objectives" - "intended outcomes of activities arising from the context" (Beetham et al., 2019).

It should be noted as a psychological feature of modern education in the context of technologization, its categorical characteristic of the design of learning outcomes, approved by the Bologna process as the "main building blocks" of higher education in the European Community (Gholson et al, 2006). Since the huge variety of knowledge, concepts, values, activities require that the available digital opportunities are correctly framed in learning outcomes. And the analysis of foreign scientists has shown that all digital technologies are sufficient to achieve results that do not imply a right/wrong decision.

According to foreign scholars (Laurie E.C.Delnoij, Kim J.H. Dirkx, José P.W. Janssen, Rob L. Martens), incomplete higher education is a constant problem in higher online education. Their findings showed that learning strategies, academic self-efficacy, academic goals and objectives, institution adaptation, employment, supportive networks, and teacher-student interactions are modifiable consistent predictors of incompleteness. And coaching, therapeutic training, and peer mentoring are ways to solve the problem of incomplete higher education (Delnoij et al, 2020). Therefore, our primary task for teachers is to bring the learning process to its logical conclusion, regardless of the accompanying educational or social goals.

Highlighting the features of online learning in the aspect of a personality-oriented approach in the context of systematic work to study the social responsibility of students is primarily due to the need to improve the quality of educational services.

5. Conclusions

So, the first important feature of e-Learning in the aspect of a person-centered approach in the system of studying social responsibility is associated with the ability to choose the right way to distinguish students from each other in learning:

- subject experience, knowledge and competence of students;
- learning motives and expectations of students;
- previous learning experience;
- social and interpersonal skills;
- digital and information literacy of students, etc.

The next important feature is related to the effectiveness of the distribution of students. Nowadays, blended learning is gaining relevance, which is characterized by a combination of student-centered and group learning, private learning and collaborative learning.

Thus, the out-of-class teaching technologies actively used by our teachers are based on a wide range of educational interaction between the teacher and the students: various voice systems, interactive online applications, video conferences, chats, etc.

The peculiarity of e-Learning at our university is an effective combination of the main components of DL in the educational process. Among the first, we can include, the choice and configuration of LMS (Learning Management System), thanks to which teachers place educational content of the entire educational process. These are video instructions, video lectures, tests, text and presentation materials, useful links to external resources. Thus, West Kazakhstan Marat Ospanov Medical University uses a modified Moodle system to create an educational electronic environment. We refer to the second component as the direct interactive cooperation of learning subjects (teaching staff and students) in the online mode. These are, first of all, videoconferencing of classes (practical and lecture classes) on various platforms (Zoom, Skype, Microsoft Teams, Webex, Google meet, YouTube, etc.). We would like to note that thanks to all these e-Learning tools, teachers and students had the opportunity to manifest and develop not only their intellectual and creative abilities but also social responsibility as a personal characteristic, in online classes through the wide use of all kinds of Internet applications and IT technologies.

We believe that despite the ambiguity of understanding and acceptance of e-Learning in modern education, the learning format itself contributes to the holistic personal development of all participants in the educational process. Thus, the features of e-Learning in the personality-oriented aspect in the system of studying the social responsibility of university students require individualization, a clear definition of the complexity of study assignments in terms of time and content, an effective selection of educational content, and concretization of a clear plan and scenario of the educational process.

Acknowledgements

This research is funded by the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan (Grant No. AP09058126).

References

Academic policy for work in DLT, approved at WKMOMU, No. 10 / 5-1-05 / 1-62 dated March 16, 2020, Aktobe. http://dl.zkgmu.kz/mod/forum/discuss.php?d=291.

Carmel Roofe (2018) "Schooling, teachers in Jamaica and social responsibility: rethinking teacher preparation", Social Responsibility Journal, Vol. 14 No. 4, pp. 816-827. https://doi.org/10.1108/SRJ-10-2017-0202.

D.A. Kalinin (2015), "Difficulties experienced by teachers in the context of distance learning", Internet magazine "Science", Vol 7, No. 3, http: //naukovedenie.ru/PDF/30PVN315.pdf (free access). Title from the screen. Language. Russian, English DOI: 10.15862 / 30PVN315.

Francesco Rosati, Roberta Costa and Armando Calabrese (2018) "Employee attitudes towards corporate social responsibility: a study on gender, age and educational level differences", Corporate Social Responsibility and Environmental Management, Vol 25, No 6, November/December, pp 1306-1319, https://doi.org/10.1002/csr.1640.

Gholson B. and Craig S.D. (2006), Promoting constructive activities that support vicarious learning during computer-based instruction, Educational Psychology Review. No 18, pp 119-39.

Helen Beetham and Rona Sharp (2019) Rethinking pedagogy for a digital age. 21st Century Learning Design. Almaty: Public fund National Translation Agency, p 352.

M.M. Knissarina, G.K. Netalina and A.D. Syzdykbaeva (2018) "Self-management of a university student", Medical Journal of Western Kazakhstan. No. 59 (3), pp 71-78.

Laure Lu Chen, Sheena Mirpuri and Nirmala Rao (2021), "Conceptualization and measurement of digital citizenship across disciplines", Educational Research Review, Vol 33, June, 100379. https://doi.org/10.1016/j.edurev.2021.100379.

Laurie E.C.Delnoij, Kim J.H.Dirkx and José P.W.Janssen (2020), Predicting and resolving non-completion in higher (online) education, A literature review/Educational Research Review, Vol 29, February, 100313, https://doi.org/10.1016/j.edurev.2020.100313.

Licui Chen and Sihan Xiao (2021) "Perceptions, challenges and coping strategies of science teachers in teaching socioscientific issues: A systematic review", Educational Research Review, Vol 32, February 2021.

Jaejin Lee and Moonhee Cho (2019), "New insights into socially responsible consumers: The role of personal values", Corporate Social Responsibility and Environmental Management, Vol 43, No 2, March, pp 123-133, https://doi.org/10.1111/ijcs.12491.

Rukhsar Sharif (2019), "The relations between acculturation and creativity and innovation in higher education: A systematic literature review", Educational Research Review, Vol 28, November, 100287. BinghamtonUniversity, NewYork, UnitedStates. ISSN 1747-938X.

Shweta Mishra (2020), "Social networks, social capital, social support and academic success in higher education: A systematic review with a special focus on 'underrepresented' students" Educational Research Review, Vol 29, February, 100307. https://doi.org/10.1016/j.edurev.2019.100307.

Sousa, J.C.R., Siqueira, E.S., Binotto, E. and Nobre, L.H.N. (2021), "University social responsibility: perceptions and advances", Social Responsibility Journal, Vol. 17 No. 2, pp. 263-281. https://doi.org/10.1108/SRJ-10-2017-0199.

Sylvia López Davis, LonginosMarín Rives and Salvador Ruiz-de-Maya (2021), "Personal social responsibility: Scale development and validation", Corporate Social Responsibility and Environmental Management, Vol 28, No 2, March/April, pp 763-775, https://doi.org/10.1002/csr.2086.

Analysis of the Curriculum of Secondary Technical Education Based on the Reflection of ICT Competencies

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DOI: 10.34190/EEL.21.070

Abstract: The paper presents the results of the analysis of the assessment of the acquisition of digital competencies of students of secondary vocational schools with a focus on the field of engineering in terms of: their importance for meeting the profile of the graduate; employability of graduates in the field; requirements of Industry 4.0; the difficulty of their acquisition at a secondary vocational school. The research team performed analysis of the implementation of the Framework Educational Program for the field of education 23-41-M / 01 Mechanical engineering in the conditions of secondary vocational school. The main tool of the quantitative research survey was an online questionnaire distributed to the principals of secondary vocational schools with a focus on the field of engineering. The research survey took place in February and March 2021, the respondents were school principals and other persons responsible for the implementation of the school curriculum. The ICT competence of students is given very strong attention by teachers of secondary schools of engineering They consider the acquisition of this competence to be the third most demanding in terms of its complexity. They consider ICT competence to be the most connected of all the requirements of Industry 4.0. ICT competence of graduates may be the second most important for employers and it is the second competence contributing to fulfilling the profile of a school graduate. ICT education is the fourth most important educational area in terms of engineering practice. And it is the most popular area for students. Two thirds of secondary schools rate the equipment with digital technologies as favorable and fully compliant. Analysis will enable us to provide FEP publishers, FEP implementing schools, graduate customers and the general professional public with supporting documents for negotiations leading to the optimization of educational documents in new and increasingly changing production and socio-economic conditions.

Keywords: secondary technical education, ICT competencies, framework educational program, education in ICT, Conditions for the implementation of the curriculum

1. Introduction

The concept of Industry 4.0 is based on the creation of fully-integrated, automated and constantly optimised means of production. New global networks based on the connection of production facilities into Cyber-Physical Systems (CPS) will be created. CPS will be the building blocks of “smart factories”. They will be able to autonomously exchange information, provoke a needed action in reaction to current conditions and mutually and independently control one another. Sensors, machines, components and IT systems will be interconnected within a value chain beyond an individual company. CPS connected in this way using standard communication protocols based on the Internet will interact and analyse data in order to predict errors and malfunctions, configure themselves and adapt to changed conditions in real time (Kolektiv, 2016). Such factories will produce “smart products” which will be unequivocally identified and localised, will know their history and current state but also alternative ways to create the final product. Industry 4.0 took up a pioneering role in industrial IT, which is currently revolutionizing the manufacturing engineering. Many industrialized countries also have already begun with adapting their industrial infrastructure to meet the requirements of the Industry 4.0 vision (Coskun, Kayıkcı & Gençay, 2019).

These characteristics of Industry 4.0 must be reflected in the content and processes of education at all levels of schools, as they are required by future employers or they will be a condition for success in further levels of education. Huba and Kozák (2016) analyzed the impact of Industry 4.0 on mechatronics and engineering education, noting that “Industry 4.0 will create many new cross-functional roles for which workers will need both IT and production knowledge. They therefore propose increase the number of interdisciplinary study programs that integrate IT and engineering,” expand their role in ongoing re-qualification of the industrial workforce, and focus on train-ability of the graduates.

In the Czech Republic, the school curriculum is designed as a two-level curriculum. The state, through the Ministry of Education, Youth and Sports, issues Framework Educational Programs (FEP) on the basis of which schools are obliged by law to develop their own School educational programs, which take into account their conditions for its implementation and the requirements of its stakeholders, especially employers and their representations (clusters, chambers of commerce, unions, guilds, etc.). The aim of the FEP is the further development of students' key competencies (including the competence we monitor - to use information and communication technology resources and to work with information - hereinafter referred to as ICT competences), it also focuses on the formation of general competence and professional competence.

FEP of the educational field of Mechanical Engineering revised in 2020 (23-41-M/01 Mechanical engineering) contains the curriculum in the form of topics and learning outcomes grouped into a total of 13 educational areas.

Table 1: General layout of the content of education in the educational program Mechanical Engineering (MŠMT, 2020)

Educational areas and content areas	Minimum number of teaching hours for the entire period of education	
	week	**total**
Language education - Czech language - foreign language	 5 10	 160 320
Social science education	5	160
Science education	6	192
Mathematical education	12	384
Aesthetic education	5	160
Health education	8	256
Education in ICT	6	192
Economic education	3	96
Design and construction	18	576
Engineering technology	10	320
Construction and operation of machines	12	384
Available lessons	28	896
Total	**128**	**4096**

The area of Education in information and communication technologies, which we prefer to monitor, contributes to the total available time during the four-year full-time study program for a total of 196 hours out of a total of 4,096 hours, which is only 4.7 % of this time. By studying the field of Mechanical Engineering (23-41-M/01 Mechanical engineering), graduates can obtain two full professional qualifications in accordance with the National Qualifications Framework: mechanical engineer designer (23-104-M) and mechanical engineer technologist (23-105-M).

The research of secondary school management's views on the importance of ICT competencies of their students and on the field of ICT education and digital equipment of schools as conditions for successful formation of ICT competencies and overall professional profile of graduates was carried out in situations of limited standard service and continued hybrid or blended teaching.

According to a recently published report by the Czech School Inspectorate (Pavlas, Zatloukal et al, 2021), the estimated number of 250,000 pupils, who did not or do not attend online distance learning due to technical difficulties but cooperated with the school and the school provides them with educational materials and tasks, decreased at the end of the school year 2019/2020 and also in the school year 2020/2021 to about one fifth (50 thousand pupils). However, in addition to those pupils who are unable to attend online distance learning for technical reasons, there is still a group of pupils who participate in online distance learning irregularly or do not work well enough, mainly due to family problems, usually associated with low motivation to education or with low family support. Most of them are older pupils, whose education is demanding even in full-time teaching.

Unfortunately, this situation still opens up "educational scissors"among pupils from socio-economically stronger and socio-economically weaker family backgrounds. However, the findings of the Czech School Inspectorate clearly show that where schools are looking for ways to educate pupils with respect to their very different conditions, in many cases, despite the unfavorable socio-economic background of these pupils, it will eventually succeed, albeit not to the full extent.

2. Method

The research data were obtained by means of a questionnaire compiled by the authors of the study. It was compiled on the basis of a previous research phase carried out by semi-structured interviews with principals and teachers of secondary engineering schools, and its content and structure were closely linked to the relevant national curricular document, which allows it to be considered validated. We did not determine its reliability due to its one-time use, however, we consider that reliability indicator could be completion of questionaire by respondents who act as coordinators of the school curriculum at individual schools and are best acquainted with its characteristics and implementation process and are fully qualified to complete it. It was administered online in the clickforsurvey.com environment. The objectives of the analysis are identifiable from the characteristics of the items of the questionnaire.

Five questions focused on the acquisition and practical use of all key competences, including ICT competences, which we discuss in more detail. The four questions focused on finding out the popularity of all educational areas of the relevant curriculum among students, on the reflection of the requirements of engineering practice related to individual educational areas, on their contribution to further potential study and the contribution of each of the educational areas to two possible professional qualifications. We were mainly interested in the field of Education in ICT. One question sought respondents' views on equipping their school for curriculum implementation, including digital technology. Respondents always answered the questions by choosing one value from a five-point scale, with a value of 1 always meaning the lowest and a value of 5 the highest level of difficulty, attention, significance or importance, popularity or benefit of the observed phenomenon, resp. satisfaction with digital equipment.

The research survey took place in February and March 2021, the respondents were school principals and other persons responsible for the implementation of the school curriculum. The request to fill in the questionnaire was sent to all schools - 82 schools in the Czech Republic that implement the educational program 23-41-M/01 Mechanical engineering. Data were obtained from 25 schools, which is almost one third of them.

3. Results

The results of the survey are organized into three parts.

3.1 ICT as key competence

To find out the opinions of secondary school management on the ICT competence of their students, resp. future graduates, five evaluation criteria were used (Figure 1).

Teachers of all subjects pay relatively considerable attention to the competence of their students to use information and communication technologies and to work with information (h = 4.13). Of the eight monitored competences, only slightly more attention is paid to problem-solving competence (h = 4.25) and learning competence (h = 4.17), and the same attention is paid to mathematical competence (h = 4.13); they pay the least attention to civic competence and cultural awareness (h = 3.13).

In terms of the difficulty of acquiring ICT competence, a rather medium value of difficulty was found (h = 3.75), which may be due to the already relatively high level of this competence in pupils coming to study at a secondary technical school. Respondents consider only mathematical competence (h = 4.13) and problem-solving competence (h = 3.88) to be more demanding on the acquisition of the monitored competences; they consider the competence to learn and the competence to work and entrepreneurial activities to be equally demanding (equally h = 3.75); respondents consider the acquisition of civic and cultural awareness competence to be the least demanding (h = 2.92).

Representatives of secondary engineering schools consider ICT competence to be the most (of all competences) connected with the requirements of Industry 4.0 (h = 4.71). Such a strong link indicates that schools are aware of the changes that the concept of Industry 4.0 brings to engineering processes. With a large value gap, the school representation evaluates the link between learning competence and problem-solving competence (equally h = 4.08); the least link to the requirements of Industry 4.0 manifests in the competence of civic and cultural awareness (h = 2.75) with the observed perspective requirements.

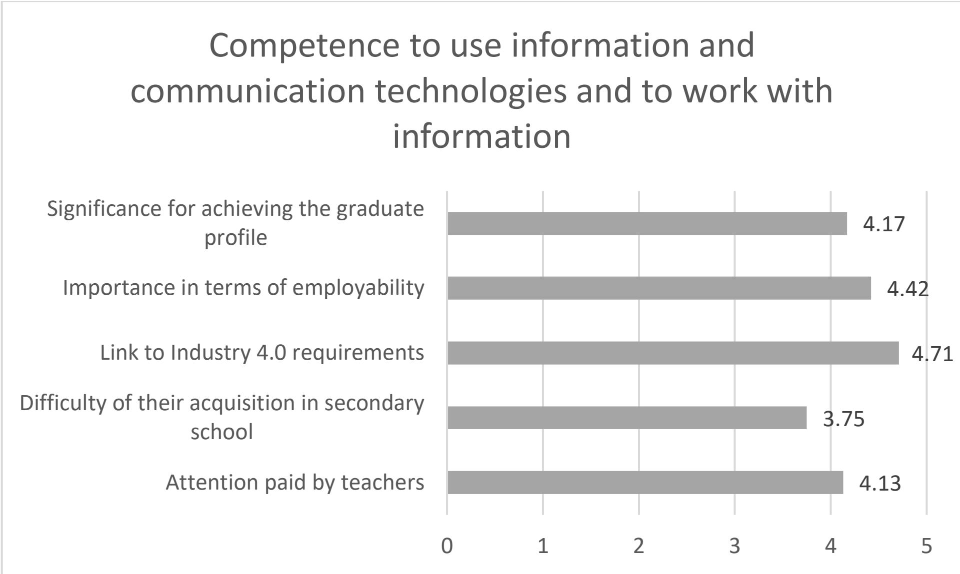

Figure 1: Selected parameters of ICT competence

When surveying the opinions of secondary school management on the importance of key competences for the employability of graduates of their schools, a high average value was found, which in this sense they attribute to ICT competence of graduates for their future employers (h = 4.42). The value for problem-solving competence was only slightly higher (h = 4.46). No value lower than 3 was found for any of all the competencies.

The opinion of teachers in secondary schools on the importance of ICT competence for achieving the study goals formulated in the profile of its graduate was also monitored. The value found for this criterion (h = 4.17) is the second highest value after the value for problem-solving competence (h = 4.33).

3.2 Evaluation of "education in ICT" as an area of education in the curriculum

Four criteria were chosen for the evaluation of the curricular area of ICT Education (Figure 2).

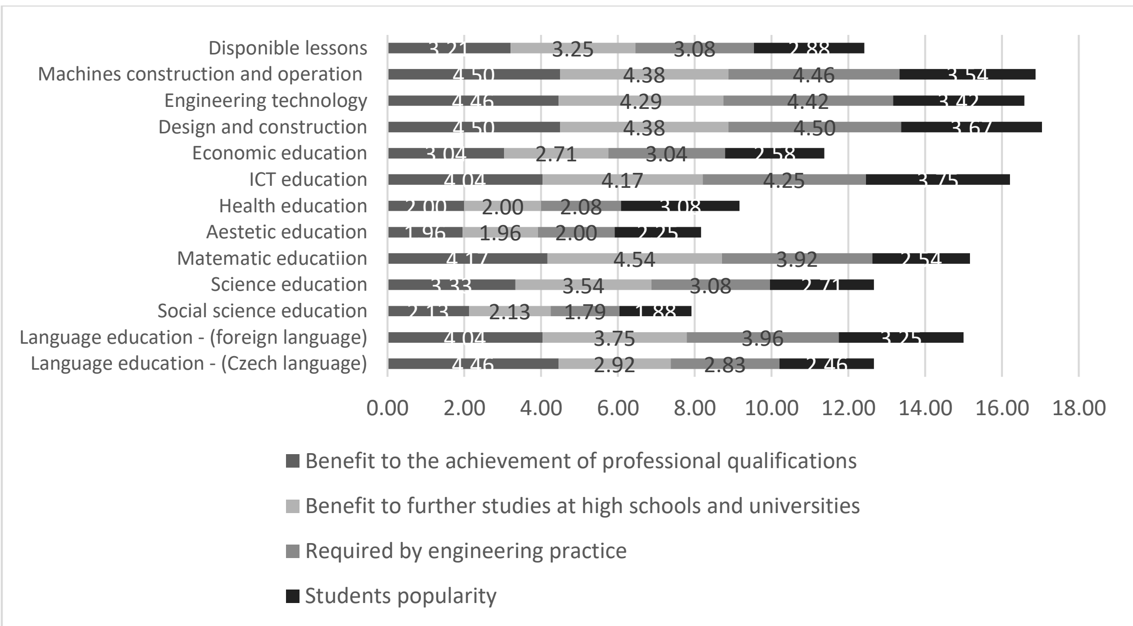

Figure 2: Evaluation of the field of Education in ICT in the context of other educational areas

According to the coordinators of the curriculum, ICT education is the most popular among of all 13 educational areas monitored among students (h = 3.75). It is followed by professionally profiling areas of Design and construction (h = 3.67), Construction and operation of machines (h = 3.54) and Engineering technology (h = 3.42); the least popular is Aesthetic education (h = 2, 25).

When asking how schools perceive the requirements of engineering practice in terms of training students in individual educational areas, a value h = 4.25 was found for the field of education in ICT, which ranks it fourth - behind the field of Design and construction (h = 4.50), Construction and operation of machines (h = 3.46) and Engineering technology (h = 4.442).

Educational area ICT education is considered to be the fifth most important area of education for students who would continue their studies at universities or colleges - with a high value of significance (h = 4.17) after Mathematical education (h = 4.54) and after three professional profiling areas: Design and construction (h = 4.38), Construction and operation of machines (h = 3.38) and Engineering technology (h = 4.29).

In terms of the contribution to the achievement of full professional qualifications provided by the curriculum, Education in ICT ranks 6th to 7th with a higher value (h = 4.04). Apart from the 4 educational areas mentioned in the previous paragraph, ICT competence was preceded (perhaps somewhat surprisingly) by language education in Czech (h = 4.46) and with the same value as for ICT education language education in a foreign language (h = 4.04).

3.3 Assessment of digital technology equipment as one of the conditions for curriculum implementation

The conditions for the implementation of the curriculum in secondary schools were categorized into a total of 10 groups (personnel, financial, technical/technological - machines, equipment, time, didactic textbooks, aids, programs, digital technology equipment, legal, political and others.

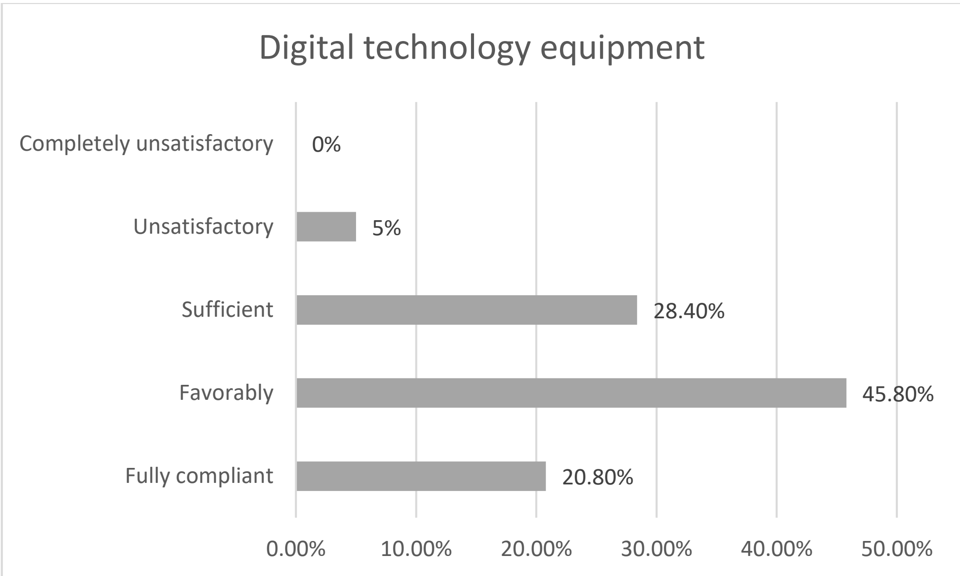

Figure 3: Evaluation of school equipment with digital technologies

Two thirds of secondary schools rate digital equipment as favorable (45.8 %) and fully compliant (20.8 %). And only one school (5 %) as unsatisfactory, so 95 % of schools have good prospects from this point of view to develop ICT competencies of their students and especially in teaching in the field of ICT education and in teaching and learning students in other educational areas.

4. Discussion

The authors assumed that, given that the research was supported by a national research institution - the Technological Agency of the Czech Republic - there would be greater involvement of the addressed secondary schools with the Mechanical Engineering educational program. One third of the schools involved can be justified by the long and demotivating situation at the time of school closure due to the pandemic situation. At the same time, we state that the percentage of schools involved in our research is similar to the surveys conducted by the National Institute of Education in recent years. In three quarters of secondary schools, most of their teachers are aware of the potential of ICT for improving the quality of education and also more and more of them include these technical resources in their teaching, only a quarter of teachers of these visited schools consider themselves confident and methodically very proficient in working with ICT (Česká školní inspekce, 2019). It will be necessary (because teaching during a pandemic required this) to accelerate the development of their ICT competencies so that they could demonstrate their declared attention to shaping the ICT competencies of their students in educational practice.

Czech students consider the development of their ICT competencies to be the most popular educational area. Similar researches deal more with the level of acquired competencies, the frequency of their use and personal equipment with technologies by students (European Union, 2019), but they did not deal with the aspect we monitored. In terms of ICT school equipment found in our sample, the current situation has improved compared to the findings of the Czech School Inspectorate (Česká školní inspekce, 2019), which stated that about 80 % of classrooms in ICT secondary schools were equipped. Researches on ICT competencies of school graduates is not yet available especially in the context of the coming 4th Industrial Revolution, and views of practice on popularity, importance for further studies and for the production practice in the field of Education in ICT. Therefore, it is not possible at this time to compare our findings with other research conclusions.

5. Summary and conclusion

The ICT competence of students is given very strong attention by teachers of secondary schools of engineering (in the 3rd place out of eight competencies). They consider the acquisition of this competence to be the third most demanding in terms of its complexity. They consider ICT competence to be the most connected of all the requirements of Industry 4.0. According to schools, the ICT competence of graduates may be the second most important for employers. It is also the second competence in terms of its contribution to fulfilling the profile of a school graduate. Of the 13 areas, ICT education is considered by schools to be the most popular area for students. It is the fourth most important educational area in terms of engineering practice. It is the fifth educational area in terms of its contribution to potential education at universities or colleges. It is the sixth to seventh area in terms of significance for obtaining both full professional qualifications by passing the relevant school-leaving examination. Two thirds of secondary schools rate the equipment with digital technologies as favorable and fully compliant, only one as completely unsatisfactory.

Overall, it can be stated that the management of engineering secondary schools is aware of the importance of ICT competencies for study and subsequent practice and pays considerable attention to its further formation in a situation of considerable popularity of ICT education among students and its importance for meeting the requirements of Industry 4.0 and graduate profile, to obtain full professional qualifications and for possible further studies. They reflect the situation that potential employers will require prepared graduates in this area and successfully strive to have the best possible conditions for the formation of ICT competencies and their integration into the profile of the graduate. Based on our findings, high school principals and school curriculum coordinators, in cooperation with their founders, should ensure that schools are fully equipped with ICT, urgently increase the ICT skills of their teachers and utilize the considerable popularity of ICT education among their students to be used more widely and frequently in all schools subjects, as their future employers require and expect a high level of ICT competence from school leavers.

Acknowledgements

This study was created as a part of the research project of the Technology Agency of the Czech Republic under the title “Education in Engineering Fields and Its Optimization for the Needs of the Labour Market”, ID TJ02000083.

References

Česká školní inspekce (2019). Rozvoj informační gramotnosti na středních školách ve školním roce 2018/2019. Tematická zpráva. Praha.

Coskun, S., Kayıkcı, Y. & Gençay, E. (2019). Adapting Engineering Education to Industry 4.0 Vision. Technologies, 7, 10, doi:10.3390/technologies7010010.

European Union (2019). 2nd Survey of Schools: ICT in Education Objective 1: Benchmark progress in ICT in schools. Final report. Luxembourg.

Huba, M. & Kozák, Š. (2016). **F**rom e-Learning to Industry4.0. 2016 International Conference on Emerging eLearning Technologies and Applications (ICETA). DOI**:** 10.1109/ICETA.2016.7802083

Kolektiv autorů: Národní Inciativa Průmysl 4.0. Praha: Ministerstvo průmyslu a obchodu (2016). https://www.businessinfo.cz/app/content/files/dokumenty/narodni-iniciativa-prumysl-40.pdf

Ministerstvo školství, mládeže a tělovýchovy (2020). Rámcový vzdělávací program pro obor vzdělání 23-41-M/01 Strojírenství.

Ondrejkovič, P., Křemenová, K., Malý, M., Krajča, B.: (2017) Koncepční analytická studie pro skupinu 23 – Strojíresntví a strojírenská výroba. Národní ústav pro vzdělávání, Praha.

Pavlas, T., Zatloukal, T., Andrys, O. & Neumajer, O. (2021). Distanční vzdělávání v základních a středních školách. Přístupy, posuny a zkušenosti škol rok od nástupu pandemie nemoci covid-19 Tematická zpráva. Česká školní inspekce, https://digifolio.rvp.cz/view/view.php?id=5103.

The Changing Landscape of Digital Technologies for Learning

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DOI: 10.34190/EEL.21.067

Abstract: Digital technologies are and will continue to be changing the way we learn and teach today and in the future. This includes not only offering every learner and teacher equal access to these technologies, but it also involves completely new forms of content delivery. Additionally, digital skills must be fundamentally strengthened as a basic human skill that is urgently needed today. It is therefore essential that learners own or have easy access to the necessary digital technologies to participate fully in the digital education era. How learners concretely use them in diverse and creative ways is of particular interest not only for educators. In this regard, we sought to study the changing landscape of technology ownership and use by students for both learning and leisure. To accomplish this, we designed and conducted three surveys. After an analysis of related work, we present a comparative, quantitative analysis of the survey results from 2013 (N_1=275), 2015 (N_2=336), and 2020 (N_3=481). It investigates the evolution of ownership and use of digital technologies over the years. Then, we explore the extent to which the use of different digital technologies has changed during this period, and the purposes for which technologies are now used in enhancing and supporting student learning. We also present a qualitative evaluation of the learners' responses. The aim is to determine how digital technologies are used and how they may depend on specific learning contexts. Finally, we give some recommendations and suggestions for further research.

Keywords: digital technologies, technology ownership, technology use, digital learning, learner's digital behaviour

1. Introduction

In recent years and especially during the COVID-19 pandemic we have seen digital technologies fundamentally changing the way we learn and teach. Digital technologies have had a significant impact on our attitudes towards education; are changing learning in schools and universities every day and are requiring all those involved to rethink the skills that are needed for the future. Extending beyond the need to offer all teachers and learners equal access to these technologies, it also involves completely new forms of didactics and content delivery. At the same time, digital skills must be fundamentally strengthened as a basic human skill that is as necessary today as reading, calculating and writing. It is therefore of particular importance that learners own the necessary digital technologies to be able to participate in digital education.

In this paper we introduce an empirical and longitudinal study consisting of three surveys conducted in 2013, 2015, and 2020, respectively. We present a comparative, quantitative analysis of the surveys' results that investigate the evolution of ownership and use of digital technologies over the years. Additionally, we present a qualitative evaluation of the learners' responses and give guidance on further attention.

2. Related work

It has become essential that students can access appropriate digital technologies to complete their studies (Sailer, Schultz-Pernice and Fischer, 2021). That includes devices such as laptops or tablets and to have access to various applications such as software solutions for writing academic papers, revising digital learning materials, or collaborating with fellow students. In any case, a 2018 study showed this connection for several American HEIs (Higher Education Institutions) and across nine countries (Galanek, Gierdowski and Brooks, 2018). That study also emphasized the increasing importance of smartphones as a learning device for students in the classroom, but also for self-paced learning. Mobile learning is increasingly becoming the standard for young learners (Romero-Rodríguez et al., 2020; Viberg, Andersson and Wiklund, 2021). Other studies also show that students in Anglophone countries in particular use this sort of device (Kay and Lauricella, 2011; Galanek, Gierdowski and Brooks, 2018; Dahlstrom, 2012). Other influential works on digital experiences of learners and educators cover similar countries and situations (Essel et al., 2018; Beetham, Newman and Knight, 2019; Killen and Langer-Crame, 2020).

The International Association of Universities, IAU, investigated the impact of the current pandemic for higher education (HE). Their study shows the significance of digital technologies for implementing technology-enhanced learning concepts (Marinoni, van't Land and Jensen, 2020, p. 11). In Germany, the association of the nine leading technical universities, TU9, is calling for comprehensive investment in the necessary digital infrastructures as the basis for meaningful digital learning and teaching concepts (TU9, 2020). This will also be critical in a post-pandemic time, i.e. how to implement new learning and teaching concepts students need to use and which technology they should own for that.

Across most research, there is a consensus that the intensive use of digital technologies has a direct impact on students' learning behaviour (Jalal and Mahmood, 2018). Some of the reasons deal with the changed behaviour of the digital-native generation (Palfrey and Gasser, 2010), which increasingly prefers informal, social learning (Viberg, Andersson and Wiklund, 2021) that becomes feasible through digital technologies. Achieving digital competence for lifelong learning, where students proactively design, contribute to, and transform theirs and society's future, requires both to perceive and evaluate their experiences online; it must acknowledge technology ownership and use.

The EDUCAUSE 2018 study (Galanek, Gierdowski and Brooks, 2018), for instance, investigates the specific ways of how students use digital technologies. Interestingly, it became apparent that the lecturer's encouragement to use digital technologies in the classroom is critical in determining the actual type of use. Nevertheless, other studies show that the advanced use of applications in the classroom also positively influences students' learning (Wankel and Blessinger, 2013). It is also apparent that there is often a prevailing attitude among lecturers that students do not need to be trained in the use of digital technologies. However, students begin their studies with a background of experience *"based on play, leisure, and entertainment"* (Gulatee and Combes, 2018).

3. Methodology

The main goal of our research is to study the development of digital technology ownership and use over the years at the HWR Berlin, a university of applied sciences in Germany. In this case, we define digital technologies as the aggregation of diverse hardware equipment like computers and physical network connections, as well as a variety of software-based applications. To accomplish this, three surveys were designed, conducted, and analysed, as well as their results compared: S1 in 2013, S2 in 2015, and S3 in 2020. They constitute an empirical, longitudinal study that focuses on technology ownership by students and its use for learning and leisure.

Some of the central research topics guiding our research are: students' ownership and use of digital technology, tools that students use/have used for learning, challenges that might depend on the current situation (e.g. related to the COVID-19 pandemic), as well as implications for the future of online teaching and learning, among others.

All three surveys were conducted and administered online. Invitations to participate in the surveys were sent to both graduate and undergraduate students per email. The original source of the questionnaires and their content are introduced in (Jefferies, Monett and Kornbrot, 2016). The surveys consisted of groups of both closed and open-ended questions in four main categories: demographics, technology ownership, use of technology, and general comments. With each survey, new questions were added to account not only for the new technological advances, but also for the teaching and learning conditions of each surveyed period. Subsequent surveys built upon the 2013 survey and followed similar, basic research questions, research design, conduction, and analysis. The time periods that were considered are: (i) September 11th, 2013, to November 27th, 2013, for S1, (ii) October 28th, 2015, to December 14th, 2015, for S2, and (iii) December 14th, 2020, to January 11th, 2021, for S3, i.e. all falling in the last study quarter of the year to allow for a better comparison.

4. Results and discussion

Conducting three surveys in similar research settings over seven years has made it possible to gather data for analysing it. The following sections present and discuss the key relevant findings.

4.1 Demographics and general data

Table 1 shows general information about the surveys as well as some demographics. The number of students willing to participate increased from survey to survey, especially the proportion of female students surveyed, representing 59.9% of the respondents in the last survey. The number of participants in the age group 30+ has been increasing too, with almost four times the number of students surveyed in that category in 2020 with respect to 2015. The majority of the students surveyed are first year students, an explanation for that being the time of the year at which the surveys were administered. Also increasing over the years is the number of international students and those whose native language is not German.

Table 1: General information about the surveys

	S1 (2013)	S2 (2015)	S3 (2020)
No. of responses received	275	336	481
Female, male, other*	53.2%, 46.8%, –	55.4%, 44.6%, –	59.9%, 38.9%, 1.2%
International students	2.4%	9%	9.4%
Native language German	96.3%	87.4%	86.3%

*: In the first two surveys, there were no options for a gender other than female or male.

4.2 Digital technology ownership

The ownership of digital technologies increases for almost all devices (see Figures 1 (a) and (b)). The increase is remarkable for the case of laptops and notebooks, with almost nine in ten students owning such a device in 2020. A similar trend can be observed for tablets and related devices. Also for smartphones with the market-dominating mobile operating systems iOS and Android, with half of the surveyed students owning at least one such a device. However, no increase can be observed for classic stationary devices—like desktop computers. In general, students now own higher-quality devices, which are faster, more expensive but also demanding high connectivity.

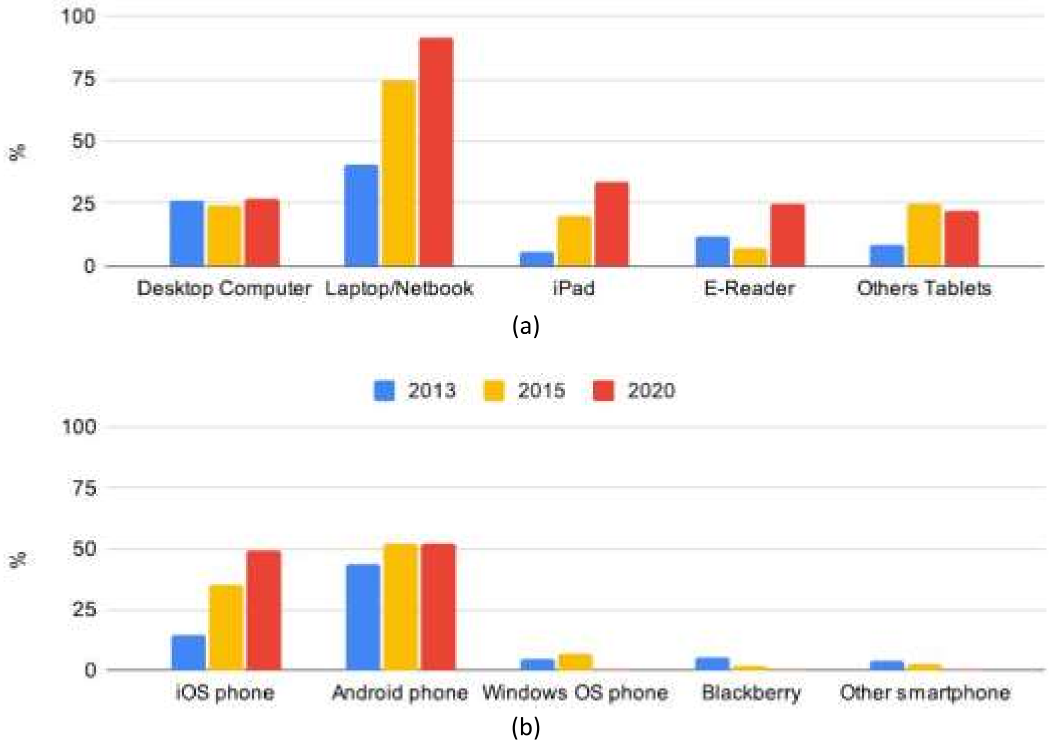

Figure 1: Technology ownership of desktop computer, laptop/netbook, and tablets, as well as smartphone devices by students

All three studies also asked about the ownership of other devices such as diverse digital camera products, video players, HD TV Sets or mp3 players. A consistent picture emerges here that illustrates a decline of such devices, except HD TV Sets. One major reason seems to be found in the technological convergence of devices that has been going on for years. The emergence of different hardware components with *"many functions and support* *many content formats"* (Alt, 2021) manifests this trend. A smartphone and a tablet not only combine formerly stand-alone devices such as cameras or video and audio players, but also provide completely new forms of applications and use. We also see this trend in modern television sets, which are often offered as smart TVs and can thus partially replace new, so far desktop-driven device developments. This could explain the increased ownership of higher-quality TV sets. The most essential insights from the device ownership range by students is consistent with other studies conducted that clearly show a dominance of mobile and convergent devices for learning (Gulatee and Combes, 2018; Galanek, Gierdowski and Brooks, 2018; Marinoni, van't Land and Jensen, 2020). Interestingly, the comparatively higher increase in Apple devices such as iPhones or iPads shows that students might have a higher willingness to buy higher-priced devices.

Mobile devices in particular promote informal learning (Viberg, Andersson and Wiklund, 2021) that can be described *"by being self-initiated and non-prescribed"* (Carraro and Trinder, 2021, p. 41) outside formal face-to-face or distance learning formats. That might require different course designs and formats, also for motivating and engaging students to learn in self-paced environments. The mobile devices available for such learning settings are no longer regulatory, much like network connectivity.

Connectivity to the internet, e.g. via WLAN or Wi-Fi at home (Wi-Fi: 96.7% S2, and 99.4% S3), has already achieved high penetration since the first study in 2013, which is not surprising. Germany is one of the countries where social status also determines access to education and therefore to HEIs (Blossfeld, 2019). Furthermore, such social groups have been among the highest internet users since the early years of the digital age (Destatis, 2021).

4.3 Quantitative analysis of digital technology use

In the first two studies (S1 and S2), we distinguished between the categories 'for study' and 'for leisure' when asking about the concrete use of technology. In the most recent study (S3), we no longer make this distinction, as our digital lives are becoming more and more blurred at the boundaries between private and professional (Lemke and Brenner, 2015), in a student's case for learning. The data gathered from the three surveys shows a consistent, high use of applications in the group of office automation over time compared to other application categories. For instance, in 2020 respondents used much more word processing applications (54,5%), presentation software (30,4%), and spreadsheet-based software (29,3%), than university library search tools (11,9%) or collaborative software tools (5%).

That application usage can be analysed together with the variety of digital activities that students perform as part of their studies. Figure 2 shows a range of those activities that respondents from the first two surveys used to perform online on a daily basis. For example, a passive usage of technology (understood e.g. as reading wikis or blogs, downloading videos, etc.) dominated an active one (understood e.g. as contributing to wikis or blogs, posting videos, etc.) in 2013. Two years later, there are many more students performing such activities online, in general, and some of these activities start to show either a decline or an increase in their frequency.

In contrast to the steadily increasing end device use, without increasing diversity due to technological convergence, application use shows a broadly diverse picture and this for each study. In order to take a closer look at the state of technology use in 2020, we asked in the third survey about the frequency with which online activities were performed. The results are presented in Figure 3. Important to notice this time is that we also focused on activities undertaken in preparation for or during study. Furthermore, concrete examples of applications widely used by young people or with high penetration in their group ages were considered for evaluation, too (this is why special cases of currently extended social networks like Instagram or TikTok appear together with categories or more general kinds of activities performed online).

As Figure 3 shows, both asynchronous and synchronous messaging still dominate the activities performed online in 2020; video-based applications as essential tools for communicating would need to mature further. Even when all these activities are performed for/when studying, the overall use of many of them drastically increased from 2015 to 2020. Using social networks like Facebook, LinkedIn, Twitter, and TikTok, is not even popular for/when studying in 2020 compared to YouTube, Spotify or Instagram, the big winners in this study. Teachers could take note of this when designing their teaching by being aware of which activities could be expected to have a higher engagement of students. On the other hand, if creating and posting videos online was a skill that should be reinforced during the studies, then teachers should find better ways to engage students in this activity since only one in ten students includes it in her repertoire of activities performed online.

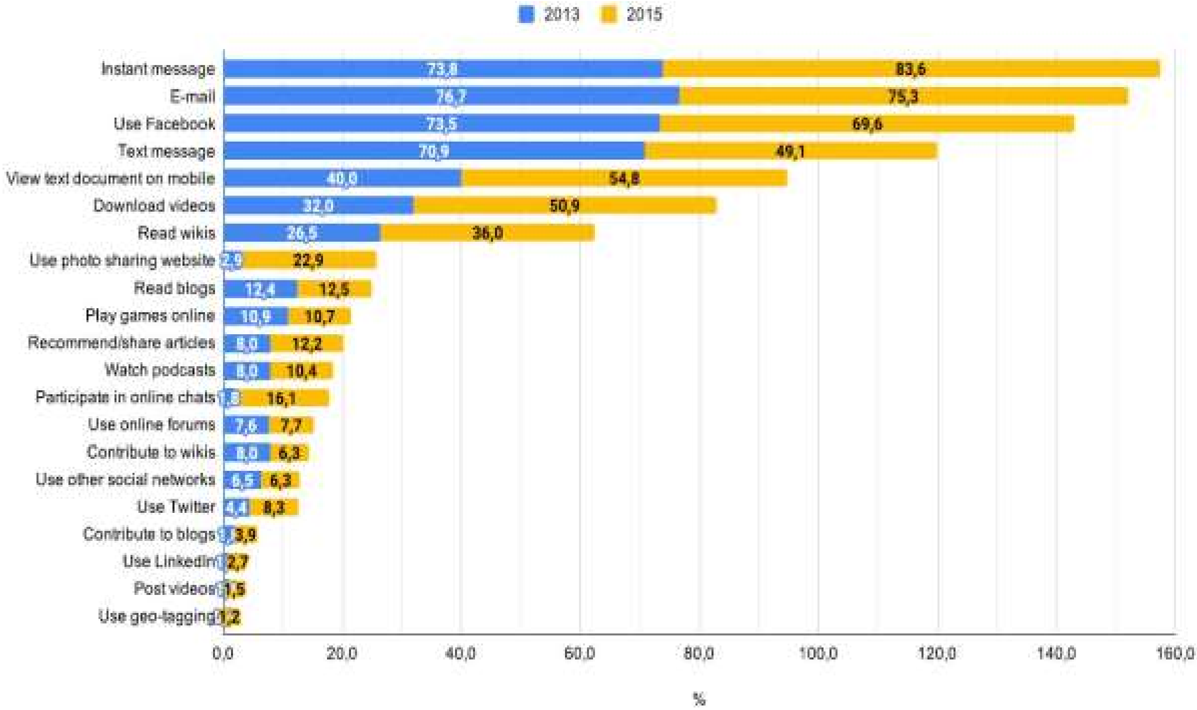

Figure 2: Activities performed online on a daily basis (i.e. *"Several times a day"* and/or *"Once a day"*), surveys 2013 and 2015

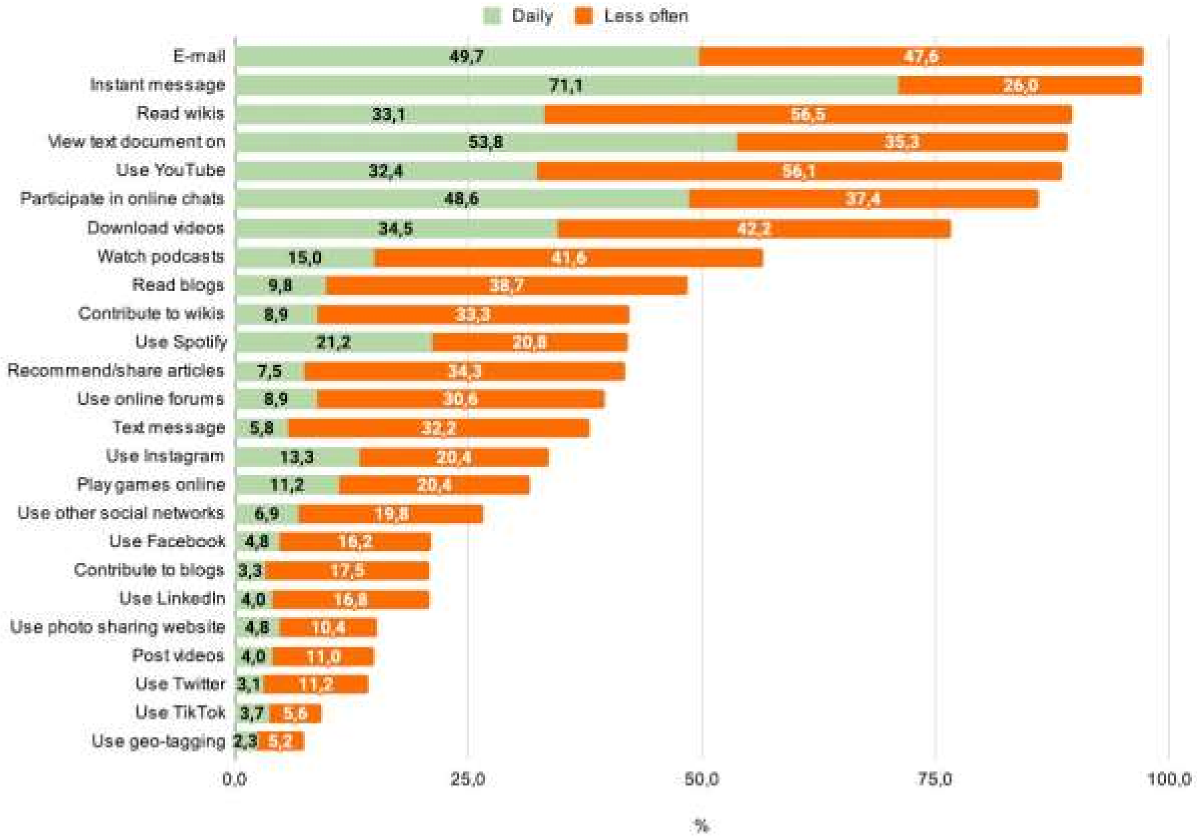

Figure 3: Activities performed online in the last 12 months, for/when studying: daily (i.e. *"Several times a day"* and/or *"Once a day"*) and less often (i.e. *"A few times a week"* and/or *"Less often"*), survey 2020

Regardless of the classification, there is a continuing trend towards the use of social and mobile applications that foster interaction and collaboration and increase students' engagement into the learning process. In combination with a nearly complete penetration of mobile devices, the lectures and also the HEI are responsible for redesigning the presentation and delivery of the course materials, thereby exploiting the potential of informal learning. As other studies show (Gulatee and Combes, 2018; Galenek et al., 2018), it requires explicit tool training involved in the learning processes of both students and lecturers. The move towards informal learning is one of the most important shifts using the advantages of mobile and social digital technologies.

The 2020 study took place in the middle of the COVID-19 pandemic and the second lockdown in Germany. Our university was in its second full online term. This is why it was of special interest to analyse the use of online video conferencing systems, something that was not considered in the previous surveys. The corresponding survey question was posed separately and the related activities analysed independently of other online activities. The data gathered from S3 shows the following: The video conferencing programs that were most used in the classroom are BigBlueButton (65%) and Zoom (30.8%), followed by MS Teams (19.1%) and Adobe Connect (16.3%). An explanation for these numbers may strongly depend on the compliance requirements of our university to use secure tools for teaching and that are integrated into the IT infrastructure of our institution. Figure 4 depicts different communication and interaction activities typical for online learning and teaching during 2020, according to students' responses from the third survey.

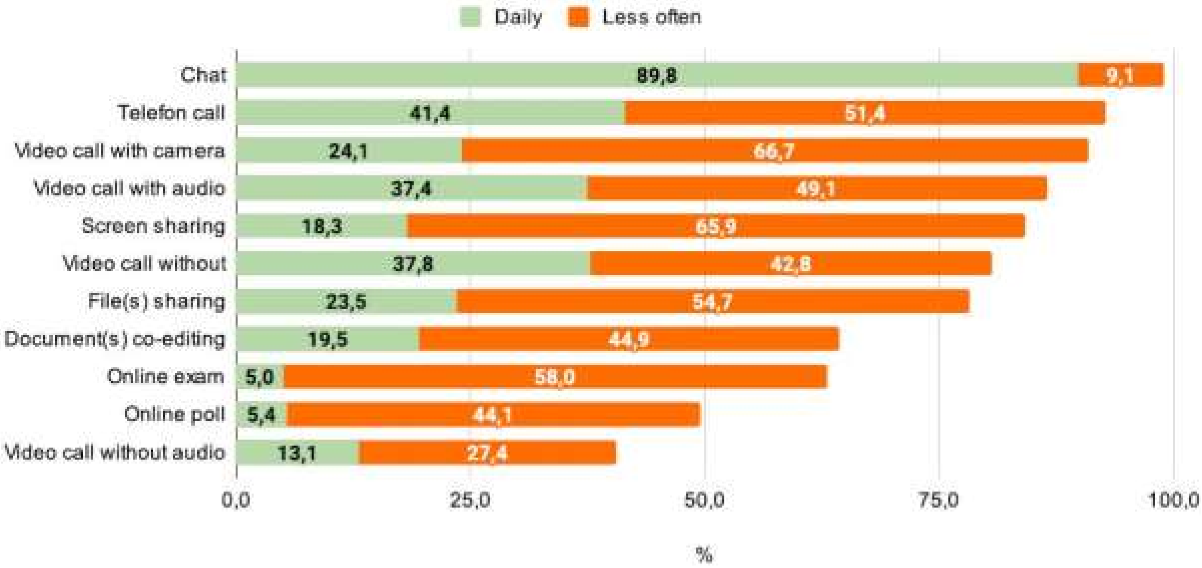

Figure 4: Communicating and interacting online in the last 12 months: daily (i.e. *"Several times a day"* and/or *"Once a day"*) and less often (i.e. *"A few times a week"* and/or *"Less often"*), survey 2020

Students use chat on a daily basis (89.8%), amounting to almost 9 in 10 students making use of this option several times a day (82.3%) or at least once a day (7.5%). In the figure, *without* camera (resp. audio) means, for example, participating in an online lecture but without activating the camera or lacking one (resp. muting the microphone, or unable or not willing to connect one). It is remarkable that only one in five students share their screen or files with others, e.g. for co-editing, these being behaviours that denote an active participation in teamwork or classroom activities. When asked about the reasons why some of those activities were avoided or not performed, some students answered they had no intention to, did not need them, did not know how to use them, or the options available were not appropriate for the actual purpose or learning situation.

4.4 Qualitative analysis of digital technology use

The question arises as to *how* students use digital technologies in such a way that they complement each other and optimally support their own learning process. For this purpose, open questions were asked in all three surveys, e.g. about how digital technologies are used or how learning can be improved. As a more advanced research approach, we started to think about a functional use model based on the ownership of digital technologies, which we evaluated in first interviews.

4.4.1 Open questions within the three surveys

The first guiding question asked for how technology components of teaching can still be improved. In all three questionnaires, it can be seen that the basic infrastructure capacities are demanded first. While in 2013 there were still components on site (such as power connections), in the year of the pandemic there were more demands for higher data bandwidth and special technology components (better network capacities were demanded throughout, but also standards for e.g. microphones for teachers). In 2013, there was a desire for more use of technology to support teaching. This was the case later anyway due to the pandemic, but could be further improved by enriching the teaching materials, such as supplementing slides with spoken information or usage instructions for extensive learning materials.

A second guiding question enquired about the perceived advantages of the technologies used. As expected, new technologies such as cloud services and the possibility of document annotation (e.g. pdf) were also readily used in the first two surveys. The diverse sources of information available through the web, as well as the possibility of structuring and storing these knowledge shares in a simple way, were also seen as an advantage. Later, the time saved in both searching for information and conducting online courses (by saving on travel to the university, for example) was also mentioned by some respondents. The keyword 'efficiency in study life' is found in some answers belonging to this category.

When asked why certain digital technologies were not used, the reasons provided fell into two broad areas: Firstly, respondents were not aware of a particular technology or application due to the lack of a situation in which such technology is used, e.g. having an online exam. Secondly, it was also due to a lack of experience with existing applications, which might be a direct consequence of a deliberate restriction or too little experience with technology in general and thus sometimes an unwillingness to use other alternatives.

In 2020, we also asked what general tips students could give to teachers. A frequent point of criticism was the commitment and abilities of the lecturers when teaching online. Here, the students found significant differences between the lecturers. As far as the future of digital teaching is concerned, one can find very contradictory opinions: while some students see the efficiency already mentioned above in the foreground and enjoy the great potential of saving time, others complain about difficulties to focus, which in their experience occur much less with face-to-face teaching. One participant even commented they had already *"[t]oo much time on a screen per day."*

4.4.2 Interviews on functional use

The qualitative use of digital technologies, although determined by the availability and level of awareness of the technologies, can still vary significantly. An indication of this can be seen in the quantitative observations of software use in the overwhelming predominance of office automation software (see Section 4.3). Here one can assume that the depth of application of the systems is not sufficient.

However, information of this kind of interaction with technology is difficult to elicit through direct questions in surveys. The primary question type in surveys is choice, which must always prescribe a set of answers. High-quality use of equipment and software systems, however, can take place in many different ways. For this reason, in an exploratory setting, we set up an initial interview with the goal to get indicators for how the development of technologies affects the respondents and how the functions offered by the systems are actually used.

Figure 5 summarises the corresponding relationships we see between students and the technologies they may use, which can be both devices and applications.

Students initially know about or maybe own digital technologies as a pre-requisite for using them for learning. Furthermore, they may plan to purchase new technologies that they have heard about and that they expect to add some kind of value to their studies. When using digital technologies, students draw on a range of functions, which are perhaps only the most common ones in certain learning settings. This difference can lead to using a technology or a set of digital technologies only very superficially and, thus, not to their full potential.

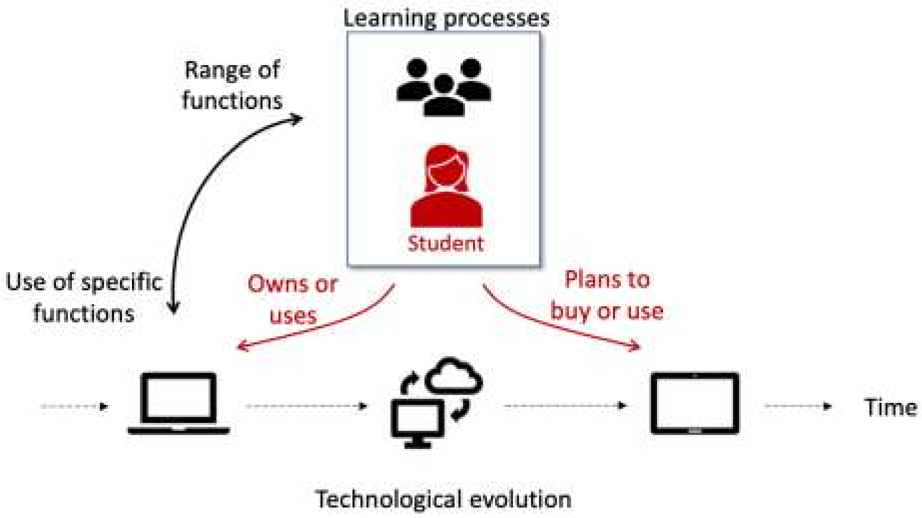

Figure 5: Relationship between students and digital technologies

We drafted four questions in line with the Figure 5 relationships to discuss in interviews:

- 1. From the digital technologies you use or have used for studying, which one has fulfilled your expectations or disappointed you the most?
- 2. What digital technologies explicitly for studying are you planning to purchase in the near future?
- 3. When using a specific technology, were you able to use it extensively according to the range of functions it provided?
- 4. Did the use of different digital technologies influence your learning behaviour?

The answers that were provided indicate that technology is often perceived as positive, as it quickly results in easily manageable use scenarios. As an example, the parallel use of different end devices in online lectures is mentioned in order to be able to follow the lecturer or others better. Monitoring one's own progress is also seen positively. Students do not seem overly concerned to purchase more and higher special technology if their current technology is sufficient for their study needs. The depth of the use of tools is assessed rather critically. The students interviewed are aware that there are probably still many functionalities in the systems they have not yet discovered and are, nevertheless, quite satisfied with the current way of using them.

Further discussion in focus groups is planned and will be reported at a later date.

5. Conclusion

> *"Before covid it was mostly Moodle and the library search that was really updated by the university and also used. With the rise of online courses now i (sic) feel that more professors are forced to use online resources which imo (sic) is a step in the right direction." — 4th year student (2020)*

Our longitudinal study shows very clear trends in favour of online learning supported by devices such as laptops, tablets and smartphones. There are also evident changes in the ownership and use of digital technologies. In addition, the use of digital technologies for studying shows an increasing and more intensive use of various social applications over the years, be it instant messaging, the use of multimedia content platforms or online processing of documents. At the same time essential digital technologies for learning, such as literature management systems, are integrated into everyday learning only to a limited extent. Such a limited use of those technologies, however, may imply only basic knowledge and command of them, this being insufficient in more complex learning situations.

Other possible use scenarios of digital technologies should be investigated more closely in the future, especially concerning the learning design and competencies of teachers. Here, a reference to the concrete learning environment must be established. For teachers and HEIs themselves, this could mean that:

- learning opportunities should be more open and include an intensive use of mobile and social apps,

- young people need to be explicitly trained in the use of specific applications for studying, especially for academic work,
- for the post-pandemic period, HEIs must invest in a high-performance and secure infrastructure with a high bandwidth, and
- teachers themselves need to be empowered to integrate digital technologies into their teaching, as role models to have a positive impact on students' behaviour.

References

Alt, R. (2021). Electronic Markets on the next convergence. *Electron Markets*, 31, pp. 1–9.

Beetham, H., Newman, T. and Knight, S. (2019). *Digital experience insights survey 2018: findings from Australian and New Zealand university students*. Jisc [online]. Available at: http://repository.jisc.ac.uk/7202/1/digital-experience-insights-survey-anz-2018.pdf (Accessed: 10 October 2020).

Blossfeld, P. N. (2019). Soziale Herkunft und langfristige Veränderungen der Übergänge zwischen akademischen und nicht-akademischen Karrieren nach dem ersten Bildungsabschluss: Bedeutung für das berufliche Bildungssystem in Deutschland. *Z Erziehungswiss*, 22, pp 535–565.

Carraro, K. and Trinder, R. (2021). Technology in formal and informal learning environments: Student perspectives. *Global Journal of Foreign Language Teaching*, 11(1), pp. 39–50.

Dahlstrom, E. (2012). *ECAR Study of Undergraduate Students and Information Technology, 2012*. Louisville: EDUCAUSE Centre for Applied Research [online]. Available at: https://library.educause.edu/-/media/files/library/2012/9/ers1208.pdf?la=en&hash=4AB35D01C0B609A289AF775CA54F1465FA67B872 (Accessed: 10 October 2020).

Destatis (2021). *Computer- und Internetnutzung im ersten Quartal des jeweiligen Jahres von Personen ab 10 Jahren.* Statistisches Bundesamt [online]. Available at: https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Einkommen-Konsum-Lebensbedingungen/IT-Nutzung/Tabellen/zeitvergleich-computernutzung-ikt.html%3Bjsessionid=5061AC73E3643A65FD71673ED88CE0CA.live732 (Accessed: 24 May 2021).

Essel, H. B., Nunoo, F. K. N., Tachie-Menson, A. and Amankwa, J. O. (2018). Higher education students' ownership and usage of smart phones and tablets: the case of Kwame Nkrumah University of Science and Technology (KNUST). *International Journal of Educational Technology*, 5(1), pp. 20–28.

Galanek, J. D., Gierdowski, D. C. and Brooks, D. C. (2018). *ECAR Study of Undergraduate Students and Information Technology, 2018*. Research report. Louisville, CO: ECAR.

Gulatee, Y. and Combes, B. (2018). Owning ICT: Student use and ownership of technology. *Walailak Journal of Science and Technology (WJST)*, *15*(1), pp. 81–94.

Jalal, A. and Mahmood, M. (2019). Students' behavior mining in e-learning environment using cognitive processes with information technologies. *Educ Inf Technol*, 24, pp. 2797–2821.

Jefferies, A., Monett, D. and Kornbrot, D. (2016). Digital Learners in Higher Education: Exploring Technology Ownership Patterns and Learning Engagement. In J. Novotna and A. Jancarik (eds.), *Proceedings of the 15th European Conference on eLearning, ECEL 2016*. Reading, UK: ACPI, pp. 315–322.

Kay, R. and Lauricella, S. (2011). Exploring the benefits and challenges of using laptop computers in higher education classrooms: A formative analysis. *Canadian Journal of Learning and Technology/La revue canadienne de l'apprentissage et de la technologie*, *37*(1).

Killen, C. and Langer-Crame, M. (2020). *Learner digital experience insights survey 2020: UK further education (FE) survey findings*. Jisc [online]. Available at: https://www.jisc.ac.uk/sites/default/files/student-dei-fe-report-2020.pdf (Accessed: 10 October 2020).

Lemke, C. and Brenner, W. (2015). *Einführung in die Wirtschaftsinformatik, Band 1: Verstehen des digitalen Zeitalters*. Berlin ,Heidelberg: Springer.

Marinoni, G., van't Land, H. and Jensen, T. (2020). *The impact of COVID-19 on Higher Education around the world, IAU Global Survey Report*. IAU [online]. Available at: https://www.iau-aiu.net/Covid-19-Higher-Education-challenges-and-responses (Accessed: 24 May 2021).

Palfrey, J. and Gasser, U. (2010). *Born digital: Understanding the first generation of digital natives*. New York: Basic Books.

Romero-Rodríguez, J. M., Aznar-Díaz, I., Hinojo-Lucena, F. J. and Gómez-García, G. (2020). Mobile learning in higher education: Structural equation model for good teaching practices. *IEEE Access*, *8*, pp. 91761–91769.

Sailer, M., Schultz-Pernice, F. and Fischer, F. (2021). Contextual facilitators for learning activities involving technology in higher education: The C♭-model, *Computers in Human Behavior*, 121(106794), pp. 2–13.

TU9 (2020). *TU9-Positionspapier: Digitalpakt für die Lehre*. TU9 [online]. Available at: https://www.tu9.de/media/download/tu9_pp_digitalpakt_fuer_die_lehre_07-2020_de.pdf (Accessed: 24 May 2021).

Viberg, O., Andersson, A. and Wiklund, M. (2021). Designing for sustainable mobile learning – re-evaluating the concepts "formal" and "informal." *Interactive Learning Environments*, 29(1), pp. 130–141.

Wankel, L. A. and Blessinger, P. (2013). *Increasing Student Engagement and Retention using Mobile Applications: Smartphones, Sykpe and Texting Technologies. Cutting-Edge Technologies in Higher Education*. Bingley: Emerald.

Improved Students' Intake and Better Conceptualization in a Flipped Classroom on-line

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Abstract: In this article I present parameters around 'babbling up' to improve learning in breakout rooms and assignment completion in a flipped classroom. Group discussions and activities were intended to instill interest and engagement and create communities of practice. As well, as we are mandated at university to cater to students in an EDII (equity, diversity, inclusion and indigenization) approach without yet any clear direction as to how to proceed, we devised group work for well-being and an evaluation scheme using follow-through, i.e. constant support during students' completion of assignments. The study is empirical as it is based on an instructor's journal notes. It is of a qualitative nature, as it is the best approach to uncover detailed information (Creswell & Poth, 2018) based on an analysis of instructional and observational notes. First we proceeded by trial and error; however overall results were positive showing that a number of factors contributed to success. Whereas, activity completion in breakout rooms showed the need for more structure and more stringent timelines as well as creativity, the 'babbling-up' of conversations had a positive effect on well-being. Final assignments showed that all students obtained high grades. Nevertheless, some students were not well organized and only completed their work at the last minute, proceeding more slowly than expected, due perhaps to cultural differences, subject background, individual needs, or just taking advantage of the positive climate created. Therefore, the conditions and structure of assignments was changed. Results show that a gaming aspect attached to work caused more engagement, for instance having groups prepare quiz questions for others. To enhance interest, instead of just assigning materials and providing links, it worked to encourage students to find other readings on assigned topics for them to explore, perhaps more suited to their individual styles and the instructor would follow-up in class, also checking contents of student proposed readings and provide corrective feed-back. Successful applications useful in any on-line teaching are presented, based on relevant research in the field and findings from analyzing observational notes. Corrective measures taken are noted with their positive results.

Keywords: on-line learning, interactions in the flipped classroom, designing activities for improvement, intake, concepts

1. Introduction

With suddenly mandated on-line teaching, instructors are especially looking for ways to improve on-line communication. In multicultural contexts like in Canada the inability to actually be in physical contact pauses additional difficulties on-line. Problematic issues point to the need for further awareness-raising in interactions intended to enhance learning.

The problem centers around bringing students in teacher training directly into capacity building as these young people often come somewhat unprepared or unaware of what it entails to get organized to carry through a project like a detailed lesson plan or a larger unit plan. Without face to face contact this has been increasingly challenging as many aspire at being fast-tracked through their professional program after having already spent five or six years at university.

The most important aspects concern developing reflexivity and critical thinking in the students in French, not their mother tongue, to become French specialists.

Myers (2004) suggests taking into account socio-pragmatic and pragma-linguistic aspects in intercultural trans-linguistic language use. The idea to improve communication through a socio-semiotic approach (Halliday, 1985) also has a lot of merit, however the challenge is to make working groups meeting on-line only, into well-functioning interactional communities.

For successful exchanges, a variety of factors based on the respect and awareness of persons' developmental needs, including linguistic, academic, cognitive, emotional, social and physical require consideration in the negotiation of persons' socio-cultural identities (Duff & Uchida, 1997). This is in-line with the new equity, diversity, inclusion and indigenization (EDII) policy put in place at the university. Taking into account these factors and making provision for a natural learning environment does bear fruit according to these researchers. Presenting students with real world problem-solving, having them work together, making available media-rich communication and workplace learning using videos, computer applications, and thematic problem solving challenges was totally feasible in on-line teaching within a flipped pedagogy approach. As far as completion of assignments was concerned students were also given time to work in groups.

In course development we had to keep in mind to work on 'story' development as courses unfolded for the targeted audience and also develop awareness of the ways of gatekeepers in textbook publishing companies. Instructors have to maintain a sense of control over the learning environments they create and ensure that these remain powerful, otherwise only meanings attached to practical experiences will constitute the backbone of what these students think and believe. In fact, courses should have a strong impact on students' cognition and actions in order to prepare them for the unforeseeable future. While interacting, people influence each other with an effect on future actions and on-going interactions. In group work instructors need to develop a certain combination of skills, expertise and commitment for students to be successful. They will need to be able to recognize the patterns in their field of practice (Barton & Tusting, 2005). Top-down instruction is not sufficient, students also have to engage in reflexivity from the bottom-up. Hence in addition to discussions, students also needed to complete practical assignments. According to Luhmann, 1995, p.136) to grasp a lot of complexity a system makes a selection and the process requires a reduction of complexity. Keeping these notions in mind, it was important to design learning units to get and hold students' interest and encourage them to take advantage of the richness of their backgrounds to help them bridge new knowledge for the duration of the course (Renninger & Hidi 2016). In the process of sorting through all the complexity however, students had to make appropriate selections. With on-line teaching only and never have met the students face-to-face, this added difficulties for the instructor.

2. The problem

One would expect that making services and communication possibilities available to students through sharing work in groups would enhance interactions and outcome, therefore having a positive impact on their productivity. However, research on on-line teaching suggests added communication problems, shallowness in interactions, lack of engagement, in addition to technological difficulties (Kebritchi, Lipschuetz & Santiague, 2017).

Working in groups on-line with only access through breakout rooms in zoom is also fraught with difficulties. We know that in communication, the dynamics and change in relationships are invariable power relations and reflect the multiple ways authority, moral regulations and traditions come to the forefront through language use (Morgan, 1997). Clark (1992), and O'Donnell and Todd (2003) suggest that in addition to academic language, students should be able to include the idiosyncratic choices they make in their language use. As the courses are intended for students to obtain their professional qualifications as language teachers, the use of the French language is required in class. However, Thomas and Collier (2012) also found that allowing code-switching and code-mixing helped with understanding and negotiation of meaning. Therefore, sometimes, the instructor felt like been caught between a hard place and a rock, as the students needed to be given a fair margin of freedom in handling class discussions and the completion of assignments despite a problematic level of mastery of French for some. Recently researchers have used the term 'babbling-up' to indicate a socially positive way for communication with people coming together in interactions on-line. However, it is doubtful that this helped student's intake of the topics under scrutiny, improved their conceptualization of theoretical tenets or enhanced their understanding of applications in practice.

Renninger and Hidi (2016) suggest that catering to the different types of interests students have, will generate more motivation and engagement. The various ways of looking at interest include different amounts of cognition and affect going from a motivational belief that is in essence a cognitive conceptualization to what corresponds to a regular feeling of positive emotion.

3. Method

3.1 Background

In the flipped classroom approach, students are to prepare materials ahead of class time, while during class they engage in discussions and activities. Hence, all relevant links were included in the syllabus given at the beginning of class when the course syllabus was handed out, listing the topics for each class. Students were to prepare these assigned materials and take notes to bring to their in-class group discussions, also with the idea that it would help with practical applications to be completed as further reinforcement for the concepts and topics are explored.

Helmholtz (1910) suggested that perceptual, cognitive and motor activities were coming together when we concentrate on something while we make inferences around what we think are relevant invisible facets. We also develop a predictive ability (Biederman, 1987; Lowe, 1990). Hence, the directions initially given to students to prepare contents for class discussions, including preparing each three questions on the contents, three things they liked and propose a new idea, or a new development, fitted nicely within these research tenets, and also giving students ways to explore contents along their own ways of being and doing, was in line with an EDII strategy.

In multicultural contexts, many different features have to be taken into our conceptualization, providing added richness. Moreover, today, in the context of linguistic change and 'glocalization' i.e. recognition of the local in the global, new insights can be gained from adjustments in multi-cultural contexts, with newcomers at different stages of integration. Therefore, the stage seemed to have been set for rich discussions to take place and deep learning to occur with improved students' intake and better conceptualization.

3.2 Method

The research method used was qualitative in nature as this approach is best to capture detailed information, which was what we looked for in order to uncover how to improve upon course delivery (Creswell, & Poth, 2018). It involved an analysis of an instructor's teaching journal notes spanning from August to December 2020 based on class preparations and entries on observations.

The notes were covering three on-line university courses in teacher training with approximately 25 students in each of two courses and 14 in another one. All students were not always present so group participation sometimes had to be adjusted. Usually students were placed in groups of four or five.

As mentioned above, flipped pedagogy was used and students were directed to ample numbers of links to a variety of materials to prepare class topics ahead of time, while during class time work was done on consolidation and practical applications. Categories and themes were identified after an initial reading of the instructor's notes and then regrouped in each case as pertaining to class discussions and assignments to be handed in.

The theoretical framework for analyzing and interpreting the data came for both class participation and assignments from Bransford, Brown and Cocking's (2000) assertion that "to develop competence in an area of inquiry, students must: a) have a deep foundation of factual knowledge, b) understand facts and ideas in the context of a conceptual framework, and c) organize knowledge in ways that facilitate retrieval and application" (p. 16).

We selected categories based on meaning. This corresponded to the process of reproduction from elements previously filtered from an over-complex environment (Maturana, & Varela, 1980).

3.3 Theoretical frameworks

We looked at systems' analysis. Luhmann (1995) uses "throughput to look at subsystems" (p.201). The two processes used in interaction are generally input and output, however in the process of adapting to avoid problems, subsystems come into play through what the researcher calls 'throughput'. The suggestion that there are different types of communication between different systems, further helps us acknowledge the added richness brought about with the EDII policy. Luhmann's position allows for holistic considerations. Steps involved entail selection, closing and reopening of probabilities as well as opening new ones.

More recently Vermeer (2006) reconfigured Luhmann's social systems for applications directed more specifically to language use, showing for instance the importance of differentiating between different phenomena, because they have different effects and consequences in the real world.

Voinov (2008) also suggests to look at hierarchies in systems, presenting them as interacting subsystems. He claims that hierarchies are subjective and serve particular purposes of an analysis. He suggests to first identify elements in one system and figure out how they are connected and next to describe the types of interactions as this helps to better understand and explain how systems work.

The researcher read the instructor journal for a first time, highlighting different emerging themes with different colors. Initially we had 'searching for common ground', 'alignment', and 'difference'. Through a second reading subcategories were identified and named under the umbrella of a major heading, in a sort of cross-sectional way, this helped with aspects of the discussion evolving around improvements, namely improved intake and improved conceptualization. Six regroupings were identified namely under understanding, orientation, adaptation, recognizing differences, selectivity and connectivity, and preparedness.

4. Results

4.1 Themes

Through the analysis of the instructor's teaching journal notes and also taking into consideration student assignment outcomes, we identified a number of interesting themes that we briefly list below as they also provide insight into the two major categories we discuss further on, namely improved students' intake and aspects related to a deeper anchoring of concepts.

4.1.1 Achieving understanding

We identified how through group interactions, transactions took place, allowing transitioning across various questions and assignments as students came to understanding involving their different social systems despite only through on-line access to one another. These students did not start on 'common ground' (Olson, 1995), however it appears that through articulating diverse factors, they were in a sense finding common ground across the materials prepared for class, from a polarizing mind-set to a productive discussion (Nostrand, 1988). In the context of EDII, multifarious skills and ways of being come into play and this constituted a great richness. Some unusual new ideas were brought forth, adding crucial information for education. These sometimes emerged from conversations "babbling up " .

4.1.2 Orientation

Across group participants, given the specific topics under scrutiny, there was communication based on what they had in common in terms of knowledge background in the subject area. There was a range of assumed similarities discovered when they observed and interpreted their peers' behaviors in order to establish communication. Nevertheless, there were also different paths that had to be aligned. According to Siegrist (1970a, 1970b) knowledge and cultural aspects allow for reflexive co-orientation. Sufficient similarity in their background knowledge allowed discussions based on assumed similar parameters.

4.1.3 Adaptation

As suggested by Luhmann (1995) when he expanded on applications of system's theory and complexity theory, we plan to establish ways to prevent communication failure in transitioning situations. This was observed among students and is in line with theoretical tenets on unavoidable reciprocal adaptations of organisms to each other. This was even more obvious as students worked in groups for class discussions of pre-assigned materials for study and also for group assignments.

4.1.4 Recognition of differences

One major concern the instructor had was around whether or not to make all the work into group work. In the end students were always given an opportunity to work on their own for their assignment if they preferred. Since creating a positive social context was more difficult in on-line meetings, and since students work better when supported by a community of practice (Barton, & Tusting, 2005) it made sense to encourage group activity. The "babbling up' in conversations was essential in supporting well-being through the lightness in such exchanges. Cooperative and collaborative work was also required in professional practice.

4.1.5 Selectivity and connectivity

As a result of group work it became obvious that different groups shared common elements, yet they re-created parameters in their different social environments. This is in line with Luhmann's belief that different systems can share the same elements and in turn these can become common to more than one system but in addition they can also acquire a different selectivity and connectivity (p. 215).

4.1.6 Preparedness to ease adaptation

In the new on-line teaching environment one is faced with students' adaptability. While taking charge of their situations, groups used strategies and skill sets. Often group members reiterated the objective to be met, summarizing the different elements to be taken into account, negotiating among themselves to ensure everyone was ready to embark on the tasks at hand. Sometimes this was not done very efficiently but it left nothing to wonder about, it constituted a gain of time further along the process. With an increase in difficulty, this initial preparedness allowed for more effective group functioning. Especially in a context where well-being is at the core, it gave the students the sense that they were in control of future developments. It could however be advisable to look into various ways to prepare the students to adapt, especially when the pace of change increases fast and tasks become more demanding throughout the semester.

4.2 Discussion

As topic preparation was assigned, with required homework being formulating three questions, three things they liked, plus listing one novel idea, the instructor assumed that all students prepared the material. Then in class the students shared their lists and narrowed them down to just one list. In doing so they had to confront one another's views on assumptions, possible misinterpretations and biases. They could neither ignore difficult questions nor the stress when confronted by hermeneutical conversations based on new notions and vocabulary from the professional field.

4.2.1 Improved intake

Improved intake was evidenced through the richness of in-class participation and also in handed-in assignments that were of superior caliber although some issues were also identified.

There is no doubt that the interactive ways of developing awareness and contact with peers helped students understand the richness different backgrounds within EDII brought about among them.

Together they sorted out what was required, looking for feasibility, in most cases anyway. From the start the students engaged positively and brought additional issues for whole class discussion after leaving the breakout rooms. The reinforcement provided by reviewing ideas during class discussions showed improved intake through the output of most students. Some students were hindered with bad access to technological means or were not close enough to good connections. Others lacked adequate background preparation and did not grasp the contents to be prepared with as much depth as necessary whether this was due to insufficient levels of French or inadequate time put into preparing. Altogether however given some repetitiveness in the process, students all managed to grasp the targeted concepts over time as evidenced in written assignments.

During discussions it appeared that some students had also accessed different links on the topics assigned for preparation, which was a welcomed spin-off. Based upon this fact and to also enable students who experienced more difficulties with the level of readings in the links assigned, the instructor recommended for students to further explore the specific topics to access materials that were more comprehensible to them i.e. more in line with their ability in order to better understand the way concepts were expressed or perhaps find an easier text in French or in addition English versions of texts on the prescribed topic. This decision proved to be beneficial and also encouraged more students to engage in research and as a corollary some of the students spent more time investigating the topics to be explored and in class were happy and proud to share additionally insightful links with their peers.

It appeared that participation was not even in all groups and therefore level of intake varied although they had to take turns to each present their lists and engage in discussion together to establish their final list to be presented to the whole class. Howell (1985) uncovered that there often is interference in problem solving by internal monologue, what Howell believes to be an irrelevant train of thought. So where dissonance was identified it had to be confronted and this in general worked very well as groups came together and evolved over time.

To reinforce intake for some students, when contents became more difficult, it would be advisable to also devise work in pairs. Establishing more one-on-one exchanges would make students responsible to one peer so preparation was necessary and this would be more comfortable for students who prefer working this way. Other groupings also spontaneously happened in fact, when there were some students absent and the students who were present selected partners from other groups. At one time a students requested to work with students she knew from previous years and the reason given was that they were used to working together. In fact, it is hard for an instructor to really get to see individual work habits during on-line teaching as breakout rooms can only be accessed one at a time.

In the contexts as presented, students were learning contents. The group interaction strategies encouraged self-reflection, listening to understand, developed empathy and perspective taking. Whenever the instructor entered a breakout room students were actively exchanging ideas, sometimes expanding beyond the contents to a more social level, bringing in their own experiences. This fact too is indicative of improved intake even though it was less theoretical in nature. This showed 'babbling up' to a point but overall students connected the information to their lives.

For students who were more reluctant to express their thinking in detail there is another possible explanation. The added difficulty could come from the fact that one does not know how non-verbal aspects impact student. Condon and Yousef (1975) think that we cannot assume that reality can be apprehended and expressed in words and more so with the added difficulty of on-line only contacts as sometimes mental activity does not find a way out of our minds (Burk & Lukens, 1979). We had to ensure that interference with learning was minimized and therefore for all assignments we proceeded with demonstrations and also provided detailed models for guidance.

Some student groups spontaneously exchanged contact information among them and even organized connections through networks. So we mentioned this to all students and encouraged them to interact on their own time to further work together on assignments using their preferred media platform, thus providing technological facilitation and more opportunities for socializing to ensure maintaining a positive climate for improved learning.

One problem with in-class discussion was the fact that the students got bored with the routine although contents and questions varied. Therefore, we implemented change, turning to more of a gaming approach.

As regards the questions they had to prepare for class discussion, these were turned into the preparation of quiz questions in order to set up class discussions with teams asking one another a series of questions. This was well received and deepened their enquiries. As well each group asking questions also had to have the answers and explain these when other groups could not provide them.

When the topic to be prepared lead itself to it, we asked groups to prepare an activity center for the other groups, leading their peer groups through a ten minutes' activity, intended to have them re-use contents from the prepared materials in a fun activity or solving a problem.

For another variation, when the topic for discussion was rather controversial we resorted to the four corners activity, having groups come to a consensus as to which corner they would agree in joining, and on-line that corresponded to positioning their argumentation to, namely, totally agreeing with the concepts under scrutiny, agreeing somewhat, somewhat disagreeing or disagreeing.

For further variety we also devised a treasure hunt on-line with all groups really interacting at a much faster pace in order to get to the results more quickly. This was very interesting as we only did this once, but it would appear that a certain competitive edge might be effective in having some students prepare materials at home for better in-class outcomes.

Various activities were carried out efficiently and effectively, although there was a tendency to prefer fun activities over serious ones. The creation of activities for other groups by the students instead of the instructor proved to be mostly successful as well as releasing the instructor from having had to prepare everything.

The variety in design created more enthusiasm, more interest and motivation for more engagement and at the same time students' intake of content improved, if only through the reinforcement of contents when reactivated in class after having been prepared at home.

In the situation described above, the different new implementations were rather spontaneous, it would be best to plan these various designs before the courses start in order to best match activity with topic to be studied.

4.2.2 Improved conceptualization

Instructor's notes point to increased depth of conceptual understanding for most students while there were problematic aspects uncovered when accurate professional jargon was not used in French by some of the students, although at times, when reverting to English there appeared to be a more spontaneous juggling with educational terms. This fact has been acknowledged in other research, where it appears more depth should be required in second language use. Swain (1993) blames it on the lack of expectations in students' output and she advocates for 'modified output' at a slightly more advanced level than the current knowledge level. White (1987) also advises to place more difficult demands on students' output in order to improve their conceptualization. It is crucial to find the right level of difficulty so as not to discourage students. One concern the instructor often had was over the depth of understanding of the concepts explored. It appeared that some students did not use the professional jargon in spontaneous ways or used wrong expressions. The instructor always provided corrective feedback throughout the process of assignment completion.

During activity centers, one group had devised a definitions game, an idea that would prove useful to revisit concepts and verify if they were anchored appropriately. However, the other groups did not like this activity center as much as the less serious ones. In order to enhance the crystallization in mind of the concepts we want students to acquire, it would perhaps be helpful having an activity center day with all groups' devising an activity around definitions in various ways, using charades or mimes or the hangman spelling game. As well, if announced in the planning, as all groups would know they had to concentrate on reviewing definitions, this might prove successful.

Overall, students' work appeared to show that in assignments, students integrated the notions being taught, although not necessarily using the new professional jargon, as the applications showed that they were in line with the tenets of the underlying theories and approaches. Most assignments were group assignments and therefore most of the problem solving happened at group levels and it was difficult to assess individual results except in follow-up individual assignments.

Students were given models for each assignment and the strategy in letting students see examples worked well, however it was not without problems. The few students who had difficulties were identified through their individual assignment lacking in precision, and although handed-in on-time had not been thoroughly completed. They were however given more time and help was provided.

It is clear that different persons work at a different pace, prioritize different things and hence it makes sense to allow for variability.

The final assignment proved especially useful in assessing increased depth of conceptualization as practical applications had to be implemented based on the concepts presented in class.

However, it should be noted that most of all, a fair amount of mediation went on as regards creating scaffolds as part of students' final culminating assignment, the creation of a module. They were to prepare three grids: one containing an initial detailed assignment description, one grid consisting of a verification list, to allow learners to check their throughput on the assignment before handing it in and the third grid was the configuration of the distribution of points for each completed step and enclosed sub-steps in order to enable the students to figure out themselves what they might need to concentrate on further if they wished to gain more points.

In retrospect such an approach with three grids around a mastery of concepts could be used as a tool throughout the course and handed out to students along with the initial course outline.

Luhmann (1995, p.136) points out that to grasp a lot of complexity a system makes a selection and the process requires a reduction of complexity and it is necessary to find the objective reality of a person. It was rather important to uncover the salience of certain objects and values for certain group members and their cultural functioning. It obviously took some students longer to make such choices especially for those who were new in the professional training program.

5. Conclusion

The interactions in breakout rooms greatly contributed to student success. As the students were not constantly monitored as they would have been during face-to-face teaching there were more options available to them as regards freedom of choice. It appeared that they were able to identify their needs, get organized, either because their group leader took charge or through companionable understanding.

To better ensure student success through intake and a deeper grasp of concepts, accepting a variety in student products is key. As well, adopting a supportive grading approach and allowing for different pathways in the work students brought to fruition, allowed students to find their own way to master contents, although at different levels of depth. This is in-line with understanding learning as the anchoring of concepts varies among learners and cyclical reviews may be required.

Additional changes could have brought about better results if more pair work had been built-in, as to make students more responsible for the preparation of materials when having to interact with only a peer and not being able to hide in a larger group.

Although students' thinking about their own learning was not always an inherent part of conversation, the use of higher cognitive functions associated with class activities, accompanied by ongoing peer and instructor interactions supporting them, can readily lead to the metacognition associated with deep learning.

References

Barton, D. and Tusting, K. (Eds.) (2005) *Beyond communities of practice. Language, power and social context,* Cambridge University Press, Cambridge.

Biederman, I. (1987) "Recognition-by-components: a theory of human image understanding", *Psychological Review,* vol 94, no 2, pp 115-147.

Bransford, J.D., Brown, A.L. and Cocking, R.R. (2000) *How people learn: Brain, mind, experience, and school*, National Acadamy Press, Washington, D.C.

Burk, J.L. and Lukens J.G. (1979) (Ed.) *Handbook of Intercultural communication*, Sage Publications, Beverley Hills, California.

Clark, H.H. (1992) *Arenas of language use*, University of Chicago Press, Chicago, Illinois.

Condon, J.G. and Yousef, F.S. (1975) *An introduction to communication*, Bobbs-Merrill, Indianapolis.

Creswell, J. and Poth, C. (2018) *Qualitative inquiry and research design* (4th ed.), Sage Publications, Thousand Oaks, California.

Duff, P.A. and Uchida Y. (1997) The negotiation of teachers' sociocultural identities and practices in post-secondary EFL classrooms, *TESOL Quarterly,* vol 31, no 3, pp 451-486.

Halliday, M.A.K. (1985*) Spoken and written language*, Deakin University, Geelong.

Helmholtz, H. von and Southhall, J.P.C. (1910) *Treatise on physiological optics,* vol 3, Dover, New York.

Howell, K.W. (1985) "A task-based analytical approach to social behavior", *Remedial and Social Education*, vol 6, no 2, pp 24-30.

Kebritchi, M., Lipschuetz, A. and Santiague, L. (2017*) Issues and Challenges for Teaching Successful Online Courses in Higher Education: A literature review,* Retrieved My 11, 2021 from https://doi.org/10.1177/0047239516661713

Lowe, D.G. (1990) "Probability theory as an alternative to complexity", *Behavioral and Brain Sciences*, vol 13, pp 423-469.

Luhmann, N. (1995) *Social systems*, Stanford University Press, Stanford, California.

Maturana, H. and Varela, F. (1980) *Autopoiesis: the organization of the living*. Reidel, Dordrecht, Holland.

Morgan, G. (1997) *Images of organization* (2nd ed.), Sage, Newbury Park, California.

Myers, M. J. (2004*) Modalités d'apprentissage d'une langue seconde*, DeBoeck Duculot, Bruxelles, Paris.

Nostrand, H.L. (1988) Culture in language teaching: the next phase, *ADFL Bulletin*, vol 20, no 1, pp 29-34. O'Donnell, W.R. and Todd, L. (2013) *Variety in contemporary English*, Routledge, London and New-York.

Olson, D. (1995) *Psychological theory and educational reform*, Cambridge University Press, Cambridge, UK. Renninger, K.A., and Hidi, S.E. (2016) *The power of interest for motivation and engagement*, Routledge, New York and London.

Siegrist, J. (1970a) "Zur reflexiven Ko-Orientierung von Kommunikationspartnern", *Linguistica Pragensia*, vol 8-9, p.12.
Siegrist, J. (1970b) "Das Consensus-Modell. Studien zur Interaktionstheorie und zur kognitiven Sozialisation", *Linguistica Pragensia*, vol 8-9, p.19.
Swain, M. (1993) "The output hypothesis: just speaking and writing aren't enough", *Canadian Modern Language Review,* vol 50, no 1, pp 158-164.
Thomas, W.P. and Collier, V. (2012) *Dual language education for a transformed world,* Fuente Press, Albuquerque, New Mexico.
Vermeer, H.J. (2006*) Luhmann's "Social systems" theory,* Frank & Timme, Berlin.
Voinov, A. (2008) *Systems science and modeling for ecological economies,* Elsevier, Amsterdam.
White, L. (1987) "Markedness and second language acquisition-the question of transfer", *Studies in Second Language Acquisition,* vol 9*,* pp 261-286.

The Development of Critical Thinking Disposition During two Online Styles of Learning

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DOI: 10.34190/EEL.21.046

Abstract: The critical thinking ability learning process of two styles of learning was analysed. The difference in progress between conventional blended learning and fully online courses was discussed. The purpose of the course was to develop the critical thinking disposition (CTD) of freshman during 15 weeks of bachelor level classes. The number of valid participants for the blended course was 229, and for the fully online course the number was 162. The effectiveness of some factors of individual characteristics such as personality, cognitive style and literacy of science and technology (LST) on learning CTD skills was considered. Since LST factors may influence learning, cluster analysis using four factor scores was performed, and four clusters were extracted. In the results of a comparison of the participant's characteristics in the four clusters, final scores for CTD depended on the cluster, and personality and information processing style may have also contributed to the development of CTD. Though the CTD development process was studied by evaluating personality and LST, the contribution of the style of learning was limited to the relationship between reviews of peer's essays and overall assessment scores.

Keywords: fully online learning, blended learning, critical thinking, student's characteristics

1. Introduction

The possibility of developing the critical thinking disposition (CTD) of university students of a formal class in a bachelor level blended learning course has been studied (Nakayama et al., 2019, 2018, 2020). As learning activity is affected by various individual factors, the contribution of a participant's characteristics, such as personality factors, cognitive style and literacy of science and technology (LST) has also been considered (Nakayama et al., 2020). In particular, participant's scores in personality evaluations and for LST affect the degree of improvement of CTD scores.

Originally, the goal of the course "Psychology of Natural Disaster Mitigation and Prevention", which is taught to freshman in a bachelor level course, is understanding ways of thinking critically through learning about human cognitive behaviour. The learning concept includes thinking skills such as "key competence" (Rychen and Salganik, 2003). In discussions about the development of ways of thinking, the contribution of LST is often emphasised. As student's attitudes toward understanding overall issues concerning Science and Technology were measured, four clusters of attitudes were proposed to measure the development of literacy of science and technology (Kawamoto et al. 2013)

In order to introduce more proactive learning opportunities for students to develop ways of thinking through discussions (Kusumi and Tanaka, 2008, Ekahitanond, 2013, Trehan et al 2017), online discussion settings have been made available to participants. Though most participants hesitated to join online discussions, some students exhibited a little willingness to discuss issues of interest. In previous surveys, the effectiveness of development of CTD in a blended learning environment was confirmed over several years of analysis.

In the spring of 2020, all face-to-face and blended learning courses were suddenly changed into fully online courses due to the pandemic. As a result, most courses were conducted without sufficient preparation, and the necessity of teaching all courses using fully online classes was examined.

Our interest, however, is whether participant's learning behaviour and learning effectiveness in a fully online course is comparable with that of a conventional blended learning course. In particular, the interaction of learning styles and student's individual characteristics should be examined. Also, the contribution of LST to CTDs of both types of learning should be confirmed. As mentioned above, four clusters of LST were presented, and the effect of the clusters on learning performance is interesting.

Some common assessment indices of learning activity used in the two types of courses can be compared. The following topics will be addressed in this paper.

- 1 The development of CTD in blended and fully online courses is confirmed.
- 2. The effectiveness of clusters of LST during the two courses is examined.
- 3. The difference in causal relationships of CTD scores due to individual characteristics is examined.

2. Method

The development of CTD was observed during a regularly scheduled course at a Japanese university (Nakayama et al., 2019, 2020).

2.1 Learning settings

The course was entitled The Psychology of Natural Disaster Mitigation and Prevention, and consisted of 15 sessions. Learning performance of participants was evaluated using several activities, such as weekly confirmation tests and report assignments.

The course was conducted using the formats of both a fully online course and a blended learning course. The details are as follows.

- (1) Blended learning

The course was organised as a face-to-face class, and participants could join the online discussions using an online discussion board equipped with a Moodle-based LMS. Most participants were familiar with the learning environment since LMSs had been employed in their other courses.

The valid number of participants was 229.

- (2) Fully online learning

The method of teaching the course switched to a fully online style suddenly in 2020. The lecturer recorded videos of his lectures in advance, and these videos were presented using the LMS. Therefore, all participants had to join the online course as off-campus students, and there was no face-to-face instruction. All course activities such as submission assignments, online tests and follow-up surveys were conducted using an online format.

The valid number of participants was 162.

2.2 Survey metrics

The following inventories were surveyed regularly during the course in order to discover the characteristics of participants. Most metrics were measured continuously, as in previous studies (Nakayama et al. 2018, 2019, 2020).

2.2.1 Personality (Big5)

Scores of participant's personalities were measured using a shortened version of the Big5 inventories, which consists of 10 question items (Kawamoto et al. 2015). The factors which were extracted were Extroversion (P1), Conscientiousness (P2), Neuroticism (P3), Openness (P4), and Agreeableness (P5). The factor scores of the Big5 use 7-point scales (1-7).

2.2.2 Critical thinking disposition (CTD)

Hirayama and Kusumi (2004) developed a Japanese inventory of behaviour exhibited during development of critical thinking. Four factors from the inventory were extracted: Awareness of logical thinking (CTD-1), Inquiry-minded (Inquisitiveness) (CTD-2), Objectiveness (Objectivity) (CTD-3), and Evidence-based judgement (CTD-4). The CTDs were scored using a 5-point scale (1-5).

2.2.3 Information-processing Style (IPS)

Personal styles of information processing and judgement were measured using the Rational and Intuitive Information Processing Style Inventory (Naito et al. 2004). Two factor scores, such as Rationality (IPS-1) and Intuition (IPS-2), were calculated using this inventory. These also were scored using a 5-point scale (1-5).

2.2.4 Literacy of science and technology (LST)

Kawamoto et al (2013) developed an inventory of science and technology literacy which is based on a survey of scientific literacy. It consists of 10 questions, from which four factors were extracted from the answers: Life-centered (LST-1), Sciencephile (people who are interested in science and technology) (LST-2), Logic-oriented (LST-3), and Authoritarian (LST-4). The LSTs were scored using a 4-point scale (1-4). Four clusters of LST were also defined in order to compare behavioural attitudes toward Social science issues using the four dimensional factor scores (Kawamoto et al. 2013).

2.2.5 Additional participant evaluation metrics

Participant's performance was measured using weekly test results from each session. These were defined as "Overall assessment scores". Additional "Review assessment" scores were extracted in order to evaluate critical thinking ability by applying the IRT technique to rating scores of participant's reviews of their peer's essays (Nakayama et al., 2020).

3. Results

3.1 Development of critical thinking disposition (CTD) during courses

One of the purposes of the course is the development of CTD by participants. CTD score levels are measured using the set of questionnaires mentioned above. During the course, surveys were conducted twice.

Score deviations of the first survey (CTD1) are summarised in Figure 1. The horizontal axis represents scores from the first survey, and the vertical axis represents scores from the second survey. If student's CTD ability improved, their scores in all ranges of the second survey would increase compared with the first survey. The two regression lines in the figure overlap.

In the figure, almost all blended learning course plots shift to above the diagonal line and the slope of the diagonal line is gradual, which suggests that the scores of most participants increased. The regression line for the fully online course, however, shows a steep incline, compared to that for blended learning. This phenomenon suggests that some participants remained at the same CTD1 level as at the beginning of the course. In particular, few developments were observed for participants with low scores in the first survey.

This phenomenon is sometimes pointed out to participants in the early stages of fully online courses.

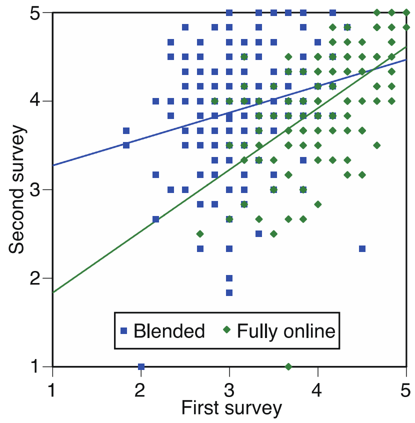

Figure 1: Comparison of development of CTD1: "Awareness of logical thinking" in two learning environments.

3.2 Four clusters of literacy of science and technology

The relationship between CTD and LST is examined in the following analysis.

First, the possibility of reconstructing the four LST clusters (Kawamoto et al. 2013) was confirmed. Using the LST scores obtained as 4-dimensional features of participants in the two courses, cluster analysis was applied to the entire set of data, and four clusters were extracted. The four clusters are illustrated in Figure 2, using two-dimensional information such as LST-1: Life-centered and LST-2: Sciencephiles. Error bars indicate standard errors.

When considering the geographical locations of clusters in a two-dimensional space, the same labels which were applied to each of the clusters in the previous study were used: Inquisitiveness for Cluster1, Sciencephiles for Cluster2, Life-centered for Cluster3, and Low-interest for Cluster4 (Kawamoto et al. 2013).

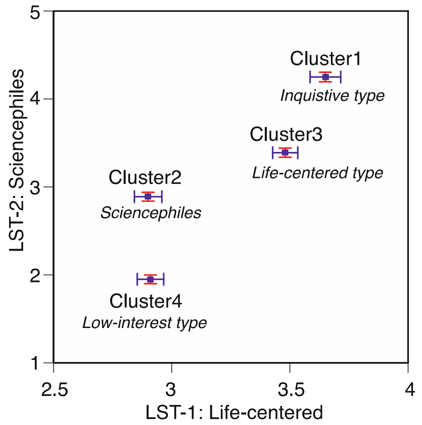

Figure 2: Distributions of four clusters in two dimensions: "Life-centered" and "Sciencephiles".

Table 1: Number of participants who were classified into clusters.

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Blended	26	94	71	64
Fully online	83	11	29	39

Table 1 shows a cross table for the number of participants between clusters and learning styles. The influence of learning style on the number of participants was examined using a Chi-test. As the result is significant, learning styles may affect the number of participants in classes.

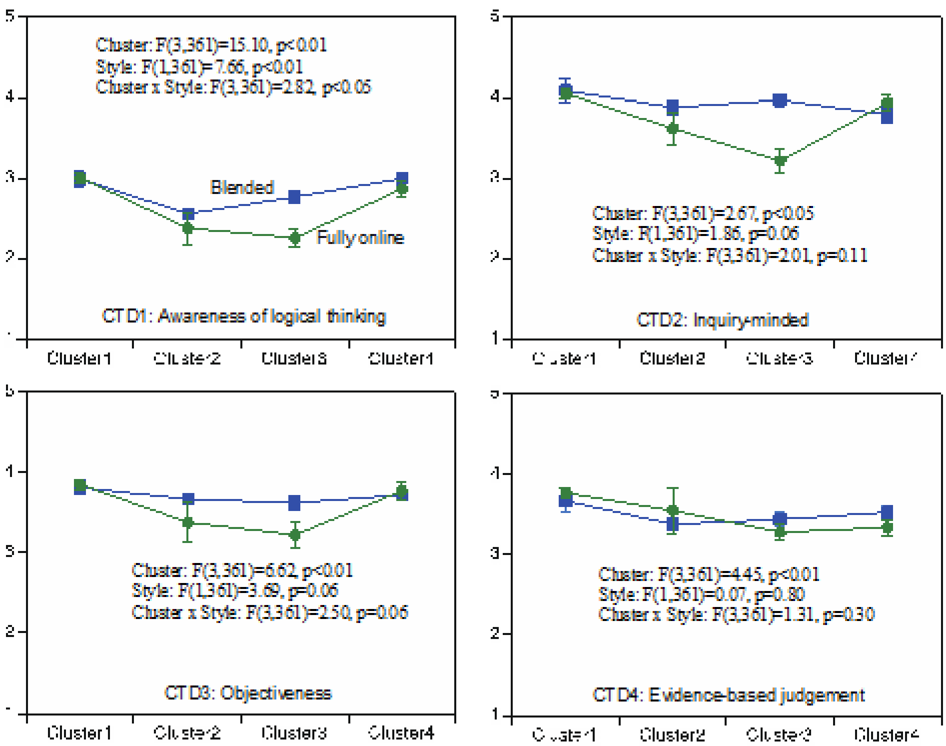

Figure 3: Changes in factor scores of CTD according to cluster and learning style.

Second, the contribution of the cluster and learning style to the second factor scores of CTD was examined using two-way ANOVA. The results for each factor of CTD are summarised in Figure 3. For all factor scores of CTD, the factors of the clusters which were extracted is significant, but the factors for learning style are only significant for CTD1: "Awareness of logical thinking".

The figure shows that the factor scores for both CTD1 and CTD3 are significantly higher in Clusters 1 and 4 than the factor scores for Clusters 2 and 3. In particular, the factor scores for Cluster 3: Life-centered are the lowest of the fully online course. Participants of Cluster 4 may have hesitated to join the learning activities throughout the course.

Even the participants in Cluster 2: Sciencephiles showed a similar tendency, and thus the relationship between the attitude of sciencephiles and their critical thinking disposition (CTD) should be considered carefully.

Table 2: Contributions of clusters and learning styles for personality (PS) and information processing styles (IPS)

	Factors		
	Cluster	Style	Cluster x Style
PS1: Extraversion	**F(3.391)=2.88**	**F(1,391)=50.42: F**	*F(3,391)=1.22*
PS2: Conscientiousness	*F(3.377)=0.31*	*F(1,377)=0.86*	**F(3,377)=3.23**
PS3: Neuroticism	**F(3.377)=3.25**	**F(1.377)=139.1: F**	*F(3,377)=1.87*
PS4: Openness	*F(3.377)=1.32*	**F(1,377)=59.96: B**	**F(3,377)=4.39**
PS5: Agreeableness	*F(3.377)=3.50*	**F(1.377)=17.29: B**	*F(3,377)=1.46*
IPS1: Rationality	**F(3,373)=16.38**	**F(1,373)=35.62: F**	**F(3,373=18.53**
IPS2: Intuition	*F(3,373)=0.51*	**F(1,373)=4.48: B**	*F(3,373)=0.97*

The contribution of clusters and learning styles to student's other characteristics was analysed using two-way ANOVA. The results are summarised in Table 2. The F-values for the two factors and their interactions are summarised. Significant F-values are represented in Bold face. For the comparison between clusters, PS1: Extraversion, PS3: Neuroticism, and Rationality are significantly different. They depend on the clusters which were extracted using scores for literacy of Science and Technology (LST). The results of F-tests on the factor of learning style indicates the participant's preference. The final initial F or B shows which course is dominant for that factor score. Participants of the fully online course have high scores for PS1: Extraversion, PS3: Neuroticism, and IPS1: Rationality, while participants of the blended learning course have high scores for PS4: Openness, PS5: Agreeableness, and IPS2: Intuition. The interactions between PS2: Conscientiousness, PS4: Openness and IPS1: Rationality are significant.

These results confirm that the participant's course preference depends on their personal characteristics.

3.3 Causal relationship

The relationship between student characteristics and measurements of critical thinking disposition has been discussed, and certain path models have been examined (Nakayama et al. 2019, 2020). In the current analysis, the contribution of the learning style is also considered, and this point will be confirmed in the following analysis.

In order to determine the effect of learning style, a multiple group structural equation modelling technique was introduced (Kline 2005), though the fundamental structure of the previous study was retained. The causal relationships were evaluated using indices of the fitness of the model (the GFI: Goodness of Fit index, AGFI: Adjusted GFI and RMSEA: Root Mean Square Error of Approximation) (Toyoda, 2007).

As a result of trial and error, a possible causal path was extracted, as shown in Figure 4. The final model was significant, the figure shows (GFI=0.89, AGFI=0.85, RMSEA=0.05). The path coefficients are indicated in Blended / Fully online format. These coefficients were compared between learning styles, and there were no significant differences except for the coefficients for reviews and overall assessment scores. When the teaching sessions transitioned from blended learning to fully online learning, some assignments could not be used in the fully online course. These differences may have influenced the difference in path coefficients. However, the remaining path structure and coefficients are comparable, and the progress of CTD development is similarly supported by the characteristics of students.

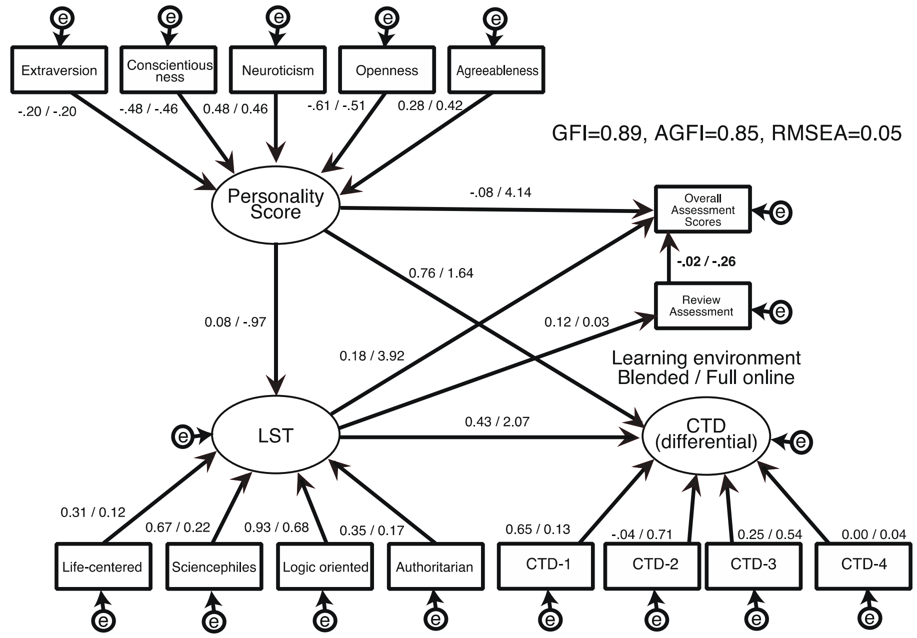

Figure 4: A causal relationship between student characteristics (Personality and Literacy of Science and Technology) and development of critical thinking disposition

4. Summary and discussion

In this paper, the factors contributing to the development of student's attitude toward critical thinking disposition (CTD) were examined. In addition to style of learning, whether the course was blended or fully online was also examined. In the investigation, participating student's characteristics and attitudes toward LST during the two types of courses were also measured.

First, the development of CTD during the two courses was compared. In the traditionally taught course, CTD scores of all levels of participants increased. Nonetheless, participants with the lowest CTD score levels did not improve their ability. One possible reason may be the factor of learning style in fully online courses. Clearly, the improvement of learning materials for fully online courses will be required.

Second, the contribution of literacy of science and technology (LST) and individual characteristics to the development of CTD was confirmed using ANOVA analysis. The factors of LST were summarised using the same four clusters that had been used in a previous study. These cluster features contributed significantly to the improvement of CTD scores. Learning style also contributed to the development of CTD.

The results show that the CTD scores of participants in the "Life-centered" LST cluster of the fully online course were the lowest. Therefore, factors for both cluster of LST and learning style should be considered in the development of CTD. Personality (PS) and information processing style (IPS) were also influenced by LST cluster and learning style. In particular, some factors of PS and IPS were affected by LST cluster and learning style selectively. These relationships may suggest that students should consider their learning setting preferences when developing their attitude toward learning.

The overall relationship between participant characteristics and CTD scores was confirmed using causal analysis, and the similarity of this relationship between each of the learning styles was confirmed.

These results show that several factors should be considered in order to provide appropriate procedures for the development of CTD by course participants. The details of strategies for improving these procedures will be the subject of our further study.

References

Ekahitanond, V. (2013) "Promoting university students' critical thinking skills through peer feedback activity in an online discussion forum", *Alberta Journal of Educational Research*, 59(2), pp. 247-265.

Hirayama, R. and Kusumi, T. (2004) "Effect of Critical Thinking Disposition on Interpretation of Controversial Issues: Evaluating Evidences and Drawing Conclusions", *Japanese Journal of Educational Psychology*, 52, pp. 186-198.

Kawamoto, S., Nakayama, M. and Saijo, M. (2013) "Using a scientific literacy cluster to determine participant attitudes in scientific events in Japan, and potential applications to improving science communication", *JCOM*, 12(1), pp. 1-12.

Kawamoto, T., Oshio, A., Abe, S., Tsubota, U., Hirashima, T., Ito, H., and Tani, I. (2015) "Age and Gender Differences of Big Five Personality Traits in a Cross-Sectional Japanese Sample", *The Japanese Journal of Developmental Psychology*, 26(2), pp. 107-122.

Kline, R.B. (2005) *Principles and practice of structural equation modelling, Second Edition*, The Guilford Press, New York.

Kusumi, T. and Tanaka, Y. (2008) "A development of critical thinking ability during a class of English for Specific purpose", *JAEP annual meeting*, PF2-35.

Naito, M., Suzuki, K. and Sakamoto, A. (2004) "Development of Rational and Intuitive Information-Processing Style Inventory", *The Japanese Journal of Personality*, 13(1), pp. 67-78.

Nakayama, M., Kikuchi, S., and Yamamoto, H. (2020) "Development of Critical Thinking Disposition During a Blended Learning Course", *Proc. of ECEL 2020*, pp. 358-364.

Nakayama, M., Kikuchi, S., and Yamamoto, H. (2019) "Lexical Analysis of Online Discussion in a Blended Learning Course", *Proc. of ECSM2019*, pp. 223-230.

Nakayama, M., Kikuchi, S., and Yamamoto, H. (2018) "The relationship between student's characteristics and online discussion activity", *Proc. of ECEL 2018*, pp. 417-423.

Rychen, D.S. and Salganik, L.H. (2003) *Key competencies for a successful life and a well-functioning society*, Hogrefe & Huber Publishers, Boston, USA.

Toyoda H. (2007) *Kyo bunsan kouzou bunseki [AMOS HEN]*, Tokyo Syoseki, Tokyo, Japan.

Trehan, S., Sanzgiri, J., Li, C., Wang, R., and Joshi, R.M. (2017) "Critical discussions on the Massive Open Online Course (MOOC) in India and China", *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, 13(2), pp. 141-165.

Designing Rubrics for Consistency of Marking in Large STEM Classes

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DOI: 10.34190/EEL.21.113

Abstract: *Context*: In science, technology, engineering, and mathematics (STEM) subjects, project-based assessment has been a key component of the assessment landscape, due to its authenticity and effectiveness as a learning approach. *Problem*: Large classes require marking of student assignments to be distributed among several markers. This raises the problem of consistency among markers, who may interpret assignment requirements and marking scales differently. *Approach*: We tried two approaches to rubric design, in attempt to provide markers with clear guidelines for assigning marks, and thereby yield consistent results among markers. The first approach, employed to mark final reports submitted by engineering students in a capstone project class, used a 10-point qualitative scale that markers used to mark components of an assignment. The second, employed in marking a series of deliverables submitted by students as a group project in a Master's level computer science project class, used "Yes/No" questions to assessed components of each deliverable. These were then aggregated, and converted into scores on the same 10-point qualitative scale. *Results*: We found that both approaches facilitated speedy but thorough marks: the 10-point rubric allowed markers to mark an entire final report in 60 minutes or less, while the "Yes/No" rubrics required between 10 and 20 minutes per deliverable, depending on size. Consistency was good for both approaches, with the "Yes/No" approach producing higher consistency at the expense of greater up-front effort. Also, while markers appreciated the speed of marking enabled by "Yes/No" rubrics, some were frustrated that there was no middle mark that they could apply to certain components. The 10-point rubric was easier to create, but produced lower initial consistency, which then had to be resolved in post-marking discussions between markers. *Conclusion*: Both approaches enable acceptable consistency when different markers mark the same subset of student assignments. The 10-point rubric takes little time to prepare and deploy, but requires more effort on the part of markers to produce acceptable consistency. The "Yes/No" rubric is easier for the markers to use, but requires more initial effort to create. Thus, the choice between one or the other is a trade-off between when effort is available to expend on consistency.

Keywords: rubrics, reliability, e-assessment, STEM, assessing large cohorts

1. Introduction

Engineering and computer science courses include a substantial amount of written assessments in their curricula, to satisfy industry demands for "soft" skills (Blyth 2019), and to provide "authentic" assessment (Svinicki 2004). Such free-form assessments require human judgment to grade properly, meaning some member of the academic staff must read and evaluate the work, and assign a grade based on some criteria. Such criteria are often communicated to markers in the form of "rubrics" (Moskal 2000), which are "descriptive rating scales that are particularly useful for scoring when judgment about the quality of an answer is required" (Brookhart 1999). Even with a scoring rubric, however, marking "free form" assessments is labour-intensive: our own experience is that final-year project reports typically require half an hour to read and evaluate, and can sometimes need more than an hour. With large student cohorts that involve hundreds of artifacts to grade; this necessitates that the marking task be distributed to many markers who work in parallel.

In this paper, we report our experience in the use of rubrics for two different modules[1] with a focus of enhancing consistency of marking, and increasing efficiency, when multiple people are involved in marking large numbers of assignments. We compare two kinds of rubrics: one based on a 10-point qualitative scale, and the other based on a set of "Yes/No" questions to be answered by the marker. Specifically, we focus on the consistency of marks assigned by different markers to the same assignments, using measures of inter-rater reliability (percentage agreement and Kappa (Cohen 1960; Cohen 1968)).

We found that both approaches produce good consistency among markers. The difference is whether the effort to ensure acceptable consistency occurs before the marking begins, or after it is complete: the Yes/No approach

1Throughout this paper, we use the English terminology, where a "module" is equivalent to a course in the US, and a "course" is a course of study in a particular topic, roughly equivalent to the American notion of "major". The "module leader" is the primary instructor or professor, while the "module team" comprises teaching assistants, part-time lecturers, graders, and occasionally other full-time academics.

requires substantial up-front effort to refine the rubric, while the 10-point scale requires a post-marking discussion to resolve differences between the first and second markers' scores.

In the next section, we present some background research on rubrics; that is followed by a description of our approach and associated rubrics and the results of our consistency analysis. We conclude with a discussion of implications, and directions for future work.

2. Background

Enszer & Buckley (2020) and Barankin (n.d.) report on the usefulness of rubrics for communicating expectations of student work. Marques et al. (2020) suggest that rubrics can be used for identifying common mistakes and enabling meaningful feedback on student performance. This could, in turn, also be used for enhancing the curriculum in subsequent academic sessions. Some authors, however, warn that the use of rubrics may lead to a "tick boxing" approach to learning by students (see, for example, Hattingh & Dison 2019).

Greater consistency of marking is often reported as a benefit of rubrics in the literature. Enszer & Buckley (2020) report on the use of rubrics to enable assessment consistency of a large cohort (around 700 first year engineering students) and over 20 markers. Barankin (n.d.) reports on how the use of rubrics led not only to more consistency between markers but also increased student satisfaction, as issues around "easy graders" were minimised. In this regard, our experience has been that an increased use of rubrics has also led to improved assessment and feedback scores on student satisfaction surveys as well as favourable evaluations from External Examiners. It is interesting to note that rubrics have been found to increase consistency of marking in a range of STEM assessment contexts, including technical reports (e.g. Enszer & Buckley 2020), coding submissions (e.g. Rodgers et al. 2020), assessment of projects (Hattingh & Dison 2019) and oral presentations (e.g. Galván-Sánchez et al. 2017). Yen et al. (2020) discuss the benefits of rubrics in educational contexts characterised by growing student numbers, and the need for greater speed of marking. Marques et al. (2020) and Enszer & Buckley (2020) also report on how rubrics were effectively used to reduce marking time. In this paper, we evaluate our use of rubrics for two different courses with a focus of enhancing consistency of marking and increasing efficiency. The importance of this work is captured by Yen et al. (2020): "…to scale instructor feedback to students is critical to maintaining high quality education".

3. Approach

We compared two approaches to marking using rubrics. One approach used a ten-point qualitative scale, the other comprising a series of "Yes/No" questions to be answered by the marker. These are described further below.

3.1 Ten-point marking scale: Engineering final project report

The individual project module in the Department of Engineering is the capstone module for undergraduate engineering students. The module is worth 30 credits and runs across the autumn and spring semesters. Overall, it constitutes 25% of the final year course load for undergraduate engineering students studying engineering subjects including Automotive, Electrical, Aerospace, Mechanical, Biomedical and Civil Engineering. Although the subject matter differs across these disciplines, the marking scheme and rubrics are the same for all subjects. In the academic year 2019-20, 333 students undertook the Individual Project module.

Table 1: Assessment stages

Stage	Assignment title	Weighting	Marking
1	Project Outline	10%	Submission marked by the project supervisor.
2	Project Progress Review	15%	Double marking. Submission marked by the project supervisor, and a second independent assessor.
3	Project Report	60%	Double-blind marking. Submission marked by the project supervisor, and a second independent assessor. Student must pass the project report and pass overall in order to be awarded a pass for the project module.
4	Project Defence	15%	Blind double marking. Submission marked by the project supervisor, and a second independent assessor. Student must pass the project defence and pass overall in order to be awarded a pass for the project module.

The final Individual Project comprises four assessment stages (as shown in Table 1): the Project Outline, a Project Progress Review, a Final Report, and an oral Defence of the Final Report. The last two components – the Final Report and the Report Defence – comprised seven (Table 2, "Final Report criteria") and five (Table 3, "Project Defence criteria") criteria respectively, that were assessed according to a ten-point qualitative scale shown in Table 4 ("Ten-point qualitative marking scale"). Both of these components were assessed by two markers: the project supervisor, and an independent second marker.

Table 2: Final report criteria

Criterion	Max mark
Quality of Report (25%)	
General presentation, structure and layout	10
Introduction & Background	15
Competence and Achievement (50%)	
Technical depth	25
Rigour and quality of analysis	25
Conclusions (15%)	
Critical evaluation	10
Further development	5
Project Management (10%)	
Project management review	10
Total	**100**

Table 3: Project defence criteria

Criterion	Max mark
Delivery (25%)	
Presentation and layout	15
Pace and clarity	10
Content (50%)	
Selection of material presented, results, critical analysis etc.	40
Conclusions and reflection on the way forward	10
Technical Competence (25%)	
Level of technical competence demonstrated	25
Total	**100**

Table 4: Ten-point qualitative marking scale

Mark	Corresponding Score %
Outstanding	95
Excellent	85
Very good	75
Good	65
Clear pass	55
Marginal pass	45
Marginal fail	35
Clear fail	25
Little or nothing of merit	10
	0

3.2 Yes/no rubric: Computer Science team research and development project

The Team Research and Development module is one of two first-semester modules required of all computer science students in the Master of Science in Computer Science programme. The focus of the module is on developing skills related to working in a team on a research and development project, such as project planning, configuration management, progress tracking, and communication and coordination. Due to widely varying computer science skills of the incoming students, the "research and development" aspect of the module involves formulating and answering a research question using elementary statistics and the R programming language.

The 2020 version of the module required project teams to deliver three main project components: a research question, a data visualization, and a final report. Because of the large number of students enrolled – 1288 students, organized into 262 teams of five – and the need to return marks to the students quickly so they could incorporate our feedback into the next deliverable, we employed a team of nine markers, working concurrently, for each component. Each team was assessed by an individual marker, with no second marker due the quick feedback requirement.

In order to meet the dual constraints of speed and consistency across markers, we developed a rubric for each deliverable comprising 25-50 assessment questions that the marker could answer either "yes" or "no." The questions were divided into component parts, and organized roughly as a decision tree for each part, so that only applicable questions needed to be answered; also, markers were instructed to answer "no" if they had any doubt about the answer to a question. Once completed, the rubrics were interpreted by a rule-based system that assigned a mark from the 10-point scale shown in Table 4 ("Ten-point qualitative marking scale") to each component part; the final score is the weighted sum of the component part scores.

The assessment rubric for the Research Question component is included in the Appendix.

3.3 Evaluation

With large student cohorts, it is necessary to have multiple markers, each evaluating a subset of the submitted work; this reduces the load on any individual marker, and allows markers to work concurrently resulting in faster turnaround.

One of the concerns with having multiple markers is consistency: different markers may interpret the rubric differently, or be more strict or lenient than their peers. This raises concerns of fairness, as some students might be graded more harshly than their peers if they happen to be assigned to a strict marker.

To assess whether the marking rubrics used in the two modules described above produce consistent results, we assessed inter-rater reliability of the scores from different markers. We analyzed inter-marker agreement for each module instance using two statistics: percentage agreement, which calculates the fraction of assessed items where both raters assigned the same mark, and Kappa (Cohen's Kappa for nominal marks, or weighted Kappa for ordinal marks), a measure of agreement that accounts for agreement that might happen by chance (Cohen 1960). Weighted Kappa takes into account the amount of disagreement between two ratings, recognizing that the difference between, say, 60 and 70 is greater than that between 60 and 62 (Cohen 1968). The calculation of weighted Kappa takes into account a "tolerance" within which two scores are deemed to be the same; we used a tolerance of 5, meaning both 60 and 70 would be considered the same as 65; we think this is reasonable given that the 10-point scale used in both marking approaches separates marks by 10 points. In either case, useful values of Kappa are bounded by 0 and 1 (see Table 7: "Kappa strength of agreement"); values between .6 and .8 represent "good" agreement, and values above .8 represent "almost perfect" agreement (Landis and Koch 1977).

4. Results

This section presents the results of our inter-marker agreement analysis, in which we calculated percentage agreement and Kappa statistics for both approaches.

4.1 Ten-point marking scale: Engineering final project report

Table 5 "Final Project Marking Agreement" shows the percentage agreement and kappa statistic values for the final report and project defence deliverables for the undergraduate Engineering Final Project module. There were 45 academics from across the relevant disciplines involved in marking, as both supervisors and second markers. To simplify the analysis, we treated all supervisors as one aggregate marker, and all second markers as another; as such, the agreement calculation is between the supervisor and second marker categories.

Table 5: Final project marking agreement (10-point rubric)

Assessment	No.	% Agreement	Kappa
Project Report	318	66% (±5%)	.7 (weighted)
Project Defence	332	57% (±5%)	.65 (weighted)

Each final project report required between 40 and 60 minutes to mark, depending on size; reports range in size from 40 to 120 pages. The project defence was marked after viewing a 10-15 minute presentation; the total time for viewing and marking was at most 20 minutes, including five minutes to assign marks and write feedback.

The results shown in Table 5 ("Final Project Marking Agreement") are for the first round of marking; after the first round, if there was substantial disagreement between the supervisor's and second marker's scores, they discussed the differences and agreed a final mark.

The fraction (percentage) of agreement is between half and two-thirds for both assignments, within a tolerance of ±5%. Weighted kappa statistics show "good" agreement according to Landis & Koch (1977) (see Table 7 "Kappa strength of agreement"), for both assignments.

4.2 Yes/no rubric: Research question

To assess the "Yes/No" rubric, we had two markers apply the rubric to a random sample of ten deliverables for the first component of the project. This "Research Question" component required project groups to formulate a research question that could be answered by applying elementary statistics (correlation, difference in means, or difference in proportions analysis) to a data set selected from Kaggle.com[2]. The deliverable comprised a statement of the research question itself, the null and alternative hypotheses for the question, the data set to be analyzed, and the specific variables from the data set to be used in the analysis; each deliverable was one or two pages.

The rubric comprised 29 questions divided into four parts (see Appendix, "Research Question rubric"). Each deliverable required about ten minutes to mark.

We analyzed the agreement between each markers' answers to the individual questions, and the agreement between the final score calculated from these answers for each deliverable; the results are shown in Table 6 ("Research Question Marking Agreement").

Table 6: Research question marking agreement ("Yes/No" rubric)

Assessment	No.	% Agreement	Kappa
Questions only	290	92%	.87 (unweighted)
Total score	10	80% (±5%)	.85 (weighted

There was high (92%) percentage agreement among the two markers for the answers to individual questions. There were 290 answers in total across ten samples; default answers for questions that are not answered explicitly due to the decision-tree structure are included in this analysis, as they represent a choice by the marker. The percentage agreement is exact (tolerance = 0) in this case, because the answers are discrete ("Yes," "No," or "N/A" (not applicable)). The unweighted kappa value was .87 for these questions, indicating "almost perfect" agreement according to Landis & Koch (1977).

There was somewhat lower (80%) percentage agreement among the final scores calculated from the question answers, even with a tolerance of ±5%. Weighted kappa agreement is .85, also indicating "almost perfect" agreement.

Table 7: Kappa strength of agreement according to Landis & Koch (1977)

Kappa	Strength of Agreement
0	Poor
.1-.2	Slight
.21-.4	Fair
.41-.6	Moderate
.61-.8	Good
.81-1.0	Almost perfect

2www.kaggle.com

5. Discussion

At first glance, it would appear that the "Yes/No" rubric produced better results than the 10-point qualitative rubric: both percentage agreement and the kappa statistics were higher for the "Yes/No" approach.

But agreement is not the whole story. The "Yes/No" rubrics require much more up-front effort to develop: they need to be trialed and refined to ensure that the quesitons are clear and unambiguous, and all important aspects are assessed. Also, the rules for aggregating the results into a final score need to be developed; this required eight hours of the module leaders's time to create and debug for the Research Question deliverable. Further, the somewhat lower agreement among the aggregated scores, as compared to the base question answers, suggests that some error may be introduced by the aggregation process; if so, care must be taken to ensure this does not unacceptably amplify divergence among markers. Finally, some markers were frustrated by the either-or nature of the "Yes/No" rubrics: in some cases, they would have preferred a third, middle option to indicate "somewhat, but not entirely 'yes'."

In contrast, the 10-point rubric results in good agreement as measured by Cohen's kappa, yet requires no tailoring for the specific module or deliverable: the scale and descriptors were taken directly from University grading policy documents, with which all academic staff are at least somewhat familiar. So, the module leader need only decide what components should be assessed, assign weights, and distribute this information along with the rubric. However, in the case of widely differing marks, final agreement had to agreed by discussion between the supervisor and second marker. In effect, the effort to ensure high agreement is shifted from the module leader to the individual markers, which is reasonable when there are a large number of markers.

Because of the difference between the scope of the deliverables analyzed, we were not able to identify any meaningful difference in time required to mark using either rubric. The choice, therefore, is a trade-off between when the effor to produce acceptable agreemen should be spent: the "Yes/No" rubric requires more up-front effort to develop and refine, but may offer better agreement once deployed. As such, it may be worth the effort for large classes that will be repeated in subsequent semesters without substantial changes, and which have a comparatively small team of markers. The 10-point approach using a generic rubric requires much less up-front effort, at the expense of post-marking discussion between markers who disagree. This approach may be more applicable when there are many markers and sufficient time in the feedback cycle to hold discusssions.

5.1 Limitations

We have used agreement as the construct for comparing the efficacy of the two marking approaches. This raises two issues: first, we allowed a variation of ±5% when comparing numeric scores. This was based on the observation that 5 points is half the separation between marks on the qualitative scale, and so marks falling within this "tolerance" could reasonably be deemed to be equal. Second, Cohen's kappa has been criticized as a measure of agreement because of the way it accounts for possible random variation: the assumption is that raters who do not know how to answer will choose an answer randomly, which is likely not the case (Uebersax 2009) in marking (in fact, markers were instructed to choose "No" rather than guessing when using the "Yes/No" rubric).

We also compared two groups of markers, rather than individual markers, when assessing agreement for the final project marking. This seems reasonable, but may have had the effect of masking the effect of large differences.

Finally, both trials were conducted in the same school, where academic staff share norms of marking present in the school and University as a whole. This may not generalize to other contexts.

6. Conclusions

Yen et al. (2020) observed: "… to scale instructor feedback to students is critical to maintaining high quality education." We have presented two approaches to grading large volumes of student work that require human judgement to mark: one based on a generic 10-point qualitative rubric, and one based on assignment-specific rubrics comprising "Yes/No" questions.

We assessed the degree of agreement between markers who assessed the same work, and found that both approaches yield good agreement. Despite good overall agreement, the 10-point generic rubric approach required a post-marking resolution discussion between the markers when the difference was too large. In contrast, the "Yes/No" approach produced very high agreement, but at the cost of substantial pre-marking effort to develop and refine the marking rubric for each assignment. Both approaches scale well to marking hundreds of assignments.

The choice of which approach to use, therefore, depends on whether the module leader and marking team prefer to expend up-front effort to ensure reliability, or expend effort after the marking is completed to resolve differences.

Following the positive findings reported here, we plan to explore the use of the "Yes/No" approach to rubric design in further in courses within the engineering and computer science departments. One aspect that we are particularly interested in is the extent to which a third, middle option to indicate "somewhat, but not entirely 'yes'" is really necessary, particulary as Enszer & Buckley (2020) report on the benefits of avoiding "fence sitting" when designing rubrics.

Additionally, we will explore the use of rubrics as a tool for communicating expectations of student work, as suggested by Muktiarni et al. (2020), Enszer & Buckley (2020), and others.

Appendix 1

Rubric – Research Question Assignment

Group ID "groupNN", or "new_groupNN"

NB: Please do not change the name of this file: "group##"/"new_group ##" links group to grading script

Date assessed: [dd/mm/yyyy 19/02/2021

Assessed by: [name of asses JN

Select score from dropdown [?/Yes/No]

Sect.	Question	Task	Score	Question order/ Navigation according to response		Assessor comments (optional) Use for all comments including E11 - General comments
		Question & Test		No	Yes	
A	1	Is the question a question?	?	Skip to A3 (Hypoth	Go to Q 2	
A	2	Are the independent and dependent variables identified?	?	Skip to A3	Go to Q2a	
A	2a	Does each variable appear as a column in the dataset?	?	Go to Q2b	Skip to Q2.1	
A	2b	Is each variable clearly derived from columns in the dataset?	?	Skip to A3	Go to A2.1	
A	2.1	Are both the independent and dependent variables interval or ordinal?	?	Skip to A2.2	Go to A2.1.1	
A	2.1.1	Is the question about correlation?	?	Skip to A2.2	Go to A2.1.1.1	
A	2.1.1.1	Are there at least 8 distinct values for the independent variable (x-axis)?	?	Go to A2.1.1.2	Go to A2.1.1.2	
A	2.1.1.2	Are the independent and dependent variables in the correct order? (deper	?	Skip to A3	Skip to A3	
A	2.2	Is the independent variable nominal (or ordinal with <8 distinct values)?	?	Skip to A3	Go to A2.2.1	
A	2.2.1	Are there at least two categories of the independent variable identified (for com	?	Go to A2.2.1.1	Go to A2.2.1.1	
A	2.2.1.1	Is the dependent variable interval?	?	Go to A2.2.2	Go to A2.2.1.1.1	
A	2.2.1.1.1	Is the question about difference between/among means or medians?	?	Skip to A3	Skip to A3	
A	2.2.2	Is the dependent variable ordinal?	?	Go to A2.2.3	Go to A2.2.2.1	
A	2.2.2.1	Is the question about differences between/among medians?	?	Go to A2.2.2.2	Go to A2.2.2.2	
A	2.2.2.2	Is the question about differences between/among means?	?	Skip to A3	Skip to A3	
A	2.2.3	Is the dependent variable nominal?	?	Skip to A3	Go to A2.2.3.1	
A	2.2.3.1	Is the question about differences between/among proportions or rates?	?	Go to A3 (next que	Go to A3 (next question)	
A	3	Is the null hypothesis expressed correctly?	?	Go to A4	Go to A4 (next question)	
A	4	Is the alternative hypothesis expressed correctly?	?	Go to section B5 (i	Go to section B5(next)	
		Dataset				
B	5	Is the Kaggle URL for the dataset included?	?	Go to B6	Go to B6	
B	6	Are column headers listed in the document?	?	Skip to B7	Go to B6.1	
B	6.1	Are the column headers listed as the output of the R colnames() function?	?	Go to B7	Go to B7	
B	7	Is the Kaggle dataset in the repository?	?	Skip to C8	Go to B7.1	
B	7.1	Is the Kaggle dataset presented as a CSV file? I.e. csv extension AND comma separated c	?	Go to C8	Go to C8	
		Presentation/Formatting				
C	8	Is the document spelled correctly?	?	Skip to C9	Go to C8.1	
C	8.1	Is the document punctuated correctly?	?	Skip to C9	Go to C8.1.1	
C	8.1.1	Is the document grammatically correct?	?	Go to C9	Go to C9	
C	9	Is the document in Markdown format, conforming to the template and example	?	Go to D10	Go to D10	
D	10	Is the Research Question interesting? I.e. not obvious, can't be answered by mathematics, or application of natural law (e.g. speed x distance). (Bonus Question.)	?	Go to E11	Go to E11	
E	11	General comments to students	DO NOT USE	DO NOT USE	DO NOT USE	

References

Barankin, M. D. M. n.d. "Chemical Engineering Senior Design at Colorado School of Mines: Recent Innovations & Achievements", accessed 15 June 2021. https://peer.asee.org/chemical-engineering-senior-design-at-colorado-school-of-mines-recent-innovations-achievements.pdf

Brookhart, Susan M. 1999. "The Art and Science of Classroom Assessment: The Missing Part of Pedagogy". ERIC Digest. Office of Educational Research; Improvement; ERIC

Cohen, J. 1960. "A Coefficient of Agreement for Nominal Scales." *Educational and Psychological Measurement* 20 (1): 37–46.

Cohen, J. 1968. "Weighted Kappa: Nominal Scale Agreement Provision for Scaled Disagreement or Partial Credit." *Psychological Bulletin* 70 (4): 213.

Enszer, J., & Buckley, J. 2020, May. "Algorithm for Consistent Grading in an Introduction to Engineering Course". In 2020 ASEE Virtual Annual Conference.

Galván-Sánchez, I., Verano-Tacoronte, D., González-Betancor, S. M., Fernández-Monroy, M., & Bolívar-Cruz, A. 2017. "Assessing oral presentation skills in Electrical Engineering: Developing a valid and reliable rubric". International Journal of Electrical Engineering Education, 54(1), 17-34.

Hattingh, T. S., & Dison, L. 2019, July. "Why lecturers in an engineering School assess the way they do". In Research in Engineering Education Symposium, July.

Landis, J. R., & Koch, G. G. 1977. "An Application of Hierarchical Kappa-Type Statistics in the Assessment of Majority Agreement Among Multiple Observers." *Biometrics* 33 (2): 363–74.

Marques, B. P., Cardoso, M., Reis, R. M., & Marques, R. 2020, October. "Evaluate manuscripts or digital assignments fairly and easily". In Eighth International Conference on Technological Ecosystems for Enhancing Multiculturality (pp. 121-125).

Moskal, Barbara M. 2000. "Scoring Rubrics: What, When and How?" *Practical Assessment, Research, and Evaluation* 7 (1): 3.

Muktiarni, M., Ana, A., Sern, L. C., & Saripudin, S. 2020. "Using Rubrics to Assess E-learning in Vocational Education". Journal of Engineering Education Transformations, 34, 49-56.

Rodgers, K., Verleger, M., & Marbouti, F. 2020, January. "Comparing Students' Solutions to an Open-ended Problem in an Introductory Programming Course with and without Explicit Modeling Interventions". In ASEE Annual Conference proceedings.

Svinicki, Marilla D. 2004. "Authentic Assessment: Testing in Reality." *New Directions for Teaching and Learning* 2004 (100): 23–29.

Uebersax, J. 2009. "Kappa Coefficients: A Critical Appraisal." web page, accessed 15 June 2021. https://john-uebersax.com/stat/kappa.htm.

Yen, M., Karayev, S., & Wang, E. 2020, August. "Analysis of Grading Times of Short Answer Questions". In Proceedings of the Seventh ACM Conference on Learning@ Scale (pp. 365-368).

Creative Audio-Visual Approaches Applied in Online and Hybrid Educational Designs

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DOI: 10.34190/EEL.21.096

Abstract: This research deals with creative audio-visual approaches applied in online and hybrid formats to support learning and inquiry in higher education. The objective of this study is to describe, explore and evaluate an educational design in which the students are introduced to creative approaches, to design and to the use of video activities, through visual facilitation, sketching, personal narratives and collaborative video production. The educational design is centred around inquiry processes and project- and problem-based learning. The empirical data consists of teaching observations, students' video productions and students' reflection entries in the Learning Management System during the course and written evaluations after completing the course. The analysis outlines the development of the educational design based on previous online teaching sessions and feedback from students. The findings show that while some students were initially challenged by the unusual teaching format, most appreciated the creative audio-visual approaches and high degree of experimentation. They responded positively to the use of various tools and collaborative activities and expressed that they have applied or plan to apply elements from the educational design to their own practices.

Keywords: visual facilitation, personal narrative, video sketching, collaboration, educational design, online

1. Introduction

The use of video activities for learning and collaboration is growing and is applied in many ways, such as using video as a tool for reflection and dissemination or for video meetings and instructions. For many years, there has been an elective at the master's programme in Information and Communication Technologies and Learning (MIL) that focuses on designing video activities. For the first four years, it was a course solely on video meetings and video conferencing applying creative workshop methods in general (Ørngreen and Mouritzen, 2013). In the following two years, the elective was run (in 2018 and 2020–21), it has become a broader course, which includes new creative audio-visual methods. In this explorative case study, the research-based educational design of the latest iteration of the course was investigated. In this section, the theoretical framework is presented according to the context of the course and the online setting in which it is taught.

1.1 Problem-Based learning

The overall pedagogical thinking of the course was rooted in problem-based learning (PBL). PBL can take many forms: from students working with smaller problems to more complex problem solving, or from problems and contexts provided for students to formats in which students themselves identify the context and the problem they wish to work on. The problem can be real-life problem investigated in collaboration with organisations or a hypothetical problem in an imagined context. PBL can take place in one teaching session or serve as the foundation of a complete teaching programme or even of a university's teaching approach (see, e.g., de Graaff and Kolmos, 2007, Jonassen and Hung, 201, Sipes, 2017, Savin-Baden, 2007).

The course in this research applies several of these PBL aspects. It stems from the master's degree education being rooted in problem-based learning (PBL) and hosted by a PBL university (in collaboration with other universities). The course focuses on real-life settings, such as the students' own work contexts, throughout the course but also allows the students to use imagined problems (if, for example, their work context does not currently use video activity). The purpose is to support a design mode and exploration of opportunities.

Though PBL in this form is based in practice, subject matter theories, models and concepts are needed for students to work reflectively and academically (Jonassen and Hung, 2015). The teachers function as *facilitators* who organise a learning environment, which involves different activities, such as instructions, students' self-directed learning, presentations and feedback sessions (Newman, 2005). From a teacher perspective, the role is different from instructional design, as the control is given to the students. This means that teachers do not know beforehand which problems the students will tackle, and the theoretical foundations and the theory-practice and theory-empirical inquiries that the students address can therefore take various directions within the framework and learning objectives of the course (Dirckinck-Holmfeld, 2009). The teacher's ability to decipher the students' needs and to improvise is therefore often needed. In an online learning setting, it can be difficult to achieve a sense of where the students are in the learning process (Salmon, 2003), and it becomes vital to have both competences and tools that support students' projects to go in various directions.

1.2 Graphic facilitation for visual-supported video activities

Graphic facilitation is often used to describe what consultants do when visually leading group processes (Sibbet, 2001; Hautopp & Ørngreen, 2018). The method was initially inspired by the ways in which designers and architects utilise visualisations and sketching with clients. Analogue drawing techniques in face-to-face (f2f) meetings are referred to as the typical way of doing graphic facilitation, but in recent years, online and digital possibilities have been investigated in the field (e.g. Smith, 2014; Blijsie, Hamons and Smith, 2019). Smith (2014) explored how graphic facilitation can be applied with the aim of creating virtual meetings that are effective and increasing engagement among participants. In educational design, this perspective on graphic facilitation was a focus when introducing students to the theme of online meetings and visually supported video activities.

1.3 Personal video narratives

The personal video narratives in this research are inspired by digital storytelling (developed at storycenter.org) and focus on supporting personal voice (Lambert, 2013). Participants explore and produce a personal three-to-five-minute video story. Individual and collaborative reflective processes scaffold the narrative inquiry and video production, including so-called story circles where participants get feedback from peers. Studies identify that digital storytelling-inspired approaches can scaffold learning, collaboration and self-knowledge and support participatory research (Jamissen et al., 2017; Wu & Chen, 2020; de Jager et al., 2017). In online educational environments, where there is a risk of students feeling isolated, the use of personal video narratives can promote well-being and a sense of community (Henningsen & Ørngreen, 2021).

1.4 Video sketching

Video sketching draws on various investigative sketching approaches to support inquiry into problem setting, solving and dialogue (Goldsmith, 2003; Schön, 1992; Olofsson & Sjölén, 2007; Barak & Albert, 2017; Ørngreen et al., 2017). In a video sketching session, participants use rapid iterative sketching processes that include pen, paper or other artefacts to materialise their ideas. The sketches are recorded, which means the video itself constitutes a form of temporal sketch – a video sketch. The video sketch is revisited, re-recorded and potentially rethought. Participants scaffold their reflective practice by shifting between mindsets inspired by the four different design genres: investigative, explorative, explanatory and persuasive (Olofsson & Sjölén, 2007). In a video sketching session, the different approaches aid explication of ideas, dialogue with peers and interaction with the material, which can lead the participants to new insights.

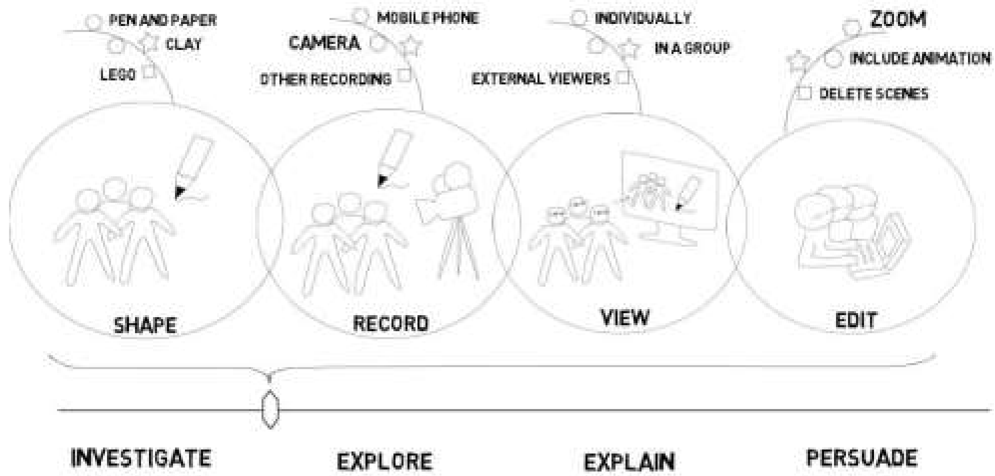

Figure 1: From Ørngreen et al. (2017), p.423

2. Research design and context

This is an exploratory case study (Yin, 2017), in which the research objective is to describe, explore and evaluate the educational design, investigating the creative audio-visual approaches mentioned above in online and hybrid formats. The elective course was conducted in the MIL master's programme, which addresses the research, development and implementation of digital learning designs in a range of organisational and educational settings. The students are often enrolled in the master's programme alongside their daily occupation. The study is a continuing research process, with inspiration from participatory action research (Kemmis, McTaggart & Nixon, 2013) and educational design approaches, as framed in the introduction. The authors were both teachers of the course and researchers of the exploratory case.

The educational design was implemented during a 12-week elective course in the winter term of 2020–2021, with 20 students. This title was 'Design and Use of Video Activities for Learning and Collaboration Processes'. Here, the students are introduced to different audio-visual methods, which they explored and reflected upon in different PBL-based settings. The teaching was organised in the learning activities shown in Figure 2, where the numbers refer to the sub-paragraphs in the following analysis (in Section 3).

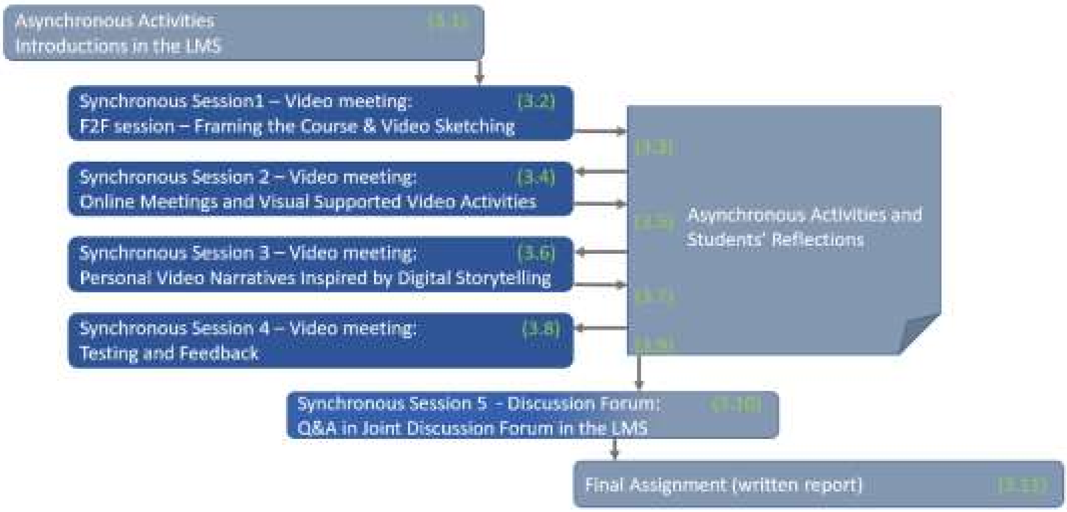

Figure 2: Overview of the educational design (the green font indicates the corresponding analysis paragraphs in the following section)

The educational design was based on the aforementioned theoretical framework of video and dialogical sketching processes, graphic facilitation and personal video narratives. The teachers worked with ways to support students to be reflective, examine situations and practices, break thinking habits and work patterns, and find their own voice through such exploration.

The first session, a five-hour f2f-session, took place during the day on a weekend. The online synchronous teaching sessions was scheduled on weekdays from 7–10 p.m. The students were organised into six groups of four to five participants. Between the online synchronous teaching sessions, the students were tasked with sharing a reflection exercise that took place asynchronously in the Learning Management System (LMS) of the education, the Moodle platform (see Figure 2). The asynchronous activities and reflections took the themes of the synchronous sessions as a starting point, and the students used different modalities in their uploads, such as written text, photos, drawings, videos and animations.

In the following section, the educational design and empirical data are presented and analysed. The empirical data includes participatory observations during teaching sessions and students' reflections on Moodle, as well as the students' PBL reports. Furthermore, a qualitative structured email interview (8 respondents) was collected in the months after the course, as well as a formal evaluation conducted by the university (in SurveyXact, with quantitative and qualitative questions, 11 respondents).

3. Presentation and analysis of the educational design

3.1 Asynchronous activities and students' reflections – introductions in the LMS

Prior to the first synchronous activities, the course commenced with an online period, which took place asynchronously in Moodle. In this period, students could familiarise themselves with the layout of the course, the reading list, and learn the teachers' expectations about active student participation. This involved the students being expected to write comments and reflections on Moodle, deliver hand-ins during and write a final assignment.

Similar to Gilly Salmon (2003) and her five-stage model, in which the first step is access and motivation and the second is online socialisation, this course used resources on scaffolding motivation and 'getting to know each other'. In this period, participants were asked to write a few sentences about their experiences and/or the expectations they had for the course. They often also wrote about where they worked and with what, in relation to the course subject. They were asked to outline what they expected to work on during the course. In the teachers' facilitation (Newman, 2005), it was underlined that this was considered a starting point and that the students could rethink, redesign and be inspired by the subjects of the course, by each other's points of departure and what they find together in groups. Likewise, they were informed that the entries would be read and used at the first synchronous f2f session. The aim of these initial student reflections was to work towards either a cluster of students who could work loosely together on the same problem, but on each individual project, or groups of students who would work jointly on the same PBL-project. The intention was to establish the expectations that things could change during the course, as their problems were formulated, framed and reframed (Schön, 1992). However, the experience was that for some students, it felt quite challenging to decide on subjects and be placed in a group so early in the process, even though it was explicitly written and despite the emphasis given to the possibility of change.

3.2 Session 1: F2F – framing the course and video sketching

The first session was a f2f session of five and a half hours, which both served the purpose of introducing the pedagogical frame and subject matter of the course and initiated participant collaboration through problem-based learning and inquiry activities. All MIL electives begin at the same time with a f2f event, which takes place at a MIL seminar. At this MIL seminar, the majority had already attended activities for other courses, which meant they were quite 'tired and satiated', as expressed in their own words. Others came to the seminar only for this elective and were not part of the general MIL programme. Furthermore, it was a diverse group of people coming from quite different work practices and from different stages in their education. Establishing common ground and a feel for the culture of this specific course was important but also challenging.

To establish rapport in-between the students, start explorations on the problem space of PBL and commence the process of working with the theoretical and practical aspects of video methods, the video sketching model was used (Figure 1 and Ørngreen et al., 2017). The model had been successfully used in the previous year of the course, but there were also challenges with students struggling to draw and sketch. There was a need to provide them with a quick way to establish a language for sketching, visual thinking and graphic facilitation (Smith, 2014; Hautopp & Ørngreen, 2018). Through a small interactive drawing session, the participants became acquainted with sketching, drawing variations of figures, situations and process diagrams (e.g. stick figures, star-men, abstractions exercises, etc.; see students' sketches in Figure 3).

After a short presentation and dialogue about the video sketching model, PBL and collaborative design thinking, participants elaborated on their ideas orally while sketching and recoding the video on their mobile phones or computers. They did this in small groups of two to three people. One presented, and the others asked questions about the sayings and drawings. They then individually listened to their own recordings (i.e. their own presentation of the idea and comments from group members). This process sparked reflections on the following questions: *What is important to me? Why? How can I elaborate on this idea? What do I know about this problem or opportunity? What do I need to find out*? Throughout the processes, the students were prompted to switch between different design genres, such as exploratory and explanatory (Olofsson & Sjölen, 2007). The purpose was for the students to experience the iterative process of designing video activities for their own work contexts (Savin-Baden, 2007).

A process of sharing the drawings and thinking took place in a plenary session (see Figure 3). The intention was to use this sharing to show the broad spectrum of design ideas and problems, to give comments on how these can function as PBL projects that explore the course objectives and to find connections among participants and thus commence the clustering of groups. Though originally planned as a 100% f2f seminar, the session took place in the wake of the first Covid-19 wave. A little less than a week before, it was therefore decided to grant permission to those few participants who could not attend, to participate from their home/work, whereas the majority were on campus. The design of the day tried to encompass this, which is also seen in Figure 3.

Figure 3: Montage of two screenshots illustrating the collaborative and plenary f2f/hybrid session and sketches

3.3 Asynchronous activities and students' reflections

Prior to Session 2, the students were prompted to revise their video sketching exercise from Session 1 and post a reflection on their initial expectations about how to design and apply video activities in their own work. When reading the students' reflections on Moodle, it became evident that several were interested in both instructional videos and in the audio-visual aspects of producing videos. Furthermore, in Session 1, some students mentioned that they would like to see teacher-produced videos as part of the course content and discuss these. The teachers found these ideas relevant and adjusted the teaching accordingly. From a PBL perspective, these adjustments to the educational design can be viewed as improvisation from teachers addressing students' interests within the frame and learning objectives of the course (Dirckinck-Holmfeld, 2009).

As preparation for Session 2, students were provided with two videos produced by the teachers about (1) using visual presentation drawings in a PowerPoint presentation with a teacher's talking head and (2) using visual templates and drawings *in situ* by recording the hands with a document camera (see Figure 4). The purpose was to exemplify different ways of working with graphic facilitation in virtual meetings (Smith, 2014) and video activities as a point of departure for pedagogical and didactical discussions in Session 2.

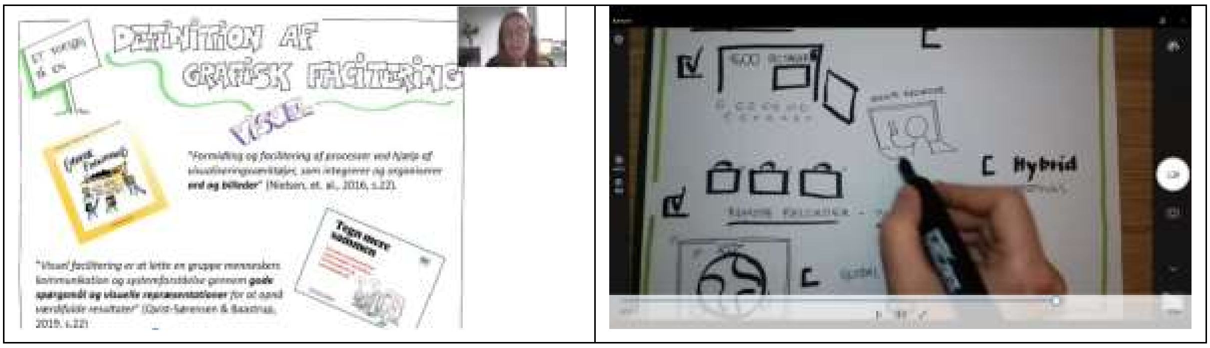

Figure 4: A screen dump from Video 1 (right) and Video 2 (left).

3.4 Session 2: Online meetings and visual-supported video activities

The themes of this three-hour session were online meetings and how visual approaches can support learning activities. Students were introduced to different video-based approaches, discussing how both teacher and students experience these online activities (e.g. Sablic et. al., 2020). They were also introduced to the use of graphic facilitation in different settings: f2f, remote, online and hybrid (Smith, 2014).

The session started with an overall introduction to online video-based meetings, with a focus on both pedagogical and technical considerations. Concrete examples from the teacher's own experiences were presented and discussed in relation to theoretical perspectives and the master's students' experiences. Afterwards, the teachers framed a group discussion about different visual approaches to online meetings in relation to the two video examples (Figure 4) and the theoretical perspectives. Awareness about the use of different modalities (e.g. Smith, 2014) as well as teachers' experimentations with hi-fi and low-fi video productions (e.g. Jelsbak et al., 2018) were discussed. The students were tasked with reflecting upon how visual elements were used differently in the two videos as well as to consider the benefits and challenges of applying these approaches in virtual meetings.

After the group discussion, the students were introduced to various aspects of applying film theory, such as camera angles, lightning, sound and other audio-visual perspectives. The purpose was to provide inspiration for both technical and pedagogical choices when students explored different video and sketching techniques in their group work. Thereafter, the students discussed in groups how the themes and activities of the session, the visual approaches to online meetings and video techniques could be applied as further exploration in their groups.

The session ended with an online bingo game: the teacher guided a contest in which students were prompted to show different objects in front of their screen, such as a cup, a book, hand sanitiser, a picture or a snack. The objects should be within reach on their desk, and the first student to reach 5 objects won. The aim of this exercise was to show an example of a relatively easy energizer exercise, which also contributes to building social space online (Salmon, 2003).

3.5 Asynchronous activities and students' reflections

Before Session 3, focused on personal video narratives, the students individually created the outline for a story in the form of text, sound file, video or storyboard. They reflected on the course to an imaginary friend who did not have academic insights into the specific field. They were encouraged to include reflections on why certain subjects were of interest and on issues they found to 'disturb their thinking' or were puzzled by. The purpose of this was to prompt personal reflections and investigative story work, exploring possible subject-specific challenges and obstacles usable in their upcoming assignment. The analysis showed that this also aided in bridging the course context with outside contexts (Savin-Baden, 2007). As preparation, the students were also tasked with finding an object symbolising a specific personal experience of the year 2020 and to watch a video produced by the teacher introducing the method of digital storytelling.

3.6 Session 3: Personal video narratives inspired by digital storytelling

The theme of this online session was personal video narratives inspired by digital storytelling (Lambert, 2013), and investigative sketching approaches were used to support inquiry in the story work (Henningsen & Ørngreen, 2021). To prompt personal stories and the social and learning experience of sharing, the students initially shared a photo from their mobile phone in pairs in separate online rooms by holding their phone up to the webcam. They also shared their artefact symbolising an experience in the year 2020. Then followed:

- 1. A 15-minute presentation on narrative approaches by one of the teachers.
- 2. A 15-minute workshop (#1) developing a storyboard or manuscript individually. The students were encouraged to explore their story by uncovering narrative elements (e.g. potential helpers, opponents, and moments of change) and/or using Systematic Inventive Thinking categories (Barak & Albert, 2017) enlarging or removing certain aspects, change relations and centres of attention. Their inquiries were scaffolded by sketching or using artefacts or Post-It notes. Post-Its made it possible to change dependencies and various dramaturgies and thereby explore different understandings. The students were encouraged to tell their stories in a first-person narrative.
- 3. A 20-minute 'story circle' session, in which students shared and received peer feedback. The students were organised into clusters of four students in separate online rooms. The students were encouraged to explore the stories by asking for alternative helpers or opponents, other structures, concrete situations from which the story could depart, emotional elements (to clarify the point of view), describing elements (to 'expand' the story) and actional elements (to drive the story forward) and overall explore what they experienced was at stake in the story.
- 4. A 10-minute introduction to video editing for students interested in the topic.

- 5. A 20-minute workshop (#2) producing a three-minute personal video narrative individually, in which the students included the feedback. Some students created their story in a one-take video on their mobile, which they recorded with a voiceover. They did no editing but rerecorded the story if they wanted to make changes. Others used video editing software.
- 6. A 60-minute sharing and feedback from the plenary group.

3.7 Asynchronous activities and students' reflections

Prior to Session 4, the students were asked to work together in their groups on planning a presentation or testing of their video activity designs with another group. The group could use the other participants as guinea pigs, as if they were part of the target group of these video activities, or they could present and receive comments on their designs. While planning this feedback session, the students could discuss it with their supervisor in a meeting or via written comments. Before the session, the students had to inform the other participants and supervisor about whether there was a specific role they had to imagine or take into consideration, if there were prior preparations, and where they wanted the activity to take place.

3.8 Session 4: Testing and feedback

This online session focused on students testing out designs in progress and receiving feedback. Other groups acted as guinea pigs and gave feedback drawing on course literature and their own experiences. The synchronous session was a three-hour gathering in which the six groups met up pairwise with one of the three teachers, who was also their supervisor. One group facilitated their testing and received feedback during a 45-minute session, then switched roles with the other group. After this, all six groups met in a plenary room and had a joint dialogue on their feedback and experiences during their testing.

The groups brought their various problem orientations to the table. One group tried a series of small two-to-three-minute instructional design videos, in which they had experimented with different genres and audio-visual effects with the same content of explaining planetary orbit. Another group tried out a design for motivating students to make their own videos as a way of learning specific concepts and words in Ancient Greek. Others were interested in how to, for example, moderate online meetings in the pairwise activity. All three teachers found it had been a lively session, with a good atmosphere and academically relevant discussions in the feedback sessions, and this corresponded with experiences from previous years. At the return to plenary, however, the session lost its momentum. The liveliness was replaced with a bit of fatigue and a one-person-speaks-at-a-time setting.

3.9 Asynchronous activities and students' reflections

Students posted individual reflections as a written post, short video sketches, a sound file or an animation in relation to their upcoming assignment, experiences from the course or comments on literature or on another student's previous posts.

3.10 Session 5: Q&A online chat in the joint discussion forum

During this online session, students could chat in written text with the teachers in real time in a 3-hour time slot. They could also choose to post questions the weekend prior, which were answered in this time slot. Students asked questions relating to the upcoming assignment and could follow the different threads of reflections in the joint online discussion forum.

3.11 Final assignment

The course ended with the students submitting a final written group assignment as a summative evaluation. They submitted their assignments to the joint discussion forum so each group could see each other's submissions and be inspired by each other's work for future use in their own practices (Dirckinck-Holmfeld, 2009). Much of the written assignment took its point of departure in the Moodle post reflections on a personal note, on the video activities explored, on literature or on general course discussions.

4. Findings and discussion

The educational design consisted of the above-presented sessions and activities. The formal evaluation immediately after the course showed that the students evaluated the course as academically meaningful. In the structured email interviews some months after the course, students expressed that the workshop approach resonated well with them, and several highlighted the hands-on creative productions qualified by feedback sessions. Analysis of their reports found that they had adopted the methods in their own work practice, applied the theories, and worked PBL-informed. Some comments included: ‘I learned something every single time’ and ‘Overall, I’ve learned a whole lot.’ The analysis also showed that the high degree of variation, including the creative audio-visual approaches combined with a pedagogical PBL-framing, supported inquiry and a ‘form of voyage of discovery’, as one student expressed it.

However, there were also challenges identified, which relate to those identified in the PBL and online learning literature (section 1.1). Several students struggled at the beginning with the structure of the course, as it seemed chaotic to follow, until they found their personal focus and problem orientation. One student commented, ‘It seemed somewhat messy [...] After completing the elective course, things feel much better connected’. The analysis showed that these initial challenges stem from insufficient insight into the purpose of the initial exercises, the variety of unfamiliar creative approaches (see Sections 1.2–1.4 and the literature referenced therein) and due to the nature of the educational design including ongoing adjustments. For some students, these adjustments were a motivating factor, as they experienced their specific problem orientation being acknowledged. For others, it created challenges. One student stated that his learning preference was a more linear and instructional pedagogy, not the collaborative and PBL approach. As the PBL approach in this course demanded complex inquiry and hands-on processing, students with other learning preferences can be challenged pedagogically or simply irritated and find it difficult to navigate.

Workable solutions to address these initial frustrations were pinpointed by the students through the evaluation. This included clear communication around the purpose and structure behind the investigative processes and continuous activities to scaffold a consistent focus. One student wrote, ‘We were kept to the bonfire [with …] activities to be done for each week.’ These continuous activities included regular sharing of reflections among the students. This scaffolded a sense of community and inspiration when frustration occurred. As one student expressed, ‘It was enriching to read the thoughts and reflections of others, just as it was hugely inspiring to watch the videos of others.’ Such findings may be relevant for other learning designers when working with establishing social ties in online communities and e-learning settings.

The educational design was built on a logic of hands-on experiences with creative audio-visual and video methods through a workshop format. Students in the mail interviews mentioned that they appreciated these approaches, which opened their mind so they could see teaching as a ‘playground’. The videos and audio-visual elements were also motivators for the more traditional course activities, such as reading and giving feedback, as they felt they needed this knowledge to do the workshop. Some students were first surprised and others sceptical about the act of sketching, but many saw it as a useful experience later: ‘It was surprisingly productive to be allowed to think with your hands in a new way. The experience made me very curious about it, and I have worked with it a lot since then [...] I have used all elements several times subsequently in my own teaching.’

The educational design strives to frame an experimental space with sufficient disturbance (from a Deweyan perspective). A student experienced it as ‘organised chaos, kaleidoscopic, inspiring and exciting. At first, I was extremely confused; later, I was confused on a higher level. I actually see this as very positive. That’s what I want to achieve with my own students. Not to give a whole lot of results, but to animate to think further.’ This showed that teaching of this kind demands awareness from the teachers to navigate in chaotic open processes and create safe settings in which students can explore, push boundaries and share. As one student stated, ‘It was with trembling heart that I shared on Moodle, as the video was far from perfect.’

All three teachers chose to be present during the online sessions, which meant there was always the necessary professional knowledge and overview present. The students experienced this as a ‘luxury’, but as teachers, it was also a positive experience both in planning and execution. Thus, it was not necessary to work to a very tight form, and it supported a looser atmosphere, with room for different opinions and laughter. However, there was also organisational framing with division of tasks. For example, there was always one teacher who had the main responsibility for specific tasks or subjects during the synchronous sessions, and the groups had each a specific teacher assigned as supervisor. In general, the students reported that they found the atmosphere pleasant, and given the very honest but decent comments during the video meetings and in the post, the course seemed to have established a room of confidence. Two students commented: ‘There was a pretty cool relational energy on the course’ and ‘There was an extremely good atmosphere’. In settings with larger class sizes, other organisational setups may be needed to ensure everyone is heard and to navigate the many asynchronous activities taking place. The research indicates that teachers need competencies in how to navigate in both the social and subject matter utterings in a sensible manner and they need to obtain a focus on establishing and keeping the good atmosphere in both the synchronous and asynchronous activities. Teaching in a team may help with this, and teaching a couple of such courses, may, for some teachers, be less demanding that having to teach a full course of their own. The feeling of ‘having each other’s back’ and ‘having someone to exchange ideas, experiences and subject matter knowledge with’ can be a powerful and motivational part of the teaching experience, even when the needed coordination resources rise somewhat.

5. Conclusion

This empirical study explores an educational design in which creative audio-visual approaches were applied and continuously developed throughout an online and hybrid format in higher education. The objective was to describe, explore and evaluate the educational design, and specifically the use of video activities, through visual facilitation, sketching, personal narratives and collaborative video production through inquiry processes and project- and problem-based learning. The findings showed that most of the students appreciated the creative audio-visual approaches and high degree of experimentation but that some students were initially challenged by the unusual teaching format. To navigate and facilitate the emerging frustration into workable learning inquiries was sometimes a challenging task for both the teachers and the students. Students responded positively to the use of the various tools and the collaborative activities in the evaluation and explained how they had applied or planned to apply elements from the educational design to their own practices. This paper described and analysed the educational design in detail with the aim of inspiring researchers and teachers teaching these approaches to students in online/hybrid educational contexts.

References

Barak M and Albert D (2017) Fostering systematic inventive thinking (SIT) and self-regulated learning (SRL) in problem-solving and troubleshooting processes among engineering experts in industry. *Australasian Journal of Technology Education* 4: 14p.

Blijsie J, Hamons T and Smith RS (eds) (2019) *The World of Visual Facilitation*: *Unlock Your Power to Connect People & Ideas*. Holland: The Visual Connection Publishers.

de Jager A, Fogarty A, Tewson A, Lenette C, and Boydell KM (2017) Digital storytelling in research: A systematic review. *The Qualitative Report* 22(10).

Dirckinck-Holmfeld L (2009) Innovation of problem-based learning through ICT: Linking local and global experiences. *International Journal of Education and Development Using ICT* 5(1): 3–12.

Goldschmidt G (2003) The backtalk of self-generated sketches. *Design Issues* 19(1): 72–88.

Graaff E and Kolmos A (2007) Management of change: Implementation of problem-based learning in engineering. In: Graaff E and Anette K (eds) *Management of Change, Implementation of Problem-Based and Project-Based Learning in Engineering*. Rotterdam: Sense, 1–8.

Hautopp H and Ørngreen R (2018) A review of graphic facilitation in organizational and educational contexts. *Designs for Learning* 10(1): 53–62.

Henningsen B and Ørngreen R (2021) Inquiry-based online learning through personal narratives and dialogical video sketching, 15p. (submitted and under review at journal)

Jamissen G et al. (2017) *Digital Storytelling in Higher Education: International Perspectives.* Palgrave Macmillan.

Jelsbak V, Buus L, and Thorsen J (2018) God kvalitet i livestreamet undervisning–fra underviserens point of view. *Tidsskriftet Læring Og Medier* (LOM) 11(18): 27p.

Jonassen DH and Hung W (2015) All Problems are not equal: Implications for problem-based learning. In: Walker A, Leary H, Hmelo-Silver CE, and Ertmer PA (eds) *Essential Readings in Problem-Based Learning*, 7-41.

Kemmis S, McTaggart R, and Nixon R (2013) *The Action Research Planner: Doing Critical Participatory Action Research.* Springer Science & Business Media.

Lambert J (2013) *Digital Storytelling: Capturing Lives, Creating Community*, 4th edition. New York: Routledge.

Newmann M (2005) Problem-based learning: An introduction and overview of the key features of the approach. *Journal of Veterinary Medical Education*: 12-20.

Olofsson E and Sjölén K (2007) *Design Sketching*. KEEOS Design Books AB.

Ørngreen R, Henningsen B, Gundersen PB, and Hautopp H (2017) The learning potential of video sketching. Mesquita IDA and Peres DP (eds) *Proceedings of the 16th European Conference on e-Learning ECEL 2017*. Academic Conferences and Publishing International, 422–430.

Ørngreen R and Mouritzen P (2013) [Teaching Desktop] Video conferencing in a collaborative and problem-based setting. In: *Proceedings of the 12th European Conference on e-Learning*. Academic Conferences and Publishing International, 360–368.

Salmon G (2003) *E-moderating: The key to teaching and learning online*. Psychology Press.

Savin-Baden M (2007) Challenging perspectives and models of problem-based learning. In: *Management of Change, Implementation of Problem-Based and Project-Based Learning in Engineering*. Rotterdam: Sense, 9-29.

Schön D (1992) Designing as reflective conversation with the materials of a design situation. *Knowledge-Based Systems* 5: 3–14.

Sibbet D (2001) A graphic facilitation retrospective. In: *Proceedings of the International Association of Facilitators: The Art and Mastery of Facilitation – Navigating the Future*. IAF Conference, Minnesota, USA, May 2001, 11p.

Sipes SM (2017) Development of a problem-based learning matrix for data collection. *Interdisciplinary Journal of Problem-Based Learning* 11(1).

Smith RS (2014) Collaborative bandwidth: Creating better virtual meetings. *Organization Development Journal*, 32(4).

Yin RK (2017) *Case study research and applications: Design and methods*. Sage Publications.

Wu J and Chen DTV (2020) A systematic review of educational digital storytelling. *Computers & Education* 147: 16p.

Art-Inspired Instructional Strategies in Online Education

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Abstract: Background: Art-infused learning provides a transformational experience for online students. Arts such as poetry, photography, and music can be incorporated into learning to achieve in-depth reflection, introspection, self-discovery, and knowledge generation. This scoping review answers the following questions: 1) what is the extent, quality, and foci of scholarly literature on the topic of arts-inspired instructional strategies in online education; 2) what are the themes common in published scholarly research related to the use of arts-inspired instructional strategies in online education; 3) what gaps exist in the published research on use of arts-inspired instructional strategies in online education; 4) what research methods have been used successfully in studying the use of arts-inspired instructional strategies in online education; and 5) what concepts and theories on the topic of arts-inspired instructional strategies in online education could be used as a conceptual framework to study arts-inspired instructional strategies as a disruptive pedagogy in online education? Purpose: This paper summarizes evidence from peer-reviewed literature related to arts-inspired instructional strategies in online education. The review offers insights into utilizing art as a disruptive pedagogy in online teaching. The outcome of including arts is adaptable, cost-effective, innovative, and effective learning environments that educate learners through creativity, leadership, and risk-taking. Methods: A four-stage algorithm was used with 128 references. The inclusion, exclusion, and screening process yielded 17 references which allowed the authors to compare themes during analysis. An inter-rater reliability check was conducted. Conclusion: The four themes are: 1) art-inspired teaching strategies facilitate transformational learning; 2) art-inspired teaching strategies offer a unique pedagogical strength in post-secondary online classrooms; 3) art-inspired approaches cultivate a sense of personal empowerment in students; and 4) art-inspired learning requires educators to utilize an intentional and skilled approach. Theoretical foundations supporting art-inspired pedagogy as a disruption in online education are discussed. The term Artistic Pedagogical Technology (APT) was discussed as an overarching concept incorporating art-inspiring and art-based teaching.

Keywords: art-inspired teaching, arts-based learning, online pedagogy, transformational learning, online learning

1. Introduction

Art-infused teaching provides a potentially transformational experience for online students. Arts such as poetry, photography, and music can be incorporated into learning to achieve in-depth reflection, introspection, self-discovery, and knowledge generation. The arts offer unique qualities that lead to profound professional education benefits (Haidet et al., 2016). This scoping review answers the following questions: 1) what is the extent, quality, and foci of scholarly literature on the topic of arts-inspired instructional strategies in online education; 2) what are the common themes in research related to the use of arts-inspired instructional strategies in online education; 3) what gaps exist in the published research on the use of arts-inspired instructional strategies in online education; 4) what research methods have been used successfully in studying the use of arts-inspired instructional strategies in online education; and 5) what concepts and theories in literature on the topic of arts-inspired instructional strategies in online education could be used as a conceptual framework for further research regarding this disruptive pedagogy?

Four themes emerged: 1) art-inspired teaching strategies facilitate transformational learning; 2) art-inspired teaching strategies offer a unique pedagogical strength in post-secondary online classrooms; 3) art-inspired approaches empower students; and 4) art-inspired teaching requires educators use an intentional approach. This paper reviews current literature related to use of arts-inspired instructional strategies in online education offering insights into utilizing the arts as a disruptive pedagogy in online teaching. As a disruptive pedagogy, arts-inspired teaching strategies encourage educators to identify and test assumptions inherent within traditional approaches to online education, including student and educator's roles.

2. Literature review

2.1 Literature search methods

Following the Arksey and O'Malley (2005) scoping review method, we started with the 5 research questions listed above. Inclusion and exclusion criteria were established, and search terms developed (Arksey and

O'Malley, 2005). Before thematic analysis, the authors conducted an independent inter-reliability check using Loignon et al. (2014). Inclusion criteria included English language full-text articles, peer-reviewed, and published on or after 2015. The Discovery Database was consulted with the search terms (aesth* or art*-based or art* based or art*) and (online or distance or technolog*) and (education or learn* or teach* or pedag*). Initially, 128 articles were located. After reviewing titles for relevance, 94 articles remained. The abstracts of these 94 articles were reviewed netting 47 articles for screening related to full-text availability and relevance to the research question. Eventually, 17 references remained for full review. The authors compared themes during the thematic analysis.

3. Findings

Four themes are addressed in the following sections.

3.1 Art-inspired teaching strategies facilitate transformational learning

Art-inspired strategies lead to transformational learning (Mayor and Tillberg-Webb, 2020). Cox, Brett-MacLean, and Courneya (2016) found that art-making increased student self-awareness, self-creativeness, and mindfulness. Edwards et al. (2012) studied the effect of Photovoice (PV) finding similar outcomes. Photovoice involves the online instructor posting a digital photographic image for the class accompanied by a reflective question. Students view the image and answer the question in an online forum. Many students found arts-inspired learning to be enlightening and therefore transformative (Potash et al., 2014).

Transformational learning changes the way students themselves, others, and the world. Increased self-awareness allows students to examine their beliefs and attitudes on specific issues (Raymundo, 2020; Ryan, Feld, and Yarrison, 2020; Sanjnani, Mayor, and Tillberg-Webb, 2020). Moreover, arts-infused learning provides opportunities for moral breakdown and breakthroughs (Cox, Brett-MacLean, and Courneya, 2016). For instance, Loignon et al. (2014) focused on uncovering healthcare professional prejudices and assumptions about poverty and found PV provided ethical moments for consideration, uncovered feelings of prejudices and assumptions regarding poverty, and offered a unique introspection on ethical principles leading to a desire for social change and advocacy related to poverty.

Similarly, Trout, Perez, and Christensen (2019) found that PV can be used for sensitive topics, such as rape culture, to motivate others to create positive change and advocate for social justice. Trout, Perez, and Christensen (2019) argue that PV helps students develop insights regarding marginalized groups. Likewise, Cox, Brett-MacLean, and Courneya (2016) found that APTs provide students with insight into patients' perspectives, cultivating a sensitivity to social justice. As one respondent concluded, "the process of art-making seems to invite a form of self-reflection that raises questions about the social distribution of health and well-being as well as the role medicine can play in addressing issues of social justice" (Cox, Brett-MacLean, and Courneya, 2016: 74). Overall, arts-infused teaching strategies help students acknowledge and change biases about patients (Cox, Brett-MacLean, and Courneya, 2016). This change increases their comfort in caring for specific patient groups, including older adults (George, Stuckey, and Whitehead, 2013), marginalized groups (Trout, Perez, and Christensen, 2019), and socioeconomically disadvantaged individuals (Loignon et al., 2014).

By adding a personalized lens on the patient experience, arts-inspired learning approaches facilitate culturally competent care (Ike, Postlethwait, and Parker, 2019) and motivate appreciation of diversity (Potash et al., 2014). One study participant commented "there was so much room for imagination and creativity in thinking of a person, patient or illness [and that their ah ha moment came as they realized that] … there's no such thing as a black and white world – but rather the difference in our perceptions" (Potash et al., 2014: 4). Using arts-inspired learning approaches facilitated feelings of compassion, understanding, and sincerity in caregivers as their view of patients was transformed (Potash et al., 2014). Empathy is cultivated, transitioning learners toward being compassionate caregivers (Potash et al., 2014).

3.2 APTs offer a unique pedagogical strength within post-secondary online classrooms

According to Kates, Byrd, and Haider (2015) arts- inspired transformational learning occurs through teamwork and collective learning. Interactive learning activities, such as APTs, lead to student engagement (Kates, Byrd, and Haider, 2015). As a pedagogical tool, PV stimulates reflection and collective learning (Ryan, Feld, and Yarrison, 2020). Art-infused teaching elicits a collective awareness that encourages individuals to commit to participating in learning activities, enhancing group learning (Loignon et al., 2014). Edwards et al. (2012: 38) reported that APTs allowed online graduate students to form distinct individual impressions of other classmates. Students contended that they "got to see more of the person as opposed to another scholar" (Edwards et al., 2012: 38). Similarly, Janzen, Perry, and Edwards (2017) showed that almost half of online graduate students who used APTs reported that they got to know themselves, their classmates, and their instructor through these activities. Online graduate students also reported that their classmates seemed more "real" because of their interactions during arts- inspired learning (Janzen, Perry, and Edwards, 2017). Overall, APTs provide an environment that fosters meaningful connections with other online classmates and the learning milieu (Ryan, Feld, and Yarrison, 2020).

Many studies found APTs in online classrooms increase student interactivity and participation (Ike, Postlethwait, and Parker, 2019; Raymundo, 2020). Arts-infused teaching promotes online community formation (Raymundo, 2020; Sanjnani, Mayor, and Tillberg-Webb, 2020). According to Edwards et al. (2012: 37), one-third of online students who used PV found it created a "warm sense of community". One participant using PV linked the words "informal" and "chat" when describing the experience; these words are associated with feelings of comfortability (Edwards et al., 2012: 38). Janzen, Perry, and Edwards (2017) found that over 90% of online graduate students who used APTs reported feeling comfortable interacting with other classmates. Kates, Byrd, and Haider (2015) found that shy students felt arts inspired learning offered a rewarding and fulfilling community experience.

Arts-infused teaching invites learners to engage in socioemotional learning, which nets the benefits of an aesthetic presence (Sajnani, Mayor, and Tillberg-Webb, 2020). The aesthetic dimension of learning allows for higher-order thinking and meeting affective learning outcomes (Sajnani, Mayor, and Tillberg-Webb, 2020). Aesthetic presence requires "attention to the use of enactive, iconic, symbolic, embodied, and other sensory strategies may animate conversation, foster openness and connection, encourage flexibility and critical thinking, and facilitate conversations about emergent and emotionally difficult themes" (Sajnani, Mayor, and Tillberg-Webb, 2020: 4). The aesthetic learning environment also provides a relaxing and calming experience for students (Carroll and Kop; 2016). The experience of art is "a medium for expression, but also a portal where I can dive into a parallel universe, away from the hectic schedules and vibrating blackberries" (Cox, Brett-MacLean, and Courneya, 2016: 70). One respondent argued that "one cannot undermine the power the process of art-making has to instill tranquillity" (Cox, Brett-MacLean, and Courneya, 2016: 70). This experience of calmness and comfort students found when engaging in APTs leads to active participation in class, increasing the possibility of transformational learning.

3.3 Art-inspired approaches cultivate a sense of personal empowerment

Cox, Brett-MacLean, and Courneya (2016: 76) found "the creativity that fuels art-making provides a sense of release, an avenue for self-expression and exploration of emotional, spiritual and other humanistic qualities of medicine that are sometimes neglected in the effort to master the science of medicine". Arts-infused learning evokes emotion which is vital in the education of health professionals since these students "are often taught that illness is a problem to be solved through objective means, denying the emotional experience of professional practice" (Haidet et al., 2016: 325). One arts-inspired learner was surprised that "there was so much room for imagination and creativity in thinking of a person, patient or illness" (Potash, 2014: 4). Moreover, arts-inspired pedagogy provides an innovative and valued opportunity to self-express learning (Kelly et al., 2013).

APTs decrease students fear of expressing themselves while tapping "into potentially hidden talents" (Janzen, Perry, and Edwards, 2017: 12). According to Janzen, Perry, and Edwards (2017), APTs can promote vulnerability, enhance creativity, and allow learning communities to embrace risk-taking. Although creativity requires risk-taking, it can yield valuable 'aha' moments (Janzen, Perry, and Edwards, 2017). Art-inspired teaching strategies allow learners to construct and build on previous knowledge; since every learner is unique, so are their learning experiences (Janzen, Perry, and Edwards, 2017). Janzen, Perry, and Edwards (2017) reported that their online student participants felt empowered and in control of their learning when engaging in APTs. Moreover, APTs allowed students to personalize their learning by pulling together course concepts and sharing them in a meaningful and unique way (Janzen, Perry, and Edwards, 2017).

APTs empower by facilitating reflection and changes to professional behaviour (Loignon et al., 2014). Cox, Brett-MacLean, and Courneya (2016: 72) concluded, "art is integral in shaping how medical students link their educational experiences to an emerging vision of how they will practice medicine". APTs have encouraged students to reflect on their evolving professional identity (Cox, Brett-MacLean, and Courneya, 2016). This reflection allows learners to explore and discover their professional identity (Trout, Perez, and Christensen, 2019). Furthermore, Cox, Brett-MacLean, and Courneya (2016: 76) concluded that, "art-making as a practice offered both students and practitioners the opportunity to identify and visually depict deeply personal, salient aspects of the process of becoming a physician, learning to practice medicine, and striving to be a compassionate healer". This journey of self-reflection and self-discovery can be personally and professionally empowering for learners.

3.4 Art-inspired learning requires educators to implement an intentional and skilled approach

Art-inspired learning requires educators to be skilled and intentional. Deliberate course design allows for aesthetic learning that involves the senses (Carroll and Kop, 2016). Leonard, Hafford-Letchfield, and Couchman (2018) recommend that the philosophy behind the inclusion of APTs should be explained to students before introducing them to related activities.

When using the arts, instructors first need to establish rapport, which is defined as the experience of being in sync with the other person (Edwards et al., 2012). Rapport "is developed through social interaction, and interaction furthers the development of rapport" (Edwards et al., 2012: 33). Art-inspired educators must provide ongoing support and encouragement to students as they engage in what are often unfamiliar and challenging learning activities (Sajnani, Mayor, and Tillberg-Webb, 2020).

In addition to rapport, educators must encourage interaction and discussion to maximize the positive consequences of arts activities (Ike, Postlethwait, and Parker, 2019), especially during initial stages of these activities (Edwards et al., 2012). Questioning and prodding are recommended pedagogical strategies to facilitate discussion (Ike, Postlethwait, and Parker, 2019; Loignon et al., 2014). Trout, Perez, and Christensen (2019) note students need reassurance and mentorship as they attempt new ways of learning, such as looking for symbolism in an image or composing a poem about a sensitive topic. Debriefing after completing a challenging activity was discussed as a supportive teaching approach (George, Stuckey, and Whitehead, 2013; Loignon et al., 2014).

Art-infused learning requires educators to be transparent (Haidet et al., 2016), authentic, and enthusiastic (Kates, Byrd, and Haider, 2015). Educators must value student-centered learning and be willing to engage with students (Kates, Byrd, and Haider, 2015) as active participants in the learning journey (Haidet et al., 2016). Integrating the arts in learning requires educators recognize and address learner discomfort (Haidet et al., 2016). Guidance, motivation, and quality feedback from educators is essential (Kates, Byrd, and Haider, 2015). Effective educators act as facilitators and scaffolders of student learning (Trout, Perez, and Christensen, 2019) and nurture purposeful interactions with students (Edwards et al., 2012). Kates, Byrd, and Haider (2015) emphasize online educators using APTs must be skilled with interpersonal communication.

Efforts to reduce power hierarchies between instructors and students are required to create trusting and safe learning environments (Haidet et al., 2016). Doing so increases learners' comfort interacting with other students and the teacher (Haidet et al., 2016). Additionally, in a study by Janzen, Perry, and Edwards (2017), two student APT participants expressed the need for mutual respect as a building block for creating safe learning environments where feelings can be expressed. Establishing a safe environment as a starting point for successful engagement in APTs was a common theme throughout the literature (Haidet et al., 2016; Janzen, Perry, and Edwards, 2017).

3.5 Theoretical foundations supporting art-inspired pedagogy in online education

The most common theoretical foundation used to support APT was constructivism (Edwards et al., 2012; Kates, Byrd, and Haider, 2015; Haidet et al., 2016; Raymundo, 2020; Trout, Perez, and Christensen, 2019). Kates, Byrd, and Haider (2015) recommend an active constructionist approach encouraging learners to construct knowledge external to their learning milieu. This yields meaningful, relevant, student-centered learning (Kates, Byrd, and Haider, 2015).

Using the arts to facilitate learning provides subjective data that is different for the maker and the viewer (Haidet et al., 2016). In other words, the "construction of meaning for a viewer are shaped by the culture and experiences of the artist, the culture and experiences of the viewer, and the time and place in which the art is encountered" (Haidet et al., 2016: 324). Social development theory (Vygotsky, 1978) is foundational to this claim.

Raymundo (2020) discussed Lin's (2011) creative pedagogy framework, which has three elements: 1) creative teaching; 2) teaching for creativity; and 3) creative and active learning. Creative pedagogy requires these three elements to nurture creativity as learning occurs "spontaneously by actively and creatively engaging with their environment through activities such as inquiring, experimenting, searching, manipulating and the like, rather than passively accepting knowledge from authority in the form of teachers or books" (Torrance, 1970 as cited in Raymundo, 2020: 102). Ryan, Feld, and Yarrison (2020) further discuss active learning using Kolb's experimental learning theory, which requires students to participate, observe, and reflect on new experiences to gain insight and knowledge. According to the experimental learning theory, learners can apply new knowledge and insights to practical and future settings (Ryan, Feld, and Yarrison, 2020).

Loignon et al. (2014) demonstrated PV could be used to change attitudes, prejudices, and biases regarding socioeconomically disadvantaged patients. Students began to desire social change as they moved through a three-step learning process (Loignon et al., 2014). First, engaging reflexively feels uncomfortable as students reflect on what poverty means to them (Loignon et al., 2014). Collective awareness and openness occur as participants discuss their prejudices about poverty (Loignon et al., 2014). Second, breaking through occurs as the ethical moment presented allows learners to reflectively question their current assumptions on poverty (Loignon et al., 2014). The last phase, taking action, is empowering as participants "report undergoing transformations in their perceptions of themselves and of the world" (Loignon et al., 2014: 5). Essentially, Loignon et al. (2014: 5) demonstrated how the arts can "be a means for expanding social consciousness and triggering social change because its use fosters both reflection and action".

The Quantum Perspective of Learning (QL) explains why APTs are effective (Janzen et al., 2011). QL argues that everything is connected, and learning is the process of discovering these connections (Edwards et al., 2012). Interaction plays a vital role in QL (Edwards et al., 2012) and is further discussed in the SITE model (Janzen, Perry, and Edwards, 2012). Student interaction creates safety and comfort within learning environments, promoting risk-taking and creative learning opportunities (Janzen, Perry, and Edwards, 2019). The "SITE Model which espouses that for learning environments to be successful, all elements (students, instructors, technology and environment) must be present and intersect resulting in Quantum Learning Environments that grow evolve and are living environments" (Janzen, Perry, and Edwards, 2017: 13).

3.6 Research methods that facilitated the study of arts-inspired teaching and learning within online education

APTs in online education were studied using various qualitative, quantitative, and mixed methods, including grounded theory (Trout, Perez, and Christensen, 2019), exploratory methods (Loignon et al., 2014), focus groups (Kates, Byrd, and Haider, 2015), and phenomenology (Raymundo, 2020). Data collection methods included online questionnaires, narratives, reflective essays, collaborative group projects, and social media (Ryan, Feld, and Yarrison, 2020). PV (Ryan, Feld, and Yarrison, 2020) and digital storytelling (Kates, Byrd, and Haider, 2015) were used to study the effects of APTs within online environments. Data analysis methods included debriefing (Loignon et al., 2014), coding (Cox, Brett-MacLean, and Courneya, 2016; Loignon et al., 2014), interpretation (Loignon et al., 2014), descriptive statistics, and NVivo (Janzen, Perry, and Edwards, 2017).

4. Discussion

Art-infused learning potentially leads to a transformational experience when educators adopt new beliefs regarding creativity, failure, and risk-taking. Educators who choose to use APTs need to embrace a specific pedagogical framework. Theoretical foundations are essential to supporting art-inspired pedagogy as a disruption in online education.

4.1 Art-infused learning as a long-lasting transformative experience

Arts can fuel transformation in learners. APTs allow students to construct and create knowledge and present this within their online social milieu (Kates, Byrd, and Haider, 2015). Arts-inspired knowledge construction involves key affective and cognitive domains and can change students' attitudes and biases so that their views align with the values of their disciplines. This transformation changes the way students see themselves, others, and the world.

Haidet et al. (2016) suggest that APTs raise learner self-awareness, address learner discomfort, and help students cope with ambiguity. Students can use creative thinking facilitated by the arts to adapt to real-world issues and to translate theory into practice (Raymundo, 2020). Moreover, APTs bring out feelings of humanity and closeness to self and others (Cox, Brett-MacLean, and Courneya, 2016). This sense of being part of humanity helps promote resilience and reduce burnout. As one respondent stated, "my greatest fear has been to lose what makes me human… each person defines their humanity differently, but for me it is my ability to feel – to feel the beauty of life or the tragedy of illness" (Cox, Brett-MacLean, and Courneya, 2016: 73). Overall, art allows healthcare students to learn "how to remain in close touch with themselves as thinking and feeling human beings," making them more empathetic practitioners (Cox, Brett-MacLean, and Courneya, 2016: 73). APTs can make the online milieu feel real and infused with humanity.

APTs evoke emotion that promotes vulnerability (Janzen, Perry, and Edwards, 2017). Cox, Brett-MacLean, and Courneya (2016) urge that art-making is a means of emotional release and freedom. One medical student described artistic creativity as making them "feel more integrated in terms of body, mind, and spirit" (Cox, Brett-MacLean, and Courneya, 2016: 71). Arts-infused learning activities can support students in escaping life stressors and encourage self-care practices.

4.2 Evolving beliefs on the role of creativity, failure, and risk-taking in meaningful learning

Failure and creativity appear to be contrasting themes. Fear of failure has negative impacts on learning, future professional practice, and limits risk-taking. Creativity requires and facilitates risk-taking and fosters a new perception of failure (Raymundo, 2020). The 21st-century learner, educator, and practitioner must fully embrace both creativity and risk-taking with a positive view of failure seeing it as a learning opportunity. APTs inspire exploration and self-discovery. Educators should encourage students to find their own voices and construct their professional identities. Creative arts empower learners to build knowledge, values, biases, and beliefs that support professional excellence. The result is new ways of thinking, doing, and being. Embracing creativity, failure, and risk-taking helps develop innovative leaders and change-agents. These qualities help create the next generation of scholars, researchers, educators, and professionals.

4.3 The role of the art-inspired educator

Arts-inspired teaching requires a transformational shift in the way teachers see education, learning, learning environments, students, and their role. Using art requires an intentional, authentic, and student-centered educator who respects learners as experts and leaders of their learning (Kates, Byrd, and Haider, 2015). This shift in control reduces hierarchies and enhances art-inspired learning (Haidet et al., 2016) by allowing teachers to be more available to students. This is vital since art-inspired learning requires educators to tap into a student's prior knowledge utilizing it to facilitate learning (Kates, Byrd, and Haider, 2015). Further, this transformation cultivates the scaffolding process, and together students and teachers discover connections and uncover emotions. The act of personalized encouragement within art-inspired pedagogy is, therefore, a vital skill. Educators who believe in the value of art in learning invest in rich-aesthetic teaching-learning environments that engage "a powerful mix of higher order thinking skills, imagination, creativity, self-regulated learning, and affective, socioemotional engagement" (Sajnani, Mayor, and Tillberg-Webb, 2020: 3). A creative instructor can transpose art-inspired strategies to almost any discipline or course topic.

4.4 Theoretical foundations supporting art-inspired pedagogy as a disruption in online education

Many theories on APTs could form a conceptual framework for research on APTs as a disruptive pedagogy in online education. As a disruptive pedagogy, APTs encourage educators to identify and challenge assumptions inherent in traditional online teaching, including contemporary views on learning and student and educator roles. Constructivism acknowledges the valuable role of external constructs that each learner brings to their learning milieu. Lin's (2011) creative pedagogy framework demonstrates how educators can nurture creativity and spontaneous learning (as cited in Raymundo, 2020). Transformational learning is elaborated on by Kolb's experimental learning theory, which reveals how experimenting with art can yield new insights that play a role in applying new knowledge to real-world settings. The three-step learning process by Loignon et al. (2014) further supports this notice by linking art-inspired teaching strategies to social change as learners reflect, make connections, and adopt values that congruent with their profession. Arts-inspired strategies support attainment of affective domain learning outcomes essential for healthcare practitioner success.

5. Gaps and future research recommendations

Existing research gaps of APT use in online education include creativity (Raymundo, 2020), aesthetic presence (Sajnani, Mayor, and Tillberg-Webb, 2020), information visualization (Carroll and Kop, 2016), rapport development (Edwards et al., 2012), and risk-taking and vulnerability (Janzen, Perry, and Edwards, 2017) are aspects of APTS of interest. Future research into the use of the arts in education could include the creation and testing of strategies based on other art forms such as sculpture, dance, drama, or music. Research methods that are participatory would be well suited to assess the impact of these strategies on students and teachers are suggested. Additionally, using art to disrupt the way students develop collaboration and leadership skills (Kates, Byrd, and Haider, 2015) and the effects of art on breaking through cultural barriers (Haidet et al., 2016) are topics requiring research.

6. Conclusion

This paper provides increased understanding of APTs, ideas for future research, and insights into how arts can disrupt online learning. Arts-inspired knowledge construction involves affective and cognitive domains and has the potential to change attitudes and biases, so they align with those desired in healthcare practitioners. APTs facilitate transformational learning and cultivate a sense of personal empowerment. Although APTs offer a unique pedagogical strength within online classrooms, art-inspired learning requires educators to be skillful and deliberate in their pedagogy. Educators can utilize arts to facilitate transformative experiences and prepare students to address real-world issues (Raymundo, 2020). APTs both require and generate risk-taking, cultivating a new way of thinking, doing, and being. Using APTs nourishes the creation of innovative leaders and change-agents. As a disruptive pedagogy, APT encourages educators to challenge assumptions inherent in traditional approaches to online education. Doing so cultivates contemporary views on learning and on student and educator roles. Overall, APTs provide a transformational experience.

Acknowledgements

Athabasca University (ARF/SSHRC EXPLORE) grant funding.

References

Carroll, F., and Kop, R. (2016) “Coloring the Gaps in Learning Design: Aesthetics and the Visual in Learning”, International Journal of Distance Education Technologies (IJDET), Vol 14, pp. 92-103.

Cox, S., Brett-MacLean, P., and Courneya, C. (2016) “My Turbinado Sugar: Art-Making, Well-Being and Professional Identity in Medical Education”, Arts & Health: An International Journal of Research, Policy and Practice, Vol 8, No. 1, pp. 65–81.

Edwards, M., Perry, P., Janzen, K., and Menzies, C. (2012) “Using the Artistic Pedagogical Technology of Photovoice to Promote Interaction in the Online Post-Secondary Classroom: The Students’ Perspective”, Electronic Journal of e-Learning, Vol 10, No. 1, pp. 34-43.

George, D., Stuckey, H., and Whitehead, M. (2013) “An Arts-Based Intervention at a Nursing Home to Improve Medical Students’ Attitudes Toward Persons With Dementia”, Academic Medicine, Vol 88, pp. 837–842.

Haidet, P., Jarecke, J., Adams, N., Stuckey, H., Green, M., Shapiro, D., Teal, C., and Wolpaw, D. (2016) “A Guiding Framework to Maximise the Power of the Arts in Medical Education: A Systematic Review and Metasynthesis”, Medical Education, Vol 50, 320–331.

Ike, J., Postlethwait, R., and Parker, R. (2019) “Nurturing Context: TRACE, The Arts, Medical Practice, and Health Literacy”, Information Services & Use, Vol 39, pp. 93–104. h

Janzen, K., Perry, B., and Edwards, M. (2017) “Building Blocks: Enmeshing Technology and Creativity With Artistic Pedagogical Technologies”, Turkish Online Journal of Distance Education, January, Vol 18, pp. 4–21.

Kates, F., Byrd, M., and Haider, M. (2015) “Every Picture Tells a Story: The Power of 3 Teaching Method”, Journal of Educators Online, Vol 12, pp. 189-211.

Kelly, M., Bennett, D., O’Flynn, S., and Foley, T. (2013) “A Picture Tells 1000 Words: Learning Teamwork in Primary Care”, Clinical Teacher, Vol 10, pp. 113–117.

Leonard, K., Hafford-Letchfield, T., and Couchman, W. (2018) “The Impact of the Arts in Social Work Education: A Systematic Review”, Qualitative Social Work: Research and Practice, Vol 17, pp. 286–304.

Loignon, C., Boudreault-Fournier, A., Truchon, K., Labrousse, Y., and Fortin, B. (2014) “Medical Residents Reflect on Their Prejudices Toward Poverty: A Photovoice Training Project”, BMC Medical Education, December, Vol 14, No. 1, pp. 1-6.

Perry, B., and Edwards, M. (2010) “Interactive Teaching Technologies That Facilitate the Development of Online Learning Communities in Nursing and Health Studies Graduate Courses”, Teacher Education Quarterly, Vol 37.

Perry, B., and Edwards, M. (2019) “Innovative Arts-Based Learning Approaches Adapted for Mobile Learning”, Open Praxis, Vol 11, pp. 303–310.
Potash, J., Chen, J., Lam, C., and Chau, V. (2014) “Art-Making in a Family Medicine Clerkship: How Does it Affect Medical Student Empathy?”, BMC Medical Education, November, Vol 14, pp. 247 – 256.
Raymundo, M. (2020) “Fostering Creativity Through Online Creative Collaborative Group Projects”, Asian Association of Open Universities Journal, Vol 15, pp. 97–113.
Ryan, M., Feld, H., and Yarrison, R. (2020) “Using Photovoice to Encourage Reflection in Health Professions Students Completing a Short-term Experience in Global Health”, American Journal of Pharmaceutical Education, Vol 84, pp. 474–483.
Sajnani, N., Mayor, C., and Tillberg-Webb, H. (2020) “Aesthetic Presence: The Role of The Arts in the Education of Creative Arts Therapists in the Classroom and Online”, The Arts in Psychotherapy, July, Vol 69, pp, 1-9.
Trout, I., Perez, B., and Christensen, M. (2019) “Connecting Classroom to Community Through Photovoice: Pedagogical Implications”, LEARNing Landscapes, Vol 12, pp. 285–301.
Vygotsky, L. (1978) Mind in Society: The Development of Higher Psychological Processes, Harvard University Press, London.

Using Arts-Based Instructional Strategies in Hybrid, Face-to-Face, and Online Nursing Courses

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DOI: 10.34190/EEL.21.019

Abstract: Background: Student disengagement is a far-reaching problem negatively affecting the educational environment and learner success. Educators need to be deliberate in their efforts to enhance learner engagement, beginning by using teaching strategies that help to create inspiring learning environments. Purpose: This paper explores the research question, What is the effect of arts-based instructional strategies on nursing student engagement in hybrid, face-to-face, or online learning environments from the instructors' perspective? Methods: A convenience purposive sampling process was used. We selected potential participants from a list of academics who had recently published articles in peer-reviewed journals on topics related to using arts-based instructional strategies in nursing education. Of the twenty-five potential participants contacted via email, 4 responded, provided informed consent, and were interviewed. Data were collected through one-to-one Skype or telephone interviews. The interviews were audio and/or video recorded, transcribed, and thematically analysed. Specifically, the interview transcripts were read several times by members of the research team. Fragments of sentences (or groups of sentences expressing a key idea) were highlighted by each team member independently. Team members then grouped these to identify core themes. Once the thematic analysis was completed by research team members independently, they compared themes identified and looked for commonalities and outliers. Through a process of discussion and negotiation, themes identified were merged, collapsed, and or renamed until team members agreed that the final themes were representative of the participants' comments. Conclusion: Associations were found between the use of arts-based instructional strategies and educator reports of a more inspiring humanized learning environment, enhanced trust between students and the instructor, connection among participants in the learning community, and increased opportunities for learner self-expression. From the perspective of the instructors, these outcomes led to enhanced student engagement. Interestingly, instructors reported that when students were more engaged, they were similarly motivated and engaged in the teaching process.

Keywords: art-inspired teaching, arts-based learning, instructional strategies, nursing education, learning environment, learner engagement

1. Introduction

This paper explores the experiences of instructors who use arts-based instructional strategies in teaching nursing students in hybrid, face-to-face, or online courses. Four instructors who purposefully used arts-based approaches in their teaching were interviewed. The interviews were transcribed and thematically analyzed. Associations were found between the use of arts-based approaches and instructor reports of a humanized learning environment, enhanced trust and connection among students, and increased opportunities for self-expression. These outcomes increased student and teacher engagement. The Community of Inquiry (CoI) model (Garrison et al., 2001) provides a foundation for understanding why arts-based strategies have these positive outcomes for students and teachers.

2. Background literature and conceptual framework

Engaged students learn (Svanum and Bigatti, 2009). However, student disengagement is a far-reaching problem in education today (Chipchase et al., 2017). Student engagement is positively correlated with post-secondary persistence, academic achievement, student retention, student satisfaction, and educational completion (Chip chase et al., 2017). Consequently, engaging students should be a priority for educators. Engagement is a multi-dimensional concept (Svanum and Bigatti, 2009). In their seminar work Bomia et al. (1997: 297) characterized student engagement as a "student's willingness, need, desire and compulsion to participate in, and be successful in, the learning process promoting higher level thinking for enduring understanding". Robinson and Hullinger (2008: 101) built on the Bomia et al. definition, concluding that engagement is "the efforts of students to study a subject, practice, obtain feedback, analyze and solve problems".

Student engagement is linked with the quality of the learning environment. According to a National Survey of Student Engagement (2011), engaging learning environments i) provide academic challenge and empowerment; ii) promote student-faculty interaction, iii) offer collaborative and active learning; iv) present enrichment opportunities; and v) are student-centered. Further, students are most engaged in learning environments that promote synthesis, judgment-making, and analytical thinking (Robinson and Hullinger, 2008). Experiential, integrated, creative, and group-based learning activities lead to increased student confidence, creative performance, independence, and intrinsic motivation (Yuan et al., 2019). Moreover, Kim (2012) found that engaging learning environments create and promote both intrinsic value (capture interest/stimulate curiosity) and extrinsic (instrumental use, meet needs/goals, real-world applicability). Engaging learning environments are facilitated by educators who communicate high expectations, value collaboration with learners, promote a high degree of student-teacher interactivity (Yuan et al., 2019), offer clear feedback, include personal support, are dynamic (Kim, 2012) and incorporate technology (Revere and Kovach, 2011).

In summary, engagement is a complex process accomplished through multiple means. It can be understood as having student and educator components focused on specific actions. For students, engagement is seen as the time and energy expended on academic activities and for teachers engagement is the deliberate use of effectual educational practices to focus student energies toward purposeful learning activities. Overall, engagement reflects a “rendezvous” between learning, technology, and pedagogical techniques that enliven students (*Deneen*, 2010: 1) and teachers.

Creating Engaging Pedagogy*.* Engaging pedagogy creates learning environments that optimize learning and forge alliances between instructors and students and among learners (Lear et al., 2010). A melding of interactivity, creativity, and technology facilitates these ends (Edwards-Groves and Davidson, 2020). Engaging pedagogy is essential no matter whether learning occurs online, face-to-face, or in a hybrid model. Cardenas (2011: 4) emphasizes that “conventional teaching promotes the separation of online and traditional classes,” and Cardenas calls for pedagogy that blurs these lines and is effective in all learning environments. Despite a growing body of literature on face-to-face teaching strategies applied in online classrooms (Brown, 2018), studies focused on creative and interactive teaching strategies used in online, hybrid, and face-to-face learning environments are lacking (Perry and Edwards, 2010). Does pedagogy that engages students in online learning environments have the same positive effects in face-to-face and hybrid learning situations? This study begins to answer this question.

The Changing Face of Education. Online learning is now commonplace and educational institutions that are not adopting a total online approach are often at least offering some courses (or a portion of a course) online in a hybrid model. The landscape of contemporary education has shifted exponentially over the last decade, and with the crisis of COVID-19, the move to online learning has become almost ubiquitous (Edwards-Grove and Davidson, 2020). This shift is also influenced by the rapid and changing ways individuals interact “in their interpersonal, virtual, digital, and textual spaces” (Edwards-Grove, 2012: 110). Another trend is toward creating “partnerships in learning rather than the traditional, [teacher-centered] hierarchy of education” (Brown et al., 2008: 283). Developing partnerships involves finding creative, interactive teaching strategies that invite, engage, motivate, and sustain learners (Edwards-Grove, 2012). Artistic Pedagogical Technologies (APTs) (Perry and Edwards, 2010) help create these partnerships.

Artistic Pedagogical Technologies. APTs are arts-based teaching strategies distinguished from traditional teaching strategies by their emphasis on aesthetics and their heightened link to creativity (Perry and Edwards, 2010). APTs can include literary, visual, musical, or drama elements. Research demonstrates that the arts evoke emotional responses in humans as areas of the brain responsible for emotion are activated by various art forms (Cupchik et al., 2009). APTs have been shown to humanize the online learning milieu (Melrose et al., 2020).

Research conducted by Perry and Edwards (2010) explored how APTs positively influence post-secondary online learning environments and student learning. APTs provide a genuine and authentic medium for instructors and students to engage in partnership with one other, with technology and educational content. APTs initiate, sustain, and enhance interaction between students and instructors and help develop community, group identity, and social connection (Perry et al., 2011). Further, APTs stimulate creative thinking, capture student attention, extend the application of course content, contribute to positive learning outcomes, and help develop a sense of professional fulfillment for instructors (Perry and Edwards, 2010). Finally, online students reported a positive influence on not only course interactions but their comfort in the educational milieu and noted that APTs aided them in getting to know themselves, classmates, and instructors (Edwards et al., 2011). In sum, APTs have been used and evaluated in the online, post-secondary undergraduate and graduate classrooms with positive outcomes for teachers and learners. Those effects included enhanced learner engagement and teacher-student partnerships.

The Community of Inquiry Model (CoI). The CoI model can help explain why APTs positively impact student engagement and learning. The CoI model highlights the attributes of social presence, cognitive presence, teaching presence, and their subsets of supporting outcomes, selecting content, and setting climate. In the CoI, all the above attributes (and their subsets) intersect to form the educational experience and learning (Garrison, 2016).

Specifically, cognitive presence relates to reflective thought and problem-solving opportunities in the learning context that involve four steps: triggering event, exploration, integration, and resolution (Garrison et al. 2010). Teaching presence relates to course design and instruction. Social presence is aspects of the online teaching and learning milieu that make it seem to online learners that other participants in the learning community are 'real'. Social presence is achieved through interaction and active involvement between students and the instructor and among learners. The various presences interconnect and influence one another, facilitating learner engagement. However, the interaction must promote “deep engagement and genuine critical reflection” related to course content for optimum learning (Garrison et al. 2010: 23).

3. Methodology

Research Questions. The overarching research question was, What is the effect of arts-based instructional strategies on nursing student engagement in hybrid, face-to-face, or online learning environments from the instructors’ perspective? Participants were asked why they choose to use APTs, the types of strategies they use, and their observations regarding how these strategies influenced the learning environment, the learners, and themselves (the teachers). Those interviewed compared the effects of APTs in the various learning environments in which they taught (online, face-to-face, and hybrid). Participants were also asked about their views of the alignment of arts-based instructional approaches with educational theory, specifically how they found using arts-based instructional approaches influenced the cognitive, social, and teaching presence outcomes as described in the CoI. Finally, participants were asked how arts-based strategies align with helping students achieve different types of learning outcomes and if other faculty members use the same strategies with similar results.

Sample. A convenience purposive sampling process was used. All 4 participants were recruited from a list of academics who had recently published articles in peer-reviewed journals on topics related to using arts-based instructional strategies in nursing education. After collecting publicly available professional email addresses for 25 individuals who met these criteria, an email invitation to participate was sent to each person. Potential participants were invited to contact the research assistant (RA) via email with questions about the study. Those who were interested received an email consent form which they signed and returned to the RA. The RA then contacted the participant and arranged a date, time, and medium for participation in the interview. Of the 25 potential participants contacted, 4 responded, provided informed consent, and ultimately were interviewed. Research ethics approval for the study was granted by the researcher’s affiliated university research ethics board prior to contacting potential participants.

Description of Participants. The table below briefly describes study participants, including where they are located geographically, the level of learners they teach, their teaching mode(s), and the types of arts-based strategies they use.

Table 1: Table of participants

Participant Number	Location	Level of Learners	Teaching Mode	Types of Arts-Based Strategies Used
Participant 1	USA	doctoral and undergraduate	face-to-face and synchronous videoconferencing online	photo interpretation, metaphors, role-playing
Participant 2	Canada	masters and doctoral	face-to-face	digital storybook, photo essay (describe a photo related to theme)

Participant Number	Location	Level of Learners	Teaching Mode	Types of Arts-Based Strategies Used
Participant 3	USA	undergraduate and masters	face-to-face and hybrid (synchronous online and face-to-face)	poetry, student-created videos and documentaries, student-created artwork (draw, clay, etc.), group mural painting
Participant 4	Canada	undergraduate, masters, and faculty	online, hybrid, and face-to-face	wordle, poetry, interpretation of art and music, photo interpretation, idea quilt

Data Collection. Data were collected through one-to-one interviews with educators who consented to participate in audio and or video recorded telephone or Skype interviews. The 40-minute interviews were conducted (and transcribed) by the RA. Interview recordings and transcriptions are stored on a password-protected computer. The RA assigned participants pseudonyms. The transcripts (with pseudonyms) were shared with the principle and co-investigators and again stored on password-protected computers. Data exists only in electronic form and will be electronically shredded once the study is published.

Data analysis. Data were analyzed using thematic analysis. Specifically, the interview transcripts were read several times by members of the research team. Fragments of sentences (or groups of sentences expressing a key idea) were highlighted by each team member independently. Team members then grouped these to identify core themes. The discovery of themes was aided by using three points of reference; 1) recurrence of ideas within the narrative data (ideas that have the same meaning but different wording); 2) repetition (the existence of the same ideas using the same wording); and 3) forcefulness (verbal or nonverbal cues that reinforce a concept) (Owen, 1984). Once the analysis process was completed by the research team members independently, they compared the themes they identified and looked for commonalities and outliers. Through a process of discussion and negotiation, themes were merged, collapsed, and renamed until team members agreed that the final themes best represented participants' comments.

Rigour. We upheld Guba and Lincoln's (1994) criteria (credibility, dependability, confirmability, and authenticity) to establish rigour in this study. For example, to achieve confirmability, the principle investigator kept reflexive notes during the process to help her reveal hidden biases that could impact data collection and analysis. Authenticity (the value of the research for others) is achieved when others integrate findings into their own practice as educators.

4. Findings

Qualities of Instructors Who Choose to Use Arts-Based Teaching Strategies. When asked what prompted them to include APTs in their courses, all participants noted that they sought means to enhance learner engagement. These educators all identified themselves as "risk-takers" who were actively seeking ways to enhance the learning experience for students. Participants 2 and 3 pointed to their backgrounds as artists in their personal lives as the reason they anticipated arts-based strategies would have positive outcomes in the learning environment. Participant 1 noted that using art-inspired approaches aligns with her teaching philosophy and goals.

All reported that they enjoyed watching students benefit from their use of arts in their learning and found satisfaction in seeing students achieve positive learning outcomes through art-inspired activities. Moreover, all participants stated that they were encouraged to continue using these teaching approaches (and seeking new options to expand their teaching repertoire) because of the positive impact the strategies had on student learning. As participant 4 stated, "I really loved watching this process of enhanced learner engagement and the heightened learning that happens when students are invited to complete an arts-based activity".

Mutual Benefit for Students and Instructors. There appear to be benefits for both instructors and students when APTs are used effectively. Participant 1 pointed to a realization students and educators often come to when art (in its many manifestations) is part of the class. Specifically, participants become aware that they are connected in a very human way and that "we are all socialized to certain viewpoints and discourses." This discovery of a basic likeness within our uniqueness helps to bond the class community and united students and educators in the common goal of learning. Participant 1 elaborated, saying arts-based approaches promote "acceptance of difference (and of knowing that difference) which is a very good thing." This realization leads to students and instructors embracing the positive impact of diversity on learning and their personal lives.

APTs invigorated the learning environment, which teachers and students both found beneficial. As learners engaged in the various art-inspired activities they started having fun, and the class was infused with laughter and increased positive energy. Participant 4 said, "as student engagement and interest improved so did my own as their instructor." Upbeat learning environments have been found to change attitudes and build confidence in learners. All-around health and well-being of teachers and learners is nurtured when the learning milieu is infused with positive energy (Joseph, 2019).

Choice of pedagogy (including the nature of instructional strategies) can profoundly affect how enjoyable the learning experience is for students and teachers. When educators create a learning milieu that is upbeat, energized, and fun, students experience increased motivation to participate fully in the learning experience. A cycle of positivity is generated resulting in more inclusive learning environments and increased potential for constructive change in students (Brydon-Miller, 2018).

Effects of Using Arts-Based Teaching Strategies on Students. Participants observed specific effects of APTs on students. The positive outcomes included learners being comfortable because of the positive learning milieu, a humanizing of the learning environment, an increased sense of community, and more opportunity for self-expression.

Leaner Engagement Supported by Increased Enjoyment and Comfort. All educators who participated agreed that arts-based approaches enhanced learner engagement. In looking deeper at precursors to enhanced engagement, Participant 3 noted that APTs "take the nervousness out of people" at the outset of the class so that they can feel comfortable participating. When students feel comfortable in the learning environment, they "ask more questions and make more comments" (Participant 3). She added "People have more fun learning when they have something that they are making and doing as part of the learning process" (Participant 3). When people "have fun while learning, they become engaged and excited about what they are learning, they feel apart of things, and they learn more deeply" (Participant 3). Finally, Participant 3 summarized the enjoyment and comfort outcomes of these approaches saying, "it leaves a good feeling." Art-infused learning activities helped reduce tensions in students and in the classroom (whether online or face-to-face) allowing learners to feel comfortable, engaged, and open to learning.

Humanizing the Learning Environment. Participants commented that APTs reveal common human bonds. As Participant 3 said, these strategies "open people up to being aware of themselves and others in the room in a distinct way." Participant 1 added to this view noting students come to relate to "humanity" in a new way as they are triggered to "deconstruct their views on topics such as racism and nationalism and the human condition," using arts as a medium for this undertaking. As Participant 4 noted, "arts engage students and our own interests", commonalities are discovered, and meaningful learning results.

Experiencing and Expressing Emotion and Creative Expression of Essential Human Qualities. Participants noticed that poetry, music, and photography often triggered tears and laughter in the class. Emotion was experienced equally by teachers and learners, again exposing their shared humanity. Early educators realized arts humanizing learning by providing an avenue for creative expression (Fowler et al., 1991). Creativity is a means of honest self-reflection that helps students "build bridges to the global community and the broader culture" (Fowler et al., 1991). Through arts-inspired activities, learners become sensitize to their emotions, values, biases and come to see the similarities between themselves and others. More inclusive viewpoints are the desired outcome; to realize that no human is greater or lesser than another. Such a view results in professionals who are potentially more caring and compassionate in their practice.

Collaborating with Art-Based Activities Enhances Trust, Connection, and a Sense of Community. Participant 1 discussed the link between students participating in APTs and the development of trust among class members. She said, "trust is actually listening to somebody, being aware of who they are, acknowledging their presence" and collaborating on art-inspired projects helps this happen (Participant 1). As "the class members begin to engage with one another, it creates trust because it's relational and encourages them to look at each other in deeper and more complex ways" (Participant 1). With trust comes "community, finding of individual voice, and engagement" (Participant 1).

This established trust is foundational to the creation of connection and a sense of class community. Participant 3 commented when you forge these community and social bonds, the links made during a semester often extend beyond the actual course. She noted when APTs were utilized, class members often achieved long-lasting social and professional bonds that "lasted long beyond their classroom days." Though participants did not consider social connections the primary reason for using APTs, these unintended consequences were reported by participants as the most meaningful collateral lessons. Class members who were involved in arts-infused learning activities are more likely to have "continuing conversations" after the course concludes (Hunter-Doniger, 2018: 17). The sense that you are not alone, that you are connected to a bigger community, is invaluable in building sensitivity to self and to others which in turn fuels the value of social justice. Nurturing a deep sense of social justice in novice health professionals was a competency the study participants valued.

Facilities Self-Expression. Helping students express ideas, questions, insights, and conclusions confidently and competently is a goal of educators in all types of learning environments. Participant 1 concluded that art "creates a context which invites people to express themselves." As Participant 3 said, the insights generated when students engage in these strategies are often "more personal and realistic" that occurs in activities that are depleted of human emotion such as authoring a literature review paper or answering a multiple-choice quiz.

Participant 3 observed when "you take a totally professional person, and you assign them to do a comedy … they learn to engage with other people" because they are pushed out of their usual ways of expressing themselves. In art-infused activities learners are encouraged (and supported) to take risks and to tap into their creative energies to express their ideas in unfamiliar ways. Challenging standard forms of expression can lead to increased self-awareness and confidence to express once hidden (or unformed) ideas in new ways.

Participants all reported that students become progressively confident and skilled at self-expression. Initially, students were hesitant to reveal their emotions and views (especially controversial views) related to a course topic, but ATPs gave them an avenue to express their opinions and deeper-held thoughts. Enhanced self-awareness resulted. Hunter-Doniger (2018: 17) concluded that employing aesthetic processes helps learners to "examine, uncover, and voice new, more complex knowledge".

5. Discussion

The CoI model (Garrison et al., 2010) provides concepts and understandings that help to explain why APTs integrated into online, hybrid, and face-to-face course design (and deployed by skillful instructors) can enhance the potential for student achievement. The primary effect of APTs is constructive engagement between the learner and instructor, among class members, and between learners and course content. First, considering cognitive presence, when students are asked to use their artistic side to draw an image of a course concept, they must first reflect on the underlying meaning of the concept. They may have to use problem-solving to move their understanding of a theory or concept to a pictorial form. These mental activities challenge learners' cognitive abilities.

With social presence, arts-based strategies necessitate that learners reveal their attitudes and personalities through artistic creations or interpretations. For example, if a student writes a poem to depict a course concept, the type of poem, content, and cadence all reveal aspects of the contributor's character. The energy (laughter or profound aha moments) that come with the sharing of art compositions within the class helps establishment social relationships (presence). Teachers and students become "real" to one another as they expose their human qualities.

Finally, the revised CoI includes emotional presence, "the outward expression of emotion, affect, and feeling by individuals and among individuals in a community of inquiry" (Cleveland-Innes and Campbell, 2012: 290). In the online classroom, digital interactions can translate into digital caring; in online nursing classrooms this establishes the core value of caring in the profession (Sitzman, 2017). Inviting students to share their learning through arts allows for the expression of "emotion, affect, and feeling" establishing an emotional presence within learning environments. The arts are an avenue for the expression of emotion, and they create emotion in others when shared. Moreover, social-emotional student engagement further builds community and feelings of closeness (Astleitner, 2018). As Perry and Edwards (2019: 309) stated, "strategies that aim to help learners feel that sense that they are part of a community of learners, and that focus on social—emotional as well as cognitive learning outcomes, are essential to success with distance learning". In summary, the various CoI presences interconnect and influence one another, facilitating learner engagement, a positive learning experience, and achievement of learning outcomes.

However, there are limitations or prerequisites for arts-based approaches to achieve these broad goals. Garrison et al., caution that the interaction must promote deep engagement and genuine critical reflection related to course content for optimum learning to occur (2010). Participant 2 noted, "Its hard to measure the learning that arises from arts-based teaching strategies." Assessing arts-based learning remains a current and significant gap in research.

6. Conclusion

The experiences of instructors who use arts-based instructional strategies in teaching nursing students in hybrid, face-to-face, or online courses were reported in this paper. Participants gave examples of how APTs made learning more enjoyable, humanized the learning environment, enhanced trust and connection among participants in the learning community, and increased opportunities for self-expression. These outcomes lead to enhanced learner and teacher engagement. The CoI model (Garrison, 2016) helped explain why APTs have these positive outcomes for students and teachers.

Acknowledgements

Funding for this study was provided by a Social Sciences and Humanities Research Council of Canada (SSHRC) Insight Grant.

References

Astleitner, H. (2018) "Multidimensional Engagement in Learning: An Integrated Instructional Design Approach", Journal of Instructional Research, Vol 7, January, pp 6-32.

Bomia, L., Beluzo, L., Demeester, D., Elander, K., Johnson, M., and Sheldon, B. (1997) "The Impact of Teaching Strategies on Intrinsic Motivation", ERIC Clearinghouse on Elementary and Early Childhood Education, January, p. 294-323.

Brydon-Miller, M. (2018). "Critical Learning, Community, and Engagement: Elements for Creating Positive Learning Environments and Opportunities for Positive Change", Educational Action Research, Vol 3, pp. 351-353.

Cardenas, D. (2011) "Blurring the Lines Between Online and Traditional Classroom Pedagogy", Community College Week, May, Vol 23, p. 4.

Chipchase, L., Davidson, M., Blackstock, F., Bye, R., Clothier, P., Klupp, N., Nickson, W., Turner, D., and Williams, M. (2017) "Conceptualising and Measuring Student Disengagement in Higher Education: A Synthesis of the Literature", International Journal of Higher Education, January, Vol 6, pp. 31–42.

Cleveland-Innes, M., and Campbell, P. (2012) "Emotional Presence, Learning, and the Online Learning Environment", The International Review of Research in Open and Distributed Learning, October, Vol 13, pp. 269-292.

Cupchik, G., Oshin, V., Crawley, A., and Mikulis, D. (2009) "Viewing Artworks: Contributions of Cognitive Control and Perceptual Facilitation to Aesthetic Experience", Brain and Cognition, January, Vol 70, pp. 84–91.

Deneen, L. (2010) "What is Student Engagement Anyway", [online], Educase, https://er.educause.edu/articles/2010/3/what--is-student-engagement-anyway

Edwards, M., Perry, B., and Janzen, K. (2011) "The Making of an Exemplary Online Educator", Distance Education, Vol 32, No. 1, pp. 77–93.

Edwards-Groves, C., and Davidson, C. (2020) "Special Issue: Talk and Interaction in the Dialogic Classroom: Pedagogy, Practice and Change", Australian Journal of Language & Literacy, February, Vol 43, p. 4.

Fowler, C., McMullan, B. J., and Omg, I. P. P. (1991) "Understanding How the Arts Contribute to Excellent Education", Study Summary, January, pp. 1-73.

Garrison, D. R. (2016) E-learning in the 21st Century: A Community of Inquiry Framework for Research and Practice, New York: Taylor & Francis.

Garrison, D. R., Anderson, T., and Archer, W. (2001) "Critical Thinking, Cognitive Presence and Computer Conferencing in Distance Education", American Journal of Distance Education, Vol 15, pp. 7–23.

Garrison, D. R., Cleveland-Innes, M., and Fung, T. S. (2010) "Exploring Causal Relationships Among Teaching, Cognitive and Social Presence: Student Perceptions of the Community of Inquiry Framework", The Internet and Higher Education, January, Vol 13, pp. 31–36.

Guba, E. G., and Lincoln, Y. S. (1994) Competing Paradigms in Qualitative Research, In Handbook of qualitative research, N. Denzin, Lincoln, Y, (Eds.), Thousand Oaks, CA: Sage Publications, pp. 163-194.

Hunter-Doniger, T. (2018) "But He Looks Like me. I Never Saw an Artist Look Like That: Making Connections to Social Justice Through Art", Art Education, Vol 71, pp. 17–19.

Joseph, D. (2019) "Fostering a Happy Positive Learning Environment for Generalist Pre-Service Teachers: Building Confidence That Promotes Wellbeing", British Journal of Music Education, July, Vol 36, pp. 183–196.

Kim, J.-Y. (2012) "A Study on Learners' Perceptional Typology and Relationships Among the Learner's Types, Characteristics, and Academic Achievement in a Blended e-Education Environment", Computers & Education, September, Vol 59. pp. 304-315.

Melrose, S., Park, C., and Perry, B. (2020) Centering Human Connections in the Education of Health Professionals, AU Press, Canada.

Owen, W.F. (1984) “Interpretative Themes in Relational Communication”, Quarterly Journal of Speech, August, Vol 70, pp. 274-287.

Perry, B., and Edwards, M. (2010) Creating a Culture of Community in the Online Classroom Using Artistic Pedagogical Technologies, In G. Veletsianos (Ed.). Using Emerging Technologies in Distance Education. Edmonton, AB: AU Press.

Perry, B., and Edwards, M. (2019) “Innovative Arts-Based Learning Approaches Adapted for Mobile Learning”, Open Praxis, November, Vol 11, pp. 303-310.

Perry, B., Menzies, C., Janzen, K., and Edwards, M. (2011). “Using the Artistic Pedagogical Technology of Photovoice to Stimulate Interaction in the Online Post-Secondary Classroom: The Instructors’ Perspective”, Ubiquitous Learning: An International Journal, 3(1), pp. 32-43.

Revere, L., and Kovach, J. V. (2011) “Online Technologies for Engaged Learning: Meaningful Synthesis for Educators”, Quarterly Review of Distance Education, June, Vol. 12, p. 113.

Robinson, C. C., and Hullinger, H. (2008) “New Benchmarks in Higher Education: Student Engagement in Online Learning”, Journal of Education for Business, Vol 84, No. 2, pp. 101-109.

Ryerson University. (2011) “National Survey of Student Engagement”, [online], https://www.ryerson.ca/content/dam/university-planning/SurveysReports/NSSE/NSSE_2011.pdf

Sitzman, K. (2017) “Evolution of Watson’s Human Caring Science in the Digital Age”, International Journal for Human Caring, January, Vol 21, pp. 46-52.

Svanum, S., and Bigatti, S.M. (2009) “Academic Course Engagement During One Semester Forecast College Success: Engaged Students Earn a Degree, Do it Faster, And Do It Better”, Journal of College Student Development, Vol 50, pp. 120-132.

Yuan, Y., Wu, M., Hu, M., and Lin, I. (2019) “Teacher’s Encouragement on Creativity, Intrinsic Motivation, and Creativity: The Mediating Role of Creative Process Engagement”, The Journal of Creative Behaviour, Vol 53, pp. 312-324.

Learning Through Social Distancing: WhatsApp as a Community of Inquiry

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DOI: 10.34190/EEL.21.139

Abstract: Once upon a time, researchers believed that the effective use of an online social media network to support a virtual community is dependent on the participants' interest in the context within which the community exists and the willingness of the participants to be part of mobile instant messaging groups. But I thought that interacting via WhatsApp groups will enable them to accept differing views and opinions as part of the group activities. This could ensure effective group engagement and co-creation of learning. I taught a 45 to 60 minute lesson every week to first-year students. The group was divided into smaller sub-groups and assigned individual and group tasks. I analysed the messages that they sent in the form of answers, responses and feedbacks. Four questions aligned to the community of inquiry framework, form part of this study: (1) Social presence - How has WhatsApp contributed to student's learning? (2) Teaching presence - Has the selected mode of engagement attracted students? (3) Cognitive presence - What kind of messages were conveyed? (4) Academic performance - Has it been beneficial towards their learning and in achieving learning outcomes? Data were collected during weekly lectures to first-year students using WhatsApp as a mobile instant messaging (MIM) platform and were analysed through WhatsAnalyzer. Finally, a matrix was proposed for the analysis of various aspects of communities of practice. I discovered that WhatsApp facilitated high levels of interactivity within the groups during the COVID19 lockdown, which will change the future of remote or online teaching. However, more research needs to be carried out to understand the reasons why some students learn better than others.

Keywords: WhatsApp, online teaching and learning, community of inquiry, student engagement, mobile learning

1. Introduction

WhatsApp is a social mobile instant messaging (MIM) application, a platform that brings people across locations together for knowledge, communication and socialising. Its user base exceeds two billion people in over 180 countries (whatsapp.com, 2021). This can act as an e-learning forum where one can share information and knowledge among enabled phone users. Through its group functions, the MIM app has reexplored the idea of a community of practice and inquiry (COI) which has faded the barrier of face to face and online communities. Due to its omnipresence, WhatsApp has been well praised, where people can come together in moments of happiness, sadness, and times of crises viz. the novel pandemic. In the higher education sector, WhatsApp has long been an effective communication tool for academics and students (Gachago et al. 2015). In June 2020, with the pandemic being at its peak in South Africa, lecturers commenced with emergency remote teaching (ERT). As a lecturer of subjects like supply chain management, human resources and marketing, choosing an appropriate platform to carry out teaching, especially theory dense subjects was tricky as we had new students who were unfamiliar with the campus, the department and the lecturers. Following the institutional directives of "no student left behind", I had to teach employing low-tech and other multimodal ways with the use of available resources

WhatsApp is cheaper, cost-effective and most available among enabled phone users across the globe which makes its presence even more acceptable across all age groups. I had set up multiple WhatsApp groups for first-year students. There were over 60 participants (students) all together. I created sub-groups out of those main groups where students would be put together to learn as a community, as part of their learning process. This paper was written in the middle of the COVID19 pandemic, where at times people preferred to stay away from each other, yet through the group function, they were able to come together as part of their learning process.

2. Research aims, objectives and questions

This self-observatory research aimed to explain how WhatsApp served as an effective communication platform with high levels of interactivity. My outcomes and recommendations might be generic as it is my observation; however, I feel sharing them might be instrumental for others who are on a similar journey that has emerged from the novel COVID-19 pandemic.

The objective of this research has been proposed in line with the COI framework in the form of four research questions. The first question forms the main research question which speaks to the second and third questions. The answers to the first three questions are through WhatsApp as a communication platform and the answer to question four is via Google forms student feedback, which validates if the engagement was beneficial in learning.

- (1) Teaching presence - Has the selected mode of engagement attracted students?
- (2) Social presence - How has WhatsApp contributed to their learning?
- (3) Cognitive presence - What kind of messages were conveyed?
- (4) Academic performance - Has it been beneficial towards their learning and in achieving learning outcomes?

Initially, as the first step, I wanted to see if the students had access and that they preferred to join and be part of the WhatsApp mode of learning, and if so, are they actively involved in the sessions by sending or responding to messages. I also intended to establish how often the students responded to my messages. Secondly, I wanted to know if students responded, what format of messages will be used, for example, audio, emojis or text, and for the last two questions, I created end of term questionnaires that were administered using google forms.

3. Literature survey

The study by Tezer et al. (2017) in support the objective stated above shows that social networks can be a suitable platform for academic success provided the method is appropriately applied during learning. Study conducted by Robinson et al. (2015) and Jaafar (2017) found that most students prefer to use WhatsApp for learning. Many researchers recommend the creation of guidelines to support learning in WhatsApp which will enable students to keep up with their learning without any distractions (El Bialy and Ayoub 2017; Dar et al. 2017). Another study also suggests focusing on the instructor's role in WhatsApp to be the main motivation to attract students' attention (Robinson et al. 2015), while research by Smit (2015) adds that the attention of a student depends on the teaching style of an educator, which will affect students' interest in learning. This shows that WhatsApp has the potential to grow as a platform for learning in education. Based on the finding described above, the main research question was derived from the intention to study the use of WhatsApp for the purpose of learning with the use of a pedagogical framework, COI.

COI, specifically intended to facilitate valuable online learning, was introduced by Garrison et al. (1999).The COI framework "represents a process of creating a deep and meaningful learning experience through the development of three interdependent elements – social, cognitive and teaching presence." This framework has been grounded in research and proven over the last three decades to be effective. The objective of this framework is to provide a valuable educational experience (occurrence of learning) among students with three overlapping elements (also called presence), namely, social presence, cognitive presence and teaching presence. This study explores the COI framework as a pedagogical framework to support WhatsApp as a learning platform as it provides an educational experience through teaching presence, social presence and cognitive presence as it promotes the elements that can be beneficial for both instructors and students. Furthermore, it is focused on educational experience that not only highlights academic performance but also social skills as well as adaptability for teaching skills. Teaching presence highlights the ability of the instructor to design and facilitate students in providing worthy and meaningful learning outcomes. Social presence focuses on the ability to communicate in the community and establish interpersonal skills and cognitive presence can be defined as the ability of learners to understand and give meaning through reflection from learning. Rap and Blonder's (2017) study shows that learning can occur if these three presences are fully utilised and well adapted. This framework has been adapted for many avenues of learning such as in e-learning, blended learning, physical learning, flip learning and learning in social networks (Scott et al. 2016) and virtual world learning (McKerlich et al. 2011). A study done by Keles (2018) on the social network platform Facebook shows that it supports teaching presence and the socialisation process through groups that certainly indicates social presence. In addition, online discussions that apply the COI framework are much more comprehensible and briefer as well as make participants feel comfortable to speak up in online conversations (Warner 2016). The COI framework has been applied in several social network platforms and thus a variety of indicators has been tested by researchers on producing a better learning environment. Many perspectives of indicators form to create better learning performance thus, providing a valuable educational experience to students. As the COI framework is strongly focused on adaptation in education, this justifies its use in a part of this research to support the WhatsApp application for learning. This framework proposes and examines the application of WhatsApp for learning purposes.

4. Research method

The paper involves the collection of data during my weekly sessions of 45 - 60 minutes with the first-year diploma students in the Department of Clothing and Textile Technology within Engineering at the beginning of their journey at a university of technology. This is a narrative (Plowright, 2011) of the lived experiences of the author using WhatsApp as a low bandwidth, cheap and the most used MIM platform. The work that I present here is with the expectation that it will echo other authors who share similar stories and sentiments during the pandemic.

4.1 Course illustration

The main communication channel was WhatsApp supplemented by Blackboard, the institution's learner management system. I followed the COI framework to enhance the social presence to maintain communication and constant interaction, which otherwise was minimal due to remote modalities of teaching and learning. Students were placed in a main large WhatsApp group and further into four separate WhatsApp groups of 10 – 12 students each to promote discussion and mutual support. They were given small individual and group learning tasks like case studies, questions and answers and mindmap creation, which could be completed in the weekly sessions. The individual tasks would be presented in the group and as a group, they would choose the best response to be posted to the main class WhatsApp group. There would be one unanimously appointed group leader who would present outcome of each group task in the main group and other members are allowed to contribute to the discussion. The activities or tasks were set up in such a manner that the students were able to complete them in allocated time or submit it at a later stage by the end of the day. At times, homework was given to students and asked to work on it and submit as a group at the end of the week and compile a list of participants, who actively worked towards the task. Initially, this was a bit time consuming as students would take some time to join the group and understand the formalities from their peers. At times, the one joining the group late due to various reasons delayed the process. At times, the ones who joined late preferred to join the group that had the most members or the one they felt comfortable with. I would then discuss the final findings and answers with them in the following weekly session through the main WhatsApp group. Most of the time, I would do that in the form of a voice note, so that students could download and save it for future reference while studying or working on a project.

The "teaching presence" was conveyed in the form of small lectures, where I introduced mini podcasts and screenshots of a PowerPoint presentation. I also became part of each group as an instructor to confirm that the interaction going on in the groups was relevant and worthwhile, and where it was not, I assisted them and responded to their questions. At times, I would message them in small groups and encourage them to expedite their activities and submit their responses so that we could all have time to discuss the topic in detail. The "cognitive presence" was attained where students showcased the ability to reflect on their knowledge and understanding through the successful completion of tasks.

4.2 Data collection

I anonymised all the data and engaged in the first three questions: To establish who participated in the learning process, I exported the WhatsApp messages in single text (.txt) format and emailed them to WhatsAnalyzer, a web-based tool developed by computer scientists from the University of Würzburg, Germany. WhatsAnalyzer collects and analyses chat histories of WhatsApp conversations (or chats): the data is completely anonymised, leaving core information like timestamps, message types and message lengths in place (Schwind and Seufert, 2018). Importantly, while the tool cannot analyse content thematically, it provides metadata about complex group interactions (Cronje and Van Zyl, 2021). WhatsAnalyzer returned a thorough analysis of twelve dimensions, including who sent the most messages, who sent most replies, how many messages were sent per day, who wanted to have the last say and other similar responses. I have presented some of the salient findings in the following section.

To answer the last question, at the end of each term, I encouraged my students to complete a student feedback Google form that asked the following questions:

- Do you feel more connected or easily reachable to the lecturer via the WhatsApp group/s that have been created for each subject/s?
- How was the live and interactive session on WhatsApp? Is it better than the live sessions on Blackboard or Teams?
- How did you feel while you were interacting in the session with your friends?
- There were activities and group work that was done in groups throughout the session. Did it add to your learning and knowledge?
- Do you want us to carry on in this manner?

5. Findings and discussions

I presented the findings of the study structured according to three research questions aligned with the Google form survey responses. Furthermore, I interpreted the results through the lens of the COI conceptual framework.

5.1 Teaching presence - has the selected mode of engagement attracted students?

This metadata extracted through the assistance of WhatsAnalyzer revealed information about the mode of engagement according to the various dimensions as described in Table 1. Importantly, each dimension gives only a fragmental cognisance into an overall engagement. There may be overlap, here and there, however, not all dimensions are of equal academic value.

Table 1: WhatsAnalyzer representation of various dimensions of group sessions

Dimension	Description
1	Who sends the most messages?
2	Who replies to whom most often?
3	Who sends how many messages of a particular type (media and text)?
4	Who sends how many text messages?
5	Who starts a new session (chat) after a period of inactivity?
6	How many messages were sent each day?
7	Which day of the week is most popular for texting?
8	What time of day is most popular for texting?
9	Who uses the most emojis?
10	Who uses the most emojis in single messages?
11	Who sends the longest messages?
12	Who wants to have the 'final say'?

By laying out the data in this way, as shown in the table above, I was able to showcase my classification of the group chat for last year batch.

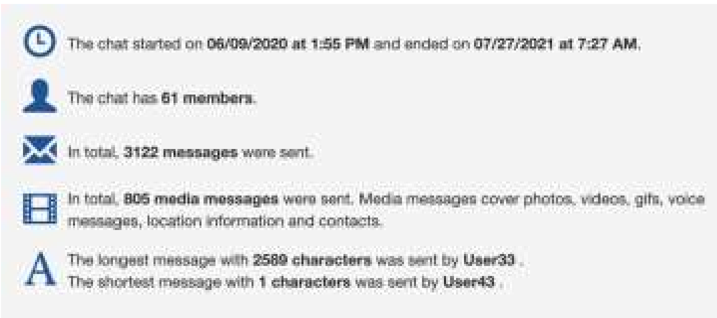

Figure 1: Meta-classification of the group chat as extracted from WhatsAnalyzer

The group chat ran effectively almost a year as the 2020 academic year ended in early 2021. The group had 61 members, including myself, the instructor (User 33). According to the initial dimensions, it is clear that as an instructor, I drove the engagement with the most messages.

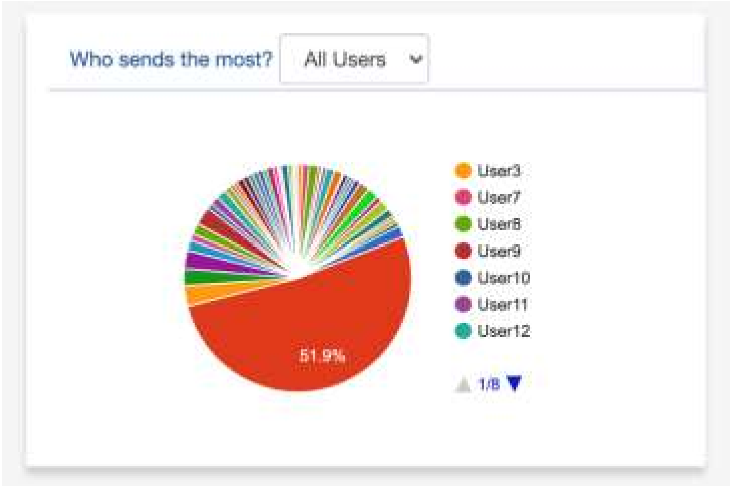

Figure 2: Messages sent per user

Figure 2 above shows that there was a good distribution of engagement, where many students (if not all) took part in the overall discussion. They all actively contributed to the discussion in the sessions. Some responses were sent later by the students in the group, for example, in the afternoon, evenings or later after midnight due to various reasons like data limitations, connectivity issues, and the surroundings they were in. Overall, it was observed that students responded and took an interest in the sessions and learnt within their own pace and schedule. Over 3000 messages were exchanged in the group, of which I sent almost 52% of them. Even though there is no such distinction that validates as a standard participation, the data confirm that as the instructor, I propelled the conversation. There is no evidence as to why some students were more active in the discussion and others were not.

Teaching presence is necessary as it facilitates learning to ensure students are in line with learning outcomes. The result suggests that an educational experience can occur among students through WhatsApp as a MIM platform. It also provides deeper insights into the acceptance of a pedagogical framework to enhance WhatsApp for learning purposes.

5.2 Social presence - how has WhatsApp contributed to their learning?

When it comes to engagement, the two figures below reflect how many messages were sent and on which days of the week.

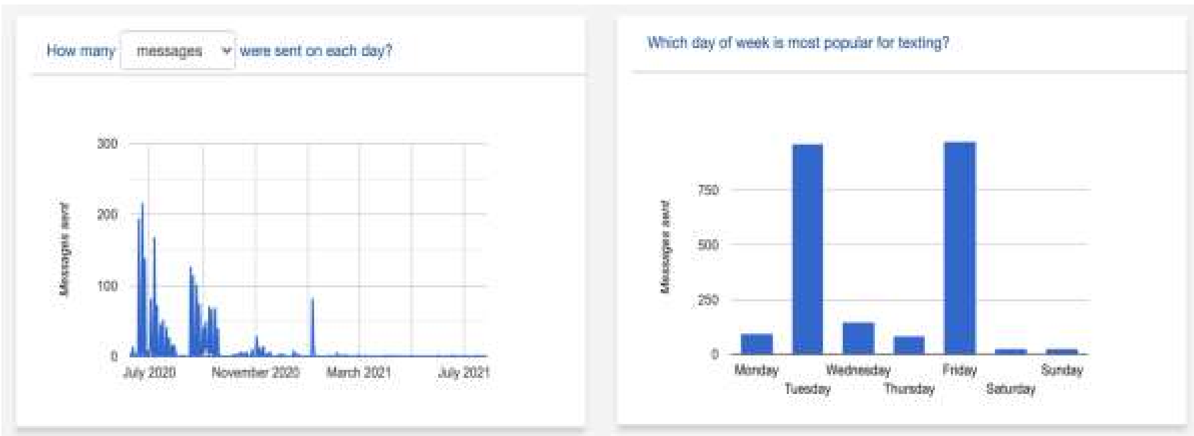

Figure 3: Student interaction throughout the course

From the graph above, engagement was high from June 2020 until Dec 2020, and slowly attenuated after that. It is not unusual for the increasing use of social media to sometimes lead to what we call "digital fatigue". Particularly, this finding is in line with that of a study conducted by Malik and colleagues (2020), digital fatigue, in turn, contributes to a decrease in academic performance. Another reason is that towards the end of the semester, not much happens in terms of teaching; students tend to go on study week for self-study before they start writing their examinations. Also, maximum discussions happened took place on Tuesdays and Fridays, the days that we had our sessions. Other days show the small homework tasks and activities that students had to work on a day before the class, and hence the engagement shown in figure 3.

In conclusion, from the above figure, in group WhatsApp engagements, students had a good participation rate, the instructor had a main role to play in facilitating the discussion and the discussion slowed down towards the end of the academic year.

Social presence supports social interaction and emotion among students and with their instructor. By expressing emotions, other students were able to understand the problems faced by their friends and allowed them to know and understand each other better (Keles, 2018). A lack of response does not necessarily indicate any less understanding, perhaps the student was shy, and in real situations, students can even learn and understand without commenting during the discussion session (Scott et al. 2016). Activities among group members certainly increased the social interaction among peers and the instructor which eventually contributed to the development of social skills (Keles, 2018).

5.3 Cognitive presence - what kind of messages were conveyed?

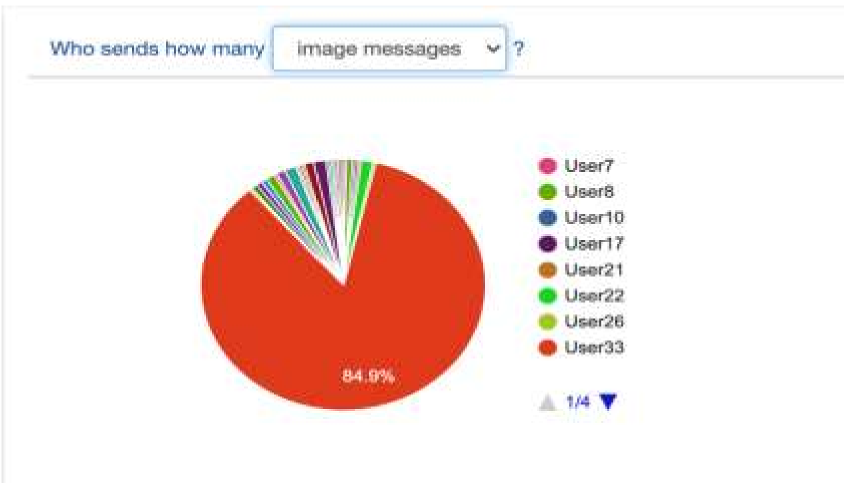

Figure 4: Most messages sent as images

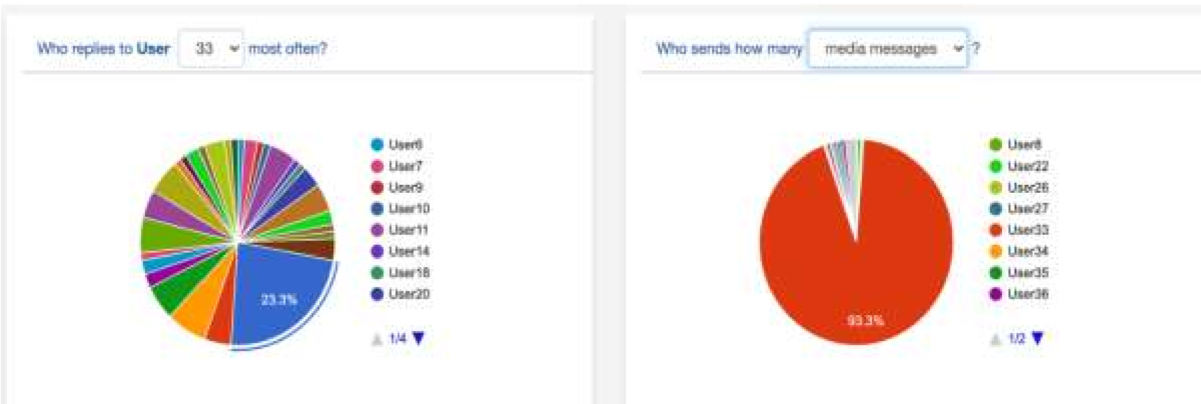

Figure 5: Most images as media messages and sent to the instructor often

Figures 4, 5 and 6, display that other than the instructor few other students sent messages in the form of text, media and documents. These students were group leaders, namely, users 34, 35, and 36. At times other students have also contributed to the discussion by sharing their documents. Text messages in this case were their answers to case studies, media involved mostly snapshots of evidence of the tasks and activities done by the students and documents, for example, mindmaps that I would have asked them to create to express their knowledge and understanding of a concept to the class.

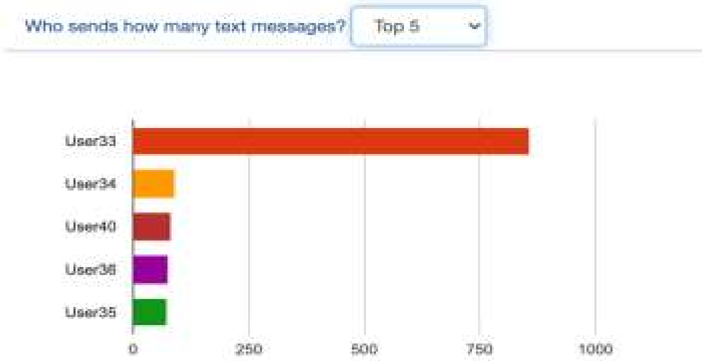

Figure 6: Top 5 most sent text messages

Cognitive presence showed an overall positive response and the validated results showed that the activities and tasks given were accepted by the majority. All these responses also suggest that educational experiences do occur on WhatsApp. Each indicator from each category used by me shows the ability of students to engage with course objectives and enhance critical thinking according to the topics discussed (Keles, 2018).

5.4 Academic performance - has it been beneficial towards their learning and in achieving learning outcomes?

At the end of each term and semester, students were asked to fill in a Google form survey with five questions to identify the themes that emerged from their experience in learning using WhatsApp. The graphs below show their responses to the questions asked.

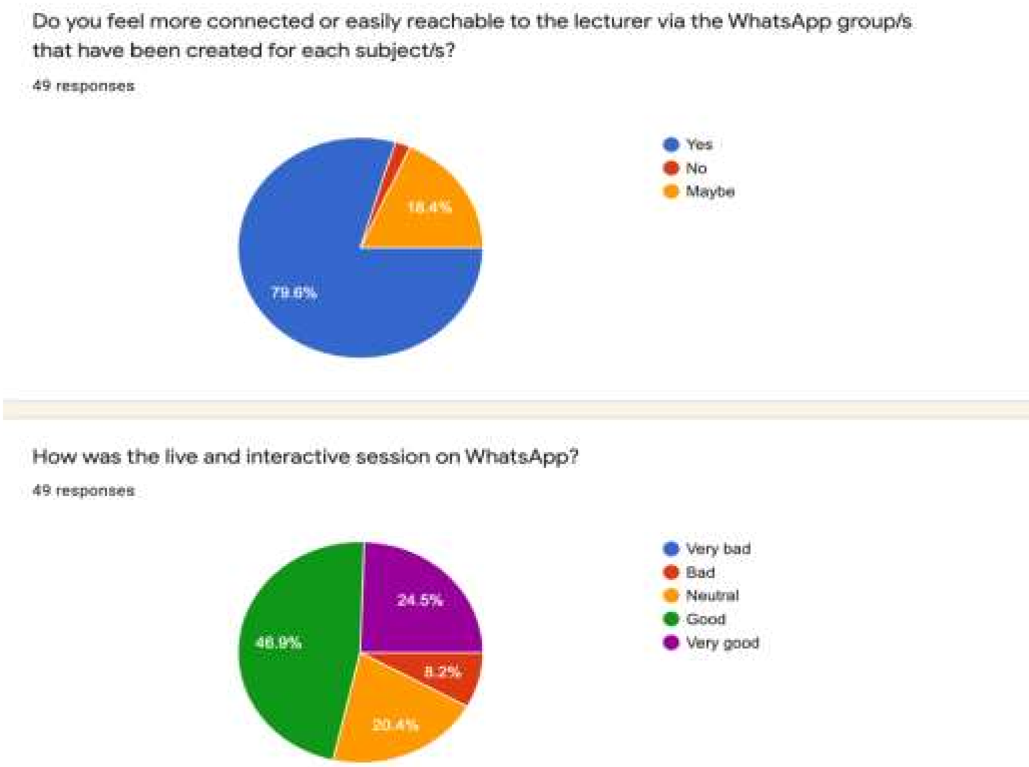

Figure 7(a): Student feedback

As can be seen from Figure 7(a) and 7(b), most students reported that WhatsApp was the preferred mode of online learning; they felt more connected to the instructor, the group work enhanced their learning and knowledge of the subject in achieving the learning outcomes, and they preferred to continue using this platform in the future.

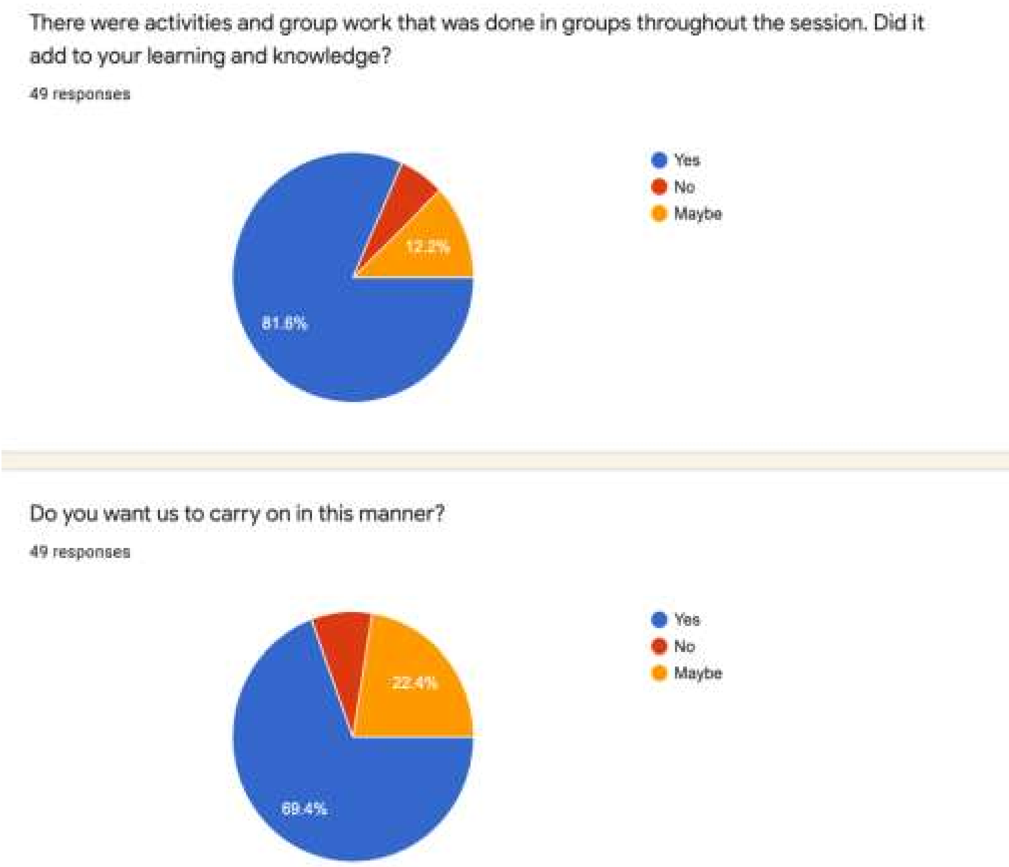

Figure 7(b): Student feedback

On being asked about "Thoughts, comments or suggestions to the instructor" this is what some of the students had to say:

> *"The time to do the activities is too short because we also have to engage as group members, that is my only concern".*
>
> *"I just feel as if all of this is new to us, it is overwhelming. Surely we will get there."*
>
> *"WhatsApp is the best, especially because I cannot access my Blackboard."*
>
> *"Appreciate the extra effort from the instructor to get everyone on the same page."*
>
> *"I enjoy the fact that we get the notes beforehand and then go online and get exercises on them."*
>
> *"I feel it is better because I'm struggling doing my work online because of the network, sometimes I cannot even access Blackboard neither my emails. WhatsApp is cheaper and faster."*
>
> *"I think the WhatsApp live session was very good, I don't mean to contradict myself but if all was well with my cellphone then I surely wouldn't be uncertain about it. In this case, it is a bit tough for me because every time the voice notes are played the screen goes off and the volume gets reduced to the lowest because of the damaged proximity sensor and then I still have to struggle to get it working, whilst I do that I get left behind and eventually get lost. So, in this case I would prefer blackboard collaborate over WhatsApp nonetheless, if the majority chooses WhatsApp live lessons, then I will strive to keep up, regardless of the challenge."*

6. Conclusions

From student feedback it was evident that they admired the content, the mode of a community of inquiry that was introduced through the WhatsApp groups. Be it engaging with peers, cognitive development or teaching presence, the outcomes came were quite positive. Some felt it was overwhelming, perhaps due to message flooding, some felt it worked well for them, for some the timing for the activities were too short and some had connectivity and device issues.

Students also indicated that they liked the group work given and felt that they were part of the learning community as they were during face-to-face learning. They preferred this platform due to its ease of access and low tech mode of learning. And finally, as this mode of learning was provided at a time of social distancing, it moved beyond that, towards presence, namely, cognitive, social and teaching presence which speaks to the COI framework.

In terms of who sent the most messages, it was the instructor followed by the group leaders who were unanimously appointed who shared the group feedback to the large WhatsApp group.

7. Recommendations

The research aimed to explain the use of WhatsApp to enhance learning as COI. The recommendations presented through my paper might be helpful for others who are using WhatsApp. Based on the small groups that were created, it would be good if the number of participants could be between five and seven and not any more to strike a perfect balance even if some decide to leave the group in between.

Further research needs to be conducted to understand if smaller groups would be effective in peer learning and support not just within the group but also outside it.

References

Dar, Q. A., Ahmad, F., Ramzan, M., Khan, S. H., Ramzan, K., Ahmed, W., & Kamal, Z. (2017). Use of social media tool “Whatsapp” in medical education. Annals of King Edward Medical University, 23(1), 39–42. https://doi-org.libproxy.cput.ac.za/10.21649/akemu.v23i1.1497.

El Bialy, S., & Ayoub, A. R. (2017). The trends of use of social media by medical students. Education in Medicine Journal, 9(1), 59–68. https://doi-org.libproxy.cput.ac.za/10.21315/eimj2017.9.1.6.

Garrison, D. R., Anderson, T., & Archer, W. (1999). Critical inquiry in a text-based environment: Computer conferencing in higher education. The Internet and Higher Education, 2(2), 87–105.

Jaafar, A. (2017). The Impact of Using Social Media and Internet on Academic Performance: Case Study Bahrain Universities, 4(1), 1–12. https://doi-org.libproxy.cput.ac.za/10.4108/eai.28-6-2017.152748.

Keles, E. (2018). Use of Facebook for the community services practices course: Community of inquiry as a theoretical framework. Computers and Education, 116, 203–224. https://doi-org.libproxy.cput.ac.za/10.1016/j.compedu.2017.09.003.

McKerlich, R., Riis, M., Anderson, T., & Eastman, B. (2011). Student perceptions of teaching presence, social presence, and cognitive presence in a virtual world. Journal of Online Learning and Teaching, 7(3), 324.

Plowright, D. (2011) Using Mixed Methods: Frameworks for an Integrated Methodology, Sage Publications, Thousand Oaks, California, USA.

Rap, S., & Blonder, R. (2017). Thou shall not try to speak in the Facebook language: Students’ perspectives regarding using Facebook for chemistry learning. Computers & Education, 114, 69–78.

Robinson, L., Behi, O., Corcoran, A., Cowley, V., Cullinane, J., Martin, I., & Tomkinson, D. (2015). Evaluation of Whatsapp for promoting social presence in a first-year undergraduate radiography problem-based learning group. Journal of Medical Imaging and Radiation Sciences, 46(3), 280–286. https://doi-org.libproxy.cput.ac.za/10.1016/j.jmir.2015.06.007.

Schwind, A. & Seufert, M., 2018. WhatsAnalyzer: A tool for collecting and analyzing Whatsapp mobile messaging communication data. Proceedings of the 30th International Teletraffic Congress, ITC 2018, [online] pp.85–88. Available at: <https://doi.org/10.1109/ITC30.2018.00020>.

Scott, K. S., Sorokti, K. H., & Merrell, J. D. (2016a). Learning “beyond the classroom” within an enterprise social network system. The Internet and Higher Education, 29, 75–90. https://doi-org.libproxy.cput.ac.za/10.1016/j.iheduc.2015.12.005.

Tezer, M., Taşpolat, A., Sami, K., & Fatih, S. (2017). The impact of using social media on academic achievement and attitudes of prospective. International Journal of Cognitive Research in Science, Engineering and Education, 5(2), 75–81. https://doi-org.libproxy.cput.ac.za/10.5937/ijcrsee1702075T.

Warner, A. G. (2016). Developing a Community of Inquiry in a face-to-face class: How an online learning framework can enrich traditional classroom practice. Journal of Management Education, 40(4), 432–452. https://doi-org.libproxy.cput.ac.za/10.1177/1052562916629515.

Student Perception of Learning During On-Site and Online Internships

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Abstract: The COVID-19 pandemic resulted in the instant digital transformation of regular, campus-based courses in higher education. Although this was an energy-consuming challenge, it was a familiar process to many universities. However, courses often include elements of skills training and internships. In many cases, these elements had to be re-planned or replaced. In other cases, it was possible to transform them to enable students to have internships by participating in workplace settings remotely. Consequently, universities have to evaluate and develop knowledge on student learning in this new setting. Therefore, the purpose of this study is to investigate student perception of the development of generic skills during internships. This qualitative study has focused on comparing the views of two student groups: one group that did their internships digitally and one group that did the same course, but on site at a physical workplace. The data collected and analysed comprised self-evaluations from 61 Swedish university students on a course in information systems development. The material was processed using directive content analysis guided by a predefined set of IS graduate core competencies from theory. The results from the study indicate that students who did an online internship perceived their development of *problem-solving skills* as being both deeper and broader when compared to the other group. Although there were more similarities in terms of *learning*, it was possible to distinguish different ways of learning due to the different circumstances. However, the most obvious difference in the analysed material relates to skills in *tolerating change*. Students who did their internships on site tended to perceive changing conditions as problems and obstacles, while students in the other group expressed the same aspects as learning opportunities.

Keywords: online internship, generic skills, student perception, COVID-19, information systems education

1. Introduction

In the international area of higher education, employability has become a common quality aspect (Divine et al, 2008). This is particularly true of institutions that provide education with practical elements, such as courses run by business schools. Employability has become, if not a direct measure, at least an accepted point of reference and an important aspect of many institutions' raison d'être from an external point of view (Jackson, 2014). At the same time, the speed of changing conditions in industry is reported to be increasing due to globalisation and technological development (ibid.). Interestingly enough, the consequences for higher education are a need for both more breadth and depth; or, to put it differently, a demand to be able to move slowly and thoughtfully, while being proactive and agile at the same time. On the one hand, a changing work situation increases the need for generic skills. University graduates need to develop general knowledge and generic abilities to be able to adapt and learn new things. On the other hand, the areas where knowledge is applied need to be continuously updated in order to remain valid.

Vast resources have therefore been spent on developing university education that is more tailored to growing industry needs (Billett, 2015). A common way to meet these challenges has been to include various forms of internships and cooperative project work in educational courses (ibid.). This enables students to have close contact with real-world situations, while being able to test and develop generic skills (Divine et al, 2008). In the spring of 2020, the conditions for standard teaching, internships and project work suddenly changed. The COVID-19 pandemic meant that education had to be restructured and, where possible, transformed to provide emergency remote teaching (Iglesias-Pradas et al, 2021). Although the very idea of internships may seem completely impossible under these conditions, there were situations where it was possible to provide this kind of educational elements in a transformed way.

The fact that something is possible does not necessarily mean that it is appropriate. Consequently, there are important questions academic institutions need answered if they have hosted or will host this type of transformed education. Key questions include, for example, the way students have perceived this 'emergency' method of education; specifically the perceptions of how their conditions for developing their generic skills have been affected.

The purpose of this study is to investigate students' perceptions of their development of generic skills during internships. Further, the focus is to compare the views of students doing an internship in a physical, on-site context with views of students doing this online. The research question guiding the study is:

> *How do university students perceive the development of generic skills in on-site versus online internship environments?*

Further, this study is delimited to the three specific skills of *problem solving*, *learning* and *change tolerance* that have been pinpointed as being of specific importance in the field of study where the empirical data is collected (Topi et al, 2017).

1.1 Information systems education, generic skills and internships

University education in information systems (IS) differ greatly in terms of their design. There are several reasons for this. Two important reasons are that the courses meet different external needs and that they can take place at different academic faculties. At a general level, there is a range that extends between a softer management perspective and a harder focus on technical expertise in systems development. IS education is often run by business schools (and similar institutions), but can also be integrated with engineering-like courses and hosted at computer science institutions. However, regardless of specialisation or institution, one common denominator is the need to acquire knowledge to understand, develop and communicate technical solutions in a social context.

As with other applied subject areas, the core skills that need to be developed as part of this education include generic skills. The international community for education and research in information systems, AIS, has developed an model curriculum over more than three decades (Topi et al, 2017, Leidig, Ferguson and Reynolds, 2019, Leidig et al, 2020, Matthee and Turpin, 2019) and as part of this process has identified a number of generic core competencies for IS graduates (Topi et al, 2017). The contemporary model curriculum highlights three categories of skills as specifically important because of the rapid changes in technological development in the future and our ways of organising (ibid.).

The first category concerns what could considered as the hallmark of higher education; critical thinking (Matthee and Turpin, 2019). In this context, however, the focus is specifically on the relationship between critical thinking and problem solving (Topi et al, 2017). This category is henceforth referred to as *problem-solving skills*. The second category *learning skills* focuses instead on 'how to learn', i.e. the development of the individual's capacity to learn, putting a long-term perspective on both domain-specific and generic learning. The third and final category *change tolerance*, regards the development of a student's capacity to manage and accept changing conditions (ibid.).

1.2 The systems development project – a IS major internship project

The one-term module *systems development project* (SDP) is a vital part of the education of IS majors studying for a systems analysis degree at Örebro University School of Business, Sweden. SDP is normally the last term for a student of this bachelor's degree program and provides an opportunity to apply and develop knowledge and skills from previous modules.

The most common setting for a student taking SDP is to work on a systems development project with 1-2 peer IS majors. The project is initiated and supervised by a host company/organisation and sometimes involves an external 'customer'. As a rule, the host organisation has specially appointed supervisors, who are responsible for practical help and consultation. Before 2020 most of the practical work was performed on site in the premises of host organisations. Since the spring term of 2020 most of the supervision has been online, with project work being carried out from home.

2. Methodology

The main analysis method was qualitative content analysis with a directive approach (c.f. Hsieh and Shannon, 2005). In this study, this meant analysing the material with three predefined main categories of student skills as the starting point (instead of conducting an all-inductive analysis). Potter and Levine-Donnerstein (1999) describe the use of a directive content analysis approach as being similar to adding a portion of deduction into qualitative knowledge development. The motive for using this approach was to delimit the study and focus on aspects of specific relevance.

2.1 Data collection process

The qualitative data that was collected originated exclusively from written student self-evaluations (c.f. Kusnic and Finley, 1993), which was the last assignment in an internship-based course (section 1.2). The self-evaluations were open ended, which meant that the only instructions had to do with range (500-1,000 words) together with a brief introduction to the theme of 'learning experiences' and possible aspects to address. This open approach was used to enable the students to reflect on important lessons learned during the semester, while trying to avoid a focus on regular course feedback items, such as technologies and systems development methodology. An initial selection of self-evaluations was based on the identification of projects that had been carried out through internships as described in section 1.2 (it is also possible to do the course without a host company). The number of students/self-evaluations was 33+28 (61 in total); 33 are from the group of students who did their internship projects on site (during the spring term of 2019), while 28 are from students who did theirs online in the spring term of 2020.

2.2 Data analysis process

The qualitative analysis was carried out using the analysis software NVivo. The benefits of this tool are that it reduces various manual tasks required to handle, organise and present qualitative data (Alabri and AlYahmady, 2013). The tool enabled a focus on the analysis itself, i.e. coding, building categories, themes and making comparisons. Data from each group was initially processed separately in order to stay true to the comparative focus of the research question. In practical terms, this meant that the self-evaluations from the on-site and online scenarios were processed in two separate datasets.

The first step of the analysis involved identifying and labelling text sections that expressed matters that could be associated with the three generic skills being studied (section 1). Thus, existing knowledge of identified skills was used as a directive framework of main categories for this initial stage, even though the analysis itself was inductive in nature (c.f. Braun et al, 2019). Since a specific student reflection on a matter was sometimes associated with more than one skill, this framework-based sorting was non-exclusive (one specific passage in the data was marked with multiple labels). Without moving directly into detailed interpretations, this first step also involved providing some of the encoded segments with short notes on the meaning of the data. In line with Charmaz (2006), this was a way keeping track of spontaneous first interpretations and not losing them along the way.

The second step of coding involved going through all the data again, but this time looking 'inside' each main category; i.e. the data labelled as being associated with problem solving, learning skills and change tolerance was analysed separately. The focus was now on interpreting meanings of what the students had expressed regarding the main category skills. In doing so, subcategories were developed and further analysed by identifying different aspects of them. This part of the process therefore included trying to understand nuances and searching for patterns in what was expressed, so more specific tags were used to group and label the data.

The last stage of the analysis was to relate and compare the data from the two student groups. That is, to again look 'inside' each main category but now with the focus set on comparing subcategories and aspects between the two semesters. In the following section, the subcategories and their aspects form the basis for the discussion on the findings from the study.

3. Results

In the following sections, the analysis results are presented structured according to the three main skill categories (section 2.2). Each section begins with the collective view taken from the reflections from all of the students, regardless of group affiliation (section 2.1). This is done by presenting and exemplifying the qualitative subcategories that were developed during the analysis. Each section ends with an interpretation of the most prominent differences where such could be identified.

3.1 Problem solving skills

When the students reflected on aspects related to problem solving the analysis led to three related subcategories. The first and widely discussed matter had to do with *different approaches to problem solving*. A noteworthy insight was about the importance of being skilled in searching for information about solutions, rather than always knowing what to do. Furthermore, students highlighted the benefits of changing 'mode' in the problem-solving process. This related to the benefits of sometimes solving problems together with others and sometimes solving them individually. In terms of collaborative problem solving, reflections concerned the importance of being able to adapt, which included being open to trying out other people's suggestions and sometimes accepting suggestions even if one did not fully believe it to be the best option oneself. A prerequisite for being able to do this was identified as faith in one's own (and other people's) problem-solving skills; i.e. being confident enough to move forward in the problem-solving process even if one felt slightly uncertain.

The second subcategory that was developed based on the data was *managing external influences*. The external influences discussed were input from clients or the professional supervisors. An aspect that was specifically highlighted was "daring to ask". This specifically related to exposing one's own lack of knowledge. This aspect was stressed as something the students wished they had been better at during the course of the project. The students expressed a belief that a less prestigious approach to asking questions would possibly have meant using the skills of the client they worked with more effectively.

The third subcategory linked to problem-solving skills concerned *the nature of the problem*. In this category the students' reflections were about the perceived effect of an individual project's nature. The first aspect was the starting point itself, i.e. how clear the client's view of the end goal was from the beginning. Another aspect was the breadth of the issue (and the appropriate solution); in other words, whether most of the project work was about disparate problems or 'more of the same'.

3.1.1 Development of problem-solving skills – differences between on-site and online internships

The analysis showed discernible differences for this skill. Although the on-site interns highlighted the development of problem-solving skills as central during the project, the pattern in terms of perceptions was more cautious and defensive in the self-evaluations from the students in this group. The benefit of having someone 'senior' to ask in problem-solving situations was highlighted as important to improving their problem-solving skills. In this student group, the aspect of "I should have asked more" was raised to a greater extent. However, the perceptions of online interns showed a more offensive pattern. In this group's self-evaluations, the COVID-19 situation was discussed extensively. It was stated as a reason for why the students had to devote so much effort to developing individual problem-solving skills.

In this context, the remote nature of the internship was seen as the cause of less frequent supervisor contact. Although access to supervision was available, students in the online group expressed that it took a lot of effort to ask for help. In addition, the appointed professional supervisors reportedly prioritised other tasks due to the unprecedented situation. However, despite this 'friction', online interns viewed the situation as something positive. They took the view that these new conditions triggered more student responsibility and consequently better individual problem-solving skills.

3.2 Learning skills

Four subcategories were developed as the result of analysing the self-evaluations with the focus set on learning skills. The first category was labelled *knowledge-related self-image* and is closely linked to the discussion on the approach to problem solving discussed above. This link is specifically related to the students' reflections on the importance of trusting their own ability. However, in this context, it was specifically about the trust in their skill to learn new things.

The student experience of initially not believing in their own learning ability was common in the self-evaluations. On a more positive note, the same students often followed up such descriptions by stating that their view had changed by the end of the project. Despite this positive development, the students also believed that they would have learned even more if they had trusted their abilities from the beginning.

However, there were other aspects that the students perceived to be important for their learning. The first concerned the importance of trusting and accepting the level of knowledge they possessed, i.e. not giving oneself a negative self-image by belittling what one has already learned. In addition, the self-evaluations highlighted the importance of realising that one cannot know everything and that this is something one shares with everyone else, including the professionals. Furthermore, the lack of knowledge and uncertainty about how to handle a situation is part of the day-to-day work of an IS professional. Closely linked to this, the ability and courage to acknowledge one's own knowledge gaps were highlighted as an important factor for learning.

The second subcategory of learning skills was labelled *ways to learn*. In this category, the importance of group interaction and relative, individual skill levels were discussed as key aspects. The interpretation was that students perceived the role of peer learning as even more important compared to previous group work in regular campus courses. This was particularly due to the fact that the 'real life' projects were seen as being so complex that it was difficult to understand the project as a whole without learning from the other group members. The aspect of complexity and the expectations to deliver something real were the main reasons why students identified the need to have time for reflection in these kinds of internship projects.

The main concern was that in-depth learning sometimes had to take a back seat in order to deliver a result. Another noticeable aspect in ways to learn concerned the support and use of structured methods for project work. Although process support (the use of formal methods for work and documentation) was sometimes dismissed as not creating value for achieving project goals, its significance for learning was highlighted by the students. The final aspect of this category related to the importance of information literacy. Although the frequency of occurrences can be a deceptive indication in a qualitative analysis, this aspect regularly appeared in the self-evaluations. In some cases, students even stated that after the internship they now perceived searching for information and adopting the results as being the core skills of their future profession.

Communication for learning was the third subcategory linked to this generic skill. This category also featured reasoning from the students' reflections on problem solving (above). The students specifically stressed the importance of "daring to ask". In other words, this skill was also identified as crucial for developing other skills than just for solving problems. In addition, the second aspect of communication for learning – listening to and adopting peer suggestions – appeared in the analysis of problem-solving aspects above. Having such an approach was described as a success factor for collaborative learning in the project group. Once again, the need to develop these necessary skills was more evident in the internship setting than in regular courses at the university.

The fifth and final category of learning skills was labelled *self-motivation* and related to students' individual conditions, which they discussed in the self-evaluations. One noteworthy aspect of this was the perceived importance of not limiting project work (and learning possibilities) to the areas one believes oneself to be good at. The students that touched upon this matter described their own project situation with 'good' initial opportunities for an interest-based division of work. Afterwards, this seemingly positive condition was perceived as an unfortunate way of limiting individual learning. This was because students then considered themselves trapped in working with the tasks they had chosen from the beginning, as they had chosen an area in which they felt more comfortable. In their self-evaluations they stated the importance of a mindset to instead actively seek learning opportunities in areas where they felt less comfortable. The second aspect of self-motivation was the importance of being in control of one's own learning. In this context the nature of the problem was identified as a crucial aspect; in other words, the advantage as an intern of being able to choose between different alternatives when deciding on methods and techniques for *how* to solve a problem.

3.2.1 Development of learning skills – differences between on-site and online internships

The differences between the views of the two student groups were not that significant for this skill, but they did exist. One important theme was the need to have faith in one's own level of knowledge, both in relation to professional supervisors and the abilities of fellow students. The important (and reassuring, as described earlier) insight that not even skilled professionals have all the answers, was more evident in the self-evaluations from on-site students. Another difference between the groups seemed to be their views of cooperative learning. The analysis indicated that online interns valued group learning more than their peers on site.

3.3 Change tolerance

The analysis associated with this generic skill was categorised as *handling changing conditions*. Overall, a large part of the student reflections concerned the importance of the experience in handling changes to project conditions during the internship. What was discussed specifically was the requirements that changed slightly for the functionality of the product being developed, and changes to the project's conditions as a whole. In terms of the changes to the requirements, the students stated that this was important and useful training in 'normal' project changes when clients or other stakeholders give new directives. However, the students regarded changes to the project's conditions as a whole as a more radical type of change where unforeseen circumstances had bigger consequences; for example, supervisor resources were suddenly restricted, changes were made to the management structure of the host organisation or the sudden shift to remote working. However, even these major changes were perceived as valuable experiences according to the students, who expressed the view that their ability to handle change had grown, despite having reduced access to support and help from supervisors (compare the discussions about perceived positive consequences of problem-solving ability and learning above).

3.3.1 Development of change tolerance – differences between on-site and online internships

On the one hand, the analysis results provided the least information about this generic skill as the content of the self-evaluations did not cover these aspects to the same extent as the other two skills. On the other hand, there was actually more to be said here because this was where the clearest differences were noted between the views of the two student groups. The students who had to redirect their planned on-site projects to online communication as a result of the COVID-19 pandemic were as a whole more positive about such changes than the other group. However, this is not to say that these students considered the change as such to be overwhelmingly positive in terms of the project and its results. Instead, what they expressed to a greater extent than their on-site peers was the perception that major unexpected changes had a positive impact on their future ability to manage change.

4. Discussion and conclusion

According to section 1 above, the research question that guided this study was:

> *How do university students perceive the development of generic skills in on-site versus online internship environments?*

To conclude and answer the research question, the first section below summarises the study's results before a brief discussion on the delimitations of the study.

4.1 Student perception of the development of generic skills

The perhaps most interesting result from this study was that the online students perceived their learning situation as positively as they did. As shown below, several of the identified differences between the groups actually spoke in favor of the online situation from the perspective of generic skill development during internships. The consequence of this is that academic institutions that plan internships online, in addition to dealing with problems, also have interesting development opportunities ahead. Again, when interpreting these results, it is important to remember that student perceptions, not actual skill development, is what have been studied here.

4.1.1 Perception of the development of problem-solving skills

The results of the study indicate that students in the online situation perceive their development of problem-solving skills as being deeper and broader when compared to the other group. Although this aspect is prominent in the self-reflections of both student groups, there is a clear difference. Online interns are more explicit and convinced when looking at their growth as problem-solvers, both as individuals and in a collaborative setting with their peer students. According to the online interns, the main reason for this is the remote situation that they had been faced with. This was not only because of it taking place online, but also because the professional supervisors had to give the students and their projects less priority.

4.1.2 Perception of the development of learning skills

The differences in aspects regarding the learning are not that evident, even though they clearly exist. It is possible to discern different ways of learning due to the different situations. In both student groups, many of the reflections focus on the importance of trusting and accepting one's own level of knowledge. This was partly in relation to the IT professionals they met during the project work, but largely in relation to their fellow students. However, one difference between the groups seems to be their views of collaborative learning. In this aspect, the analysis indicates that the online interns valued group learning more than the on-site interns did.

4.1.3 Perception of the development of change tolerance

However, the main difference in the analysed material is the view of the changing conditions during the project work. Students who did their internship on site describe the changing conditions as being more problematic and obstructive than the students in the online group. Instead, the online group views similar experiences as being positive.

4.2 Limitations of this study

As a qualitative study based on data from a single course, the overall claim for the results is known as *transferability*. This term has been used by, inter alia, Lincoln & Guba (1985), which explains its importance as the possibility of transferring qualitative research results to contexts other than the context studied. The argumentation is further that the concept needs to replace misguided attempts to translate the more quantitatively oriented quality measure of external validity (ibid.; Yin, 2015). For this reason, anyone who builds on the results from this study must pay attention to the contextual circumstances of the bachelor's degree in information systems at a European business school. Although the aim has been to convey a clear picture of student perceptions and the analysis process, the paper format somewhat delimits the possibilities for presenting in-depth, 'thick' descriptions (Lewis and Ritchie, 2003) of empirical data that would be beneficial for an even higher degree of transferability.

References

Alabri, S. S. and Alyahmady, H. H. 2013. "Using Nvivo for Data Analysis in Qualitative Research", *International interdisciplinary journal of education,* Vol 2**,** No. 2, pp 181-186.

Billett, S. 2015. Integrating Practice-Based Experiences with Higher Education. *In:* BILLETT, S. (ed.) *Integrating Practice-Based Experiences into Higher Education.* Dordrecht: Springer Netherlands.

Braun, V., Clarke, V., Hayfield, N. and Terry, G. 2019. Thematic Analysis. *In:* LIAMPUTTONG, P. (ed.) *Handbook of Research Methods in Health Social Sciences.* Singapore: Springer Singapore.

Charmaz, K. 2006. *Constructing Grounded Theory : A Practical Guide through Qualitative Analysis,* Sage, London.

Divine, R., Miller, R., Wilson, J. and Linrud, J. 2008. "Key Philosophical Decisions to Consider When Designing an Internship Program", *Journal of Management and Marketing Research,* Vol 2**,** No. 1, pp 1-8.

Hsieh, H.-F. and Shannon, S. E. 2005. "Three Approaches to Qualitative Content Analysis", *Qualitative Health Research,* Vol 15**,** No. 9, pp 1277-1288.

Iglesias-Pradas, S., Hernández-García, Á., Chaparro-Peláez, J. and Prieto, J. L. 2021. "Emergency Remote Teaching and Students' Academic Performance in Higher Education During the Covid-19 Pandemic: A Case Study", *Computers in human behavior,* Vol 119**,** No. June 2021, pp 1-18.

Jackson, D. 2014. "Factors Influencing Job Attainment in Recent Bachelor Graduates: Evidence from Australia", *Higher education,* Vol 68**,** No. 1, pp 135-153.

Kusnic, E. and Finley, M. L. 1993. "Student Self-Evaluation: An Introduction and Rationale", *New Directions for Teaching and Learning,* Vol**,** No. 56, pp 5-14.

Leidig, P., Anderson, G., Sooriamurthi, R. and Babb, J. 2020. Is2020: Updating the Information Systems Model Curriculum. *Proceedings of the 51st ACM Technical Symposium on Computer Science Education.* Portland, OR, USA: Association for Computing Machinery.

Leidig, P., Ferguson, R. and Reynolds, J. 2019. "Is2010: A Retrospective Review and Recommendation", *Journal of information systems education,* Vol 30**,** No. 4, pp 298-302.

Lewis, J. and Ritchie, J. 2003. Generalising from Qualitative Research. *In:* RITCHIE, J. and LEWIS, J. (eds.) *Qualitative Research Practice : A Guide for Social Science Students and Researchers.* London: Sage.

Matthee, M. and Turpin, M. 2019. "Teaching Critical Thinking, Problem Solving, and Design Thinking: Preparing Is Students for the Future", *Journal of Information Systems Education,* Vol 30**,** No. 4, pp 242-252.

Potter, W. J. and Levine-Donnerstein, D. 1999. "Rethinking Validity and Reliability in Content Analysis", *Journal of applied communication research : JACR,* Vol 27**,** No. 3, pp 258-284.

Topi, H., Karsten, H., Brown, S. A., Carvalho, J. A., Donnellan, B., Shen, J., Tan, B. C. Y. and Thouin, M. F. 2017. Msis 2016: Global Competency Model for Graduate Degree Programs in Information Systems. Association for Computing Machinery.

Yin, R. K. 2015. *Qualitative Research from Start to Finish,* Guilford Press, New York

The Concept of Qualitative Analysis of Students' Behaviour in Learning Analytics for the Wiki and e-Learning Courses

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DOI: 10.34190/EEL.21.083

Abstract: E-Learning is often associated with Learning analytics (LA) as a tool used to determine the actual extent to which the students use the content. Traditional LA is able to provide data on the number of visits and retrievals of a given website or parts thereof. When using common LA tools (e.g. web metrics systems), it is usually possible to reliably measure data relating to the entire website or its individual parts. The analysis of log files (e.g. from LMS systems), on the other hand, allows for the identification of visits and retrievals for individual logged-in users. Both of these approaches to LA can be described as quantitative. However, quantitative metrics are often too vague and general to offer a better insight into the approach, behaviour, and perception of educational content. Such metrics measure the content in terms of quantity and frequency, overlooking the details of the individual students' approach. Therefore, we focused on the possibility of a more detailed method to monitor the students' activities in the course. We used a record of individual student visits which included recording of mouse cursor movements, insertions of content in forms, visited web pages, scrolling on these pages, and visits of external hypertext links. We have thusly obtained a large amount of qualitative video data concerning the students' movement in two e-Learning courses (e-Learning and wiki course) taught at our workplace. We created the records for individual students, so it is possible to monitor their progress through the course on various devices. We used these records to perform an analysis of student behaviour (coding, summarisation), which is presented here on selected examples together with the conclusions. Such qualitative LA allows us to have a different look at the students' perception of the course content and to find possible issues and areas suitable for a subsequent quantitative analysis.

Keywords: learning analytics, qualitative research, wiki, LMS, e-Learning

1. Introduction

LA either actually helps us in many aspects related to online learning (e-Learning) or it at least has the potential to help. In general, LA makes it possible to obtain data on how students use educational content and how they access it in an online environment. For example, it facilitates focus on the overall aspects of online education and evaluation of the performance of education and educational institutions in the higher education sector (Tsai *et al.*, 2020). This is achieved, for example, by providing feedback for students' motivation and achievement (Jiun-Yu Wu *et al.*, 2021). Nowadays, e-Learning is mostly implemented in some online form available on the web or through web-based technologies (LMS, PLE, wiki, MOOC etc.). The generally used form thus allows for technical monitoring to be performed, in particular of traffic, accesses, retrievals, etc. Furthermore, if we use the appropriate tools, it is possible to map detailed behaviour, i.e. the visitors' interaction with the content of the website or with its individual elements. Nowadays, most statistics (and therefore also LA) focus mainly on quantified or quantifiable data that we can obtain about visits (Jana and Chatterjee, 2004). Numerous publications also show that LA is currently a popular issue (Romero and Ventura, 2020).

1.1 Web analytics and learning analytics

Given the concept of parameters monitored by web analytics, we can say that it served as the basis for the concept of LA. In the beginning of web analytics, it focused on analyses of log files generated by web servers for individual retrieved pages (Bertot *et al.*, 1997; Jana and Chatterjee, 2004). Traditionally tracked metrics include pageviews, sessions, new visitors, bounce rate, visit length, click-through rate, and total visitors (Massaro *et al.*, 2021). From the technical side of log file analysis, the visitor's movement through web content is usually not analysed. Thus, the vast majority of these metrics are site-centric rather than user-centric.

Subsequently, most of the analytics moved to external online analytics tools, often Google Analytics (Clark *et al.*, 2014; Delgado-Cepeda, 2019; Katuu, 2018; Luo *et al.*, 2015), or other similar ones. They generate a lot of data, charts and overview tables that can be put into a certain context with phenomena or, for example, the content of an educational course. In contrast to the analysis of web server log files, this is a more detailed insight (including screen resolution, the movement of visitors in individual visits with a certain degree of accuracy, returning and new visitors, etc.).

As part of their concept, most LA use off-line data (that are extracted from system) for analysis and further processing (Jiun-Yu Wu *et al.*, 2021; Nishihara *et al.*, 2017). Off-line data within LA will help especially in the field of content editing and learning design (LD) (Law and Liang, 2020; Lockyer *et al.*, 2013). However, they cannot be used to influence ongoing studies, when one of the students may be at risk of academic failure (Gašević *et al.*, 2015; Miranda and Vegliante, 2019; Tomasevic *et al.*, 2020). Real-time data, on the other hand, allow for adequate response during the electronic course studies. When using machine learning or reinforcement learning (Jiun-Yu Wu *et al.*, 2021), the education system can automatically identify those students at risk of academic failure.

1.2 A more general concept of learning analytics

LA can be understood as data that provide feedback about the course or students after due analysis. Within the concept of methods to work with data, certain frameworks (Greller and Drachsler, 2012) have been created that form a basic structure for the interconnection of individual areas and factors or the interconnection of individual functional units (Kuromiya *et al.*, 2020). For example, within the framework of "Analytics Layers for Learning Design" (AL4LD) (Hernández-Leo *et al.*, 2019). AL4LD is divided into the Community Analytics layer (learning design activities, etc.), the Design Analytics layer (goals, tasks, etc.) and finally the LA layer (profiles, checkpoints, processes, performance). In this case, LA is perceived as one segment of the Learning Design (LD) process. From the concept of the AL4LD model, the most attention is usually paid to the Learning analytics layer, which is a source of a large amount of data through the concept of web metrics that can be further analysed and evaluated.

1.3 Breakdown of learning analytics according to the type of obtained data and technical implementation

For our breakdown of LA, we will focus only on the basic nature of the data that we obtain from the analysis. In principle, we see a possible division into quantitative LA, which output a lot of data that can be statistically evaluated and tested (Delgado-Cepeda, 2019; Marcu and Danubianu, 2019). This type of LA by output data is dominant. Typically, the source of this LA data are the already mentioned various web analytical tools, data collection within educational systems, activity records (logs) (Araka *et al.*, 2020; Kuromiya *et al.*, 2020), individual activities of students in such systems (Yang *et al.*, 2021), etc. By nature, these are data in the form of numbers, URLs, access data, etc.

As for the approach, which we can call qualitative, there is not a lot of research in LA on this concept to be found (Dawson *et al.*, 2014; Loperfido *et al.*, 2018; Ochoa and Merceron, 2018). The nature of data collected in certain research is close to our concept of qualitative data – eye-tracking (Srivastava *et al.*, 2021), mouse movement (Arapakis and Leiva, 2020), mouse scrolling (Milisavljevic *et al.*, 2021), but these are usually further quantified or statistically quantitatively evaluated in the research (Srivastava *et al.*, 2021).

1.4 Qualitative learning analytics

In qualitative LA, we perceive the concept as similar to the classical qualitative research, where the results of the student's activities are subjected to analysis, coding, etc. (Creswell, 2012). In this case, however, it is not necessarily creations, outputs or tasks, but also the "mere" way of accessing and using the course (Hewson, 2014) that can take various forms. By their nature, these are data that are more difficult to collectively evaluate in a statistical manner and they require individual interpretation in context, such as the movement and clicking of the mouse cursor on the screen, scrolling the content of a given web page, inputs entered into web forms, eye-tracking (Djamasbi *et al.*, 2011; Srivastava *et al.*, 2021) etc. We can include them in the behavioural data within user engagement (O'Brien, 2016).

Breakdown of LA according to technical implementation and type of collected data:

- Quantitative (dominant)
- *E.g. Google Analytics*
- *Web logs*
- *LMS, CMS, PLE, VLE logs with student identification*
- *Movement tracking (and mass evaluation)*

- *Qualitative*
- *Heatmaps (Solis-Martinez et al., 2020)*
- *Tracking of mouse movements and clicks (for individual visits, interpretation of meaning)*
- *Recording of values entered in course forms*
- *Examination of created or entered texts (Web 2.0)*
- *Questionnaire – also common for traditional qualitative research*
- *Interview – also common for traditional qualitative research*

The suitability of using qualitative LA in our concept grows with the complexity of the educational content. In the case of complex (longer) web pages, from the point of view of quantitative LA, the focus is always only on one retrieval, or the length of the visitor's stay on the given page. You can see from what site the visitor came and for which he or she left. Looking at the qualitative LA, we can monitor in more detail the specific interactions of the visitor with this site. Whether and in what way the visitor moved (scrolled) within the site, on which parts and for how long he or she remained with the mouse cursor. These are data that we would not otherwise have obtained in a given situation and we would thus not know the student's actions in more detail.

Within the qualitative concept, we can talk about online educational content in terms of monitoring the student's interaction with the content, which is usually presented using web-based technology. We should also mention user experience (UX) (Dekkers *et al.*, 2021; Verhulsdonck and Shalamova, 2020), although it does not necessarily have to be based only on qualitative data (Tullis and Albert, 2013).

2. Methods

As part of the subject "Computer Networks" in the summer semester of the school year 2020/2021 (8 February – 7 May 2021) (during the Covid-19 pandemic), students had access to an e-Learning course created according to the MicroLearning (ML) principles (Polasek, 2019, 2020; Polasek and Javorcik, 2019). The course consists of 135 short learning units (MicroLearning Units; MLU), which are divided into 9 topics. Individual MLUs were created as interactive elements containing text, images, embedded quizzes or interactive videos (the H5P module was used). The course was attended by two groups of students, one (eL Group; n = 14; 12 males, 2 females) attended the course in the LMS Moodle environment and the other (wiki Group; n = 16; 8 males, 8 females) in the wiki environment. The distribution into groups took place entirely according to the students' preferences in terms of schedule. The eL Group had the task of submitting a seminar paper in MS Word to LMS Moodle, the wiki Group had to create it in the form of one page of the given wiki. Both groups are full-time students of the second year of a two-subject three-year bachelor's study programme in teaching, where one of their subjects is always information and communication technologies in education with second subject. To fulfil the conditions for completing the course, students had to successfully pass a written examination (test). For our qualitative analysis, we selected a total of 5 students from both groups (see Table 1). The parameters of choice included gender, participation in a wiki-based or traditional e-Learning course, the intensity and method of course visits and the study result.

As part of the technical solution, we used the Tiki Wiki CMS Groupware for the wiki. For the purpose of a more detailed analysis of students' behaviour and approach to the course, we used the SmartLook service (Smartlook.com) to record the movement of the mouse cursor, the number of and location of mouse clicks and pages visited. For each record of the visit, there is a timeline indicating the event of the visit (mouse click, next page, data entry in a form input field). According to our above-mentioned breakdown of LA, we consider these detailed records of user behaviour can be included in the qualitative LA category. Within the technical concept of SmartLook, or rather due to the limitations created by H5P caused by the inline frames in HTML, it was not possible to monitor the movement of students within individual MLUs in detail.

The records of how the students of both groups participated in the courses are 5598 minutes (wiki Group) and 7625 minutes (eL Group) long. These recordings can be played, annotated in the web interface, but not any tool can be used to add a code or tag. For further analysis, we recorded the recordings of selected students using Open Broadcaster Software into videos in MP4 format.

We focused on the records of detailed visits of selected course students (Table 1). In total, we worked with 194 videos with a total length of 26.19 hours (1572 minutes), the vast majority of which are records of students included in the main analysis (see Table 1); furthermore, we used records of 1-2 videos per student for another 6 students, which were used to verify the consistency of the data.

Table 1: Students whose videos were included in the analysis (excluding 7 additional videos)

student	group	sex	number of videos	length of all videos (min)	average length (min)	number of events	average number of events per video
S1Mel	eL	Male	19	107.6	5.7	710	37.4
S2Fwi	wiki	Female	36	206.2	5.7	2053	57
S3Fwi	wiki	Female	58	719.1	12.4	2976	51.3
S4Mel	eL	Male	37	240.4	6.5	1875	50.7
S5Fel	eL	Female	37	105.1	2.8	622	16.8
			Sum:	Sum:	Average:	Sum:	Average:
Total			187	1378.4	6.62	1647.2	42.64

As part of the video data we obtained in this manner, we proceeded to carry out a qualitative analysis of the video. After considering the software options available to us (Snelson *et al.*, 2021), we proceeded to create our own web-based information system for video analysis – Video Coding Analytics System (VCAS). VCAS enables coding (tagging, linking of similar cases) and attaching comments at the level of individual video recordings, students and specific places within the videos, which capture the movement of students in the LMS or wiki. The window with a video recording of the students' behaviour in the course can be maximised. To alert you to what is happening or what is to happen in the video, VCAS is equipped with a floating panel, which displays the codes (tags) assigned to the current timestamp of the video and those that will follow in the next 4 seconds.

In our concept, the videos are specific, they are recordings of movement within the web environment, not social interaction, as is usual with video recordings in qualitative research (Heath *et al.*, 2010). Thus, we generally combined Narrative Research (unit of analysis is one or more individuals; focus on exploring "the life" of a student in an eLearning course) and Case Study (studying an event, activity; focus on in-depth description and analysis of a case or multiple cases) (Creswell, 2012).

In the first phase, we analysed several videos (especially the longer ones) to determine the basic codes (tags) and events and activities we will track. Within the First cycle coding (Saldaña, 2009), we mainly monitored the movement of students through the course, from where they accessed the individual parts of the course, how they moved and behaved within it, what activities they performed and we assigned codes (tags) to such data. Then within second cycle coding - focus coding method - (Saldaña, 2009) - we chose most often occurred tags, which were used to define themes.

3. Findings

The student's approach to studies was less active, most likely due to the ongoing COVID-19 pandemic. The students' engagement during the lessons was relatively lax (webcams turned off; slow responses to questions we asked them). The irregular and fitful manner of studying shortly before the test date has been confirmed in the past (Polasek and Javorcik, 2020), it is possible that the current pandemic situation has exacerbated it. In the case of the eL Group, 82.8% of accesses to the study content of the course took place during the test day and 5 days before it; in the case of the wiki Group, it was 51.9% of accesses. Even in the case of our current research, the attendance at the courses always culminated in the days immediately preceding the written examinations.

During the First cycle coding, we defined codes (tags), which reached the total number of 92 after the Second cycle coding. However, this includes service tags, which serve to keep better track of the individual videos. From there 92 tags we have selected most often occurred and significant 21 tags, which created base for below mentioned themes.

Besides the obvious interactions with the web page (clicking on hyperlinks, text, mouse cursor movement, web page retrieval), we were able to detect the following events: (a) (re-)retrieval of the current page (when the student left and returned to the current web browser window or when switching to a second window within our course/web); (b) movement forward/backward within the history of visited pages using web browser buttons;

(c) inserting text from clipboard memory when using WYSIWYG editor on web pages (not common form elements); and (d) changing the size of the browser window in which the current web page is loaded.

As part of the coding and analysis, we identified the following four themes.

3.1 Theme 1: The student only solves current problems

At the beginning of the course, students usually attended the e-Learning course page, where they chose the topic of their seminar work. They repeatedly returned to the LMS Moodle page, where the seminar paper was to be submitted. They visited the site, checked it and left again after a while. This was repeated for several students. They also went through the schedule of presentations, where it was stated when they should present their seminar work in class.

In the wiki-based course, students began working on the assigned seminar work only after repeated notifications by the lecturer. The seminar papers were intended to be publicly available so that other students could become acquainted with the knowledge and resources established and prepared by their classmates. However, according to the analysis of video recordings of visits, there was a kind of comparison in what form “my” seminar work was processed and what the others look like.

Similarly, we can see intensive attendance of the course (study) only in the days just before the written test. As part of his or her low course attendance, the student (S5Fel) made 56% of all course visits on the day of the test.

As part of checking the deadlines for submitting assignments, reading the requirements for completing the course, etc., students repeatedly used the mouse cursor to move over the content they were currently reading. They repeatedly clicked on particularly important parts (terms, more demanding? requirements), as if imaginatively adding exclamation marks to them.

3.2 Theme 2: The student does not understand, creates background and connections

Hovering the mouse cursor over the text and clicking on particularly important passages can also describe a situation where the student is failing to understand something. We can observe this, for example, in the overview of individual topics of the course, where the student goes through the individual points of the topic, control questions and looks for appropriate answers in specific MLU. He or she repeatedly returns to the overview of the topic and to the individual MLUs. In the topic overview, he or she moves the cursor over the questions, clicking on those that he or she probably considers important.

Sometimes, on the other hand, the student has two windows of the electronic course open and compares them and switches between them in combination with the displayed topic. While learning, there is also hesitation, when the mouse cursor hovers over the hyperlinks of individual MLUs that make up the topic and the student decides which ones to display. At that moment, the student can be going over the knowledge or deciding which MLU to choose for further learning.

3.3 Theme 3: The student behaves dishonestly during the online test

When correcting the submitted tests, we came across very similar answers. As part of the subsequent analysis of video recordings, we found students who actually inserted texts (probably from the Internet) from the clipboard into the online test form (written in LMS Moodle) during the test and subsequently edited them in the test. This is also the most striking indicator of cheating when writing an online test. Furthermore, as part of writing the test, the students left and returned to the web browser window with the test. Another indicator was the reduction of the size of the window to the vertical or horizontal half of the screen associated with leaving the browser window with the online test loaded. Not all cheating students inserted entire tests from the clipboard memory, many only left the window and then typed in the text.

In video recordings, where it is possible to indicate copying, the student’s hesitation (inactivity, small continuous movements of the mouse cursor without entering text) also occurred during the test. Students also moved the mouse cursor more often over the text of test questions or clicked on some parts repeatedly during these visits.

3.4 Theme 4: The student finds it hard to operate the website

During the coding and analysis of videos, we also came across situations that indicate that students did not always find it easy to work with the course in its form. The individual MLUs were created so that they could be conveniently displayed on mobile devices (sufficiently large text, responsiveness). According to the analysed videos, this proved to be a certain disadvantage. The text of the MLU was sometimes too large on the computer (its responsive scaling down was not enough) and so the mobile first approach (Romeo MARGEA *et al.*, 2017) was possibly to the detriment. According to video recordings, students did not study on mobile devices. Some students had to scroll repeatedly during the course (while studying) to see the entire MLU content or to move to the MLU content. Several of them then came up with a solution of viewing the MLU in a smaller browser window, which in a way simulates approximately the display on the tablet (display width).

3.5 Differences between LMS Moodle and wiki

We deployed the wiki for one group of students due to the simpler environment and especially the easier opportunities for students to actively (co-)create its content. However, as part of the video analysis, we found that a simpler concept of the wiki is a benefit for easier display of content (individual MLUs). For example, the students did not have to scroll to get content (they always had to scroll in Moodle). The more compact concept of the wiki web template (as opposed to the comprehensive one in LMS Moodle) also allowed students to move faster within the course structure. Especially in the transition from MLU to individual Topics. In the wiki environment, students also made much more use of the hyperlinks to move from one MLU to the next. Although such hyperlinks are also present in LMS Moodle.

In the case of the wiki Group, students then had the opportunity to follow the work and compare their submitted seminar papers (i.e. wiki pages) with those of their classmates. We observed that they mainly checked or compared the works of others, i.e. they used it less to study or supplement the knowledge available in the individual course Topics.

4. Conclusion

Within our concept of qualitative LA, we are able to use indirect observation to monitor in detail how students behave in the web application environment (LMS/wiki) and how they interact with it. With the help of four main detectable events (a/ re-retrieval; b/ moving forward / backward within the site; c/ inserting text into forms; d/ reducing the browser window size) we are able to find out how students use the site, or to identify their specific behaviour (cheating during tests). A general look at themes, as well as the analysis of video recordings, shows that the students (probably not surprisingly) were only solving the current “problem”. At the beginning of the semester, the students rather only explore the course. Subsequently, they start examining the requirements for the semester (presentation in class, seminar work). Only in time, as the date of the test approaches, do they begin studying in a more intensive manner. However, the approach to studying varies considerably from student to student – in how well in advance of the test they start and in its intensity. However, looking at the study groups as a whole, “last minute” studying prevails.

Using four events (a/ to d/) and the ability to track and evaluate mouse cursor movement and clicks performed within the website, we were able to detect copying in an online test. Another interesting finding is the importance of mouse cursor movement over the page content or clicking on the text content of the website. By moving the cursor over the text, students emphasised the focus on certain passages they read. This was repeatedly done for the dates of seminar paper presentations, when studying individual topics and also during tests. This is a finding that illustrates or confirms the current research that suggests a relation between the movement of the eyes and the mouse (Milisavljevic *et al.*, 2021). In addition, we identified the importance of repeated clicks on problematic passages in the text or test, where multiple clicks probably suggest a greater problem. Our concept of qualitative LA offers a closer insight into the behaviour of visitors, which “traditional” LA cannot always capture. We see other possibilities for research into mouse movements and clicks on web content as potentially promising. Also, the benefits for the analysis of the user-friendliness of the e-Learning course are essential mainly due to the current trend of shifting towards online education.

References

Araka, E., Maina, E., Gitonga, R. and Oboko, R. (2020), "Research trends in measurement and intervention tools for self-regulated learning for e-learning environments—systematic review (2008–2018)", *Research and Practice in Technology Enhanced Learning*, Vol. 15 No. 1, available at:https://doi.org/10.1186/s41039-020-00129-5.

Arapakis, I. and Leiva, L.A. (2020), "Learning Efficient Representations of Mouse Movements to Predict User Attention", *ArXiv:2006.01644 [Cs, Stat]*, available at: http://arxiv.org/abs/2006.01644 (accessed 21 June 2021).

Bertot, J.C., McClure, C.R., Moen, W.E. and Rubin, J. (1997), "Web usage statistics: Measurement issues and analytical techniques", *Government Information Quarterly*, Vol. 14 No. 4, pp. 373–395.

Clark, D.J., Nicholas, D. and Jamali, H.R. (2014), "Evaluating information seeking and use in the changing virtual world: the emerging role of Google Analytics", *Learned Publishing*, Vol. 27 No. 3, pp. 185–194.

Creswell, J.W. (2012), *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research*, 4th ed., Pearson, Boston.

Dawson, S., Gašević, D., Siemens, G. and Joksimovic, S. (2014), "Current state and future trends: a citation network analysis of the learning analytics field", *Proceedins of the Fourth International Conference on Learning Analytics And Knowledge - LAK '14*, presented at the Proceedins of the Fourth International Conference, ACM Press, Indianapolis, Indiana, pp. 231–240.

Dekkers, T., Melles, M., Vehmeijer, S.B.W. and de Ridder, H. (2021), "Effects of Information Architecture on the Effectiveness and User Experience of Web-Based Patient Education in Middle-Aged and Older Adults: Online Randomized Experiment", *Journal of Medical Internet Research*, Vol. 23 No. 3, p. e15846.

Delgado-Cepeda, F.J. (2019), "Four Years Following for Open Learning in a Numerical Methods Course Based on Learning Analytics", presented at the 17th International Conference e-Society 2019, Utrecht, pp. 45–52.

Djamasbi, S., Siegel, M., Skorinko, J. and Tullis, T. (2011), "Online Viewing and Aesthetic Preferences of Generation Y and the Baby Boom Generation: Testing User Web Site Experience Through Eye Tracking", *International Journal of Electronic Commerce*, Vol. 15 No. 4, pp. 121–158.

Gašević, D., Dawson, S. and Siemens, G. (2015), "Let's not forget: Learning analytics are about learning", *TechTrends*, Vol. 59 No. 1, pp. 64–71.

Greller, W. and Drachsler, H. (2012), "Translating Learning into Numbers: A Generic Framework for Learning Analytics", *EDUCATIONAL TECHNOLOGY & SOCIETY*, Vol. 15 No. 3, pp. 42–57.

Heath, C., Hindmarsh, J. and Luff, P. (2010), *Video in Qualitative Research: Analysing Social Interaction in Everyday Life*, SAGE, Los Angeles.

Hernández-Leo, D., Martinez-Maldonado, R., Pardo, A., Muñoz-Cristóbal, J.A. and Rodríguez-Triana, M.J. (2019), "Analytics for learning design: A layered framework and tools: Analytics layers for learning design", *British Journal of Educational Technology*, Vol. 50 No. 1, pp. 139–152.

Hewson, C. (2014), "Qualitative Approaches in Internet-Mediated Research: Opportunities, Issues, Possibilities", in Leavy, P. (Ed.), *The Oxford Handbook of Qualitative Research*, Oxford University Press, Oxford ; New York, pp. 423–451.

Jana, S. and Chatterjee, S. (2004), "Quantifying Web-site visits using Web statistics: an extended cybermetrics study", *Online Information Review*, Vol. 28 No. 3, pp. 191–199.

Jiun-Yu Wu, Yang, C.C.Y., Chen-Hsuan Liao, and Mei-Wen Nian. (2021), "Analytics 2.0 for Precision Education: An Integrative Theoretical Framework of the Human and Machine Symbiotic Learning.", *Journal of Educational Technology & Society*, International Forum of Educational Technology & Society (IFETS), Vol. 24 No. 1, pp. 267–279.

Katuu, S. (2018), "Using Web Analytics to Assess Traffic to the Mandela Portal: The Case of African Countries", *New Review of Information Networking*, Vol. 23 No. 1–2, pp. 1–18.

Kuromiya, H., Majumdar, R. and Ogata, H. (2020), "Fostering Evidence-Based Education with Learning Analytics: Capturing Teaching-Learning Cases from Log Data", *Educational Technology & Society*, Educational Technology & Society, Vol. 23 No. 4, pp. 14–29.

Law, N. and Liang, L. (2020), "A Multilevel Framework and Method for Learning Analytics Integrated Learning Design", *Journal of Learning Analytics*, Vol. 7 No. 3, pp. 98–117.

Lee, J., Song, H.-D. and Hong, A. (2019), "Exploring Factors, and Indicators for Measuring Students' Sustainable Engagement in e-Learning", *Sustainability*, Vol. 11 No. 4, p. 12.

Lockyer, L., Heathcote, E. and Dawson, S. (2013), "Informing Pedagogical Action: Aligning Learning Analytics With Learning Design", *American Behavioral Scientist*, Vol. 57 No. 10, pp. 1439–1459.

Loperfido, F.F., Dipace, A. and Scarinci, A. (2018), "Qualitative Learning Analytics to Understand the Students' Sentiments and Emotional Presence in EduOpen", *European Distance and E-Learning Network (EDEN) Conference Proceedings*, European Distance and E-Learning Network, No. 1, pp. 115–122.

Luo, H., Rocco, S. and Schaad, C. (2015), "Using Google Analytics to Understand Online Learning: A Case Study of a Graduate-Level Online Course", *2015 International Conference of Educational Innovation through Technology (EITT)*, presented at the 2015 International Conference of Educational Innovation through Technology (EITT), IEEE, Wuhan, China, pp. 264–268.

Marcu, D. and Danubianu, M. (2019), "Learning Analytics or Educational Data Mining? This is the Question...", *BRAIN: Broad Research in Artificial Intelligence & Neuroscience*, EduSoft SRL, Vol. 10, pp. 1–14.

Massaro, A., Giannone, D., Birardi, V. and Galiano, A.M. (2021), "An Innovative Approach for the Evaluation of the Web Page Impact Combining User Experience and Neural Network Score", *Future Internet*, Vol. 13 No. 6, p. 145.

Milisavljevic, A., Abate, F., Le Bras, T., Gosselin, B., Mancas, M. and Doré-Mazars, K. (2021), "Similarities and Differences Between Eye and Mouse Dynamics During Web Pages Exploration", *Frontiers in Psychology*, Vol. 12, p. 554595.

Miranda, S. and Vegliante, R. (2019), "Learning analytics to support learners and teachers: The navigation among contents as a model to adopt", *Journal of E-Learning and Knowledge Society*, Vol. 15 No. 3, pp. 101–116.

Nishihara, R., Moritz, P., Wang, S., Tumanov, A., Paul, W., Schleier-Smith, J., Liaw, R., *et al.* (2017), "Real-Time Machine Learning: The Missing Pieces", *Proceedings of the 16th Workshop on Hot Topics in Operating Systems*, presented at the HotOS '17: Workshop on Hot Topics in Operating Systems, ACM, Whistler BC Canada, pp. 106–110.

O'Brien, H. (2016), "Theoretical Perspectives on User Engagement", in O'Brien, H. and Cairns, P. (Eds.), *Why Engagement Matters*, Springer International Publishing, Cham, pp. 1–26.

Ochoa, X. and Merceron, A. (2018), "Quantitative and Qualitative Analysis of the Learning Analytics and Knowledge Conference 2018", *Journal of Learning Analytics*, Vol. 5 No. 3, available at:https://doi.org/10.18608/jla.2018.53.10.

Polasek, R. (2019), "Approach to the Creation of a Microlearning Course in Coding Web Pages Within the LMS Environment", in Smyrnova-Trybulska, E. (Ed.), *E-Learning and STEM Education*, Vol. 11, Studio NOA for University of Silesia in Katowice, Katowice - Cieszyn, pp. 557–569.

Polasek, R. (2020), "Design of Wiki Application in Microlearning in Terms of Attendance and Course Utilisation by Students", *13th International Scientific Conference on Distance Learning in Applied Informatics*, presented at the DIVAI 2020 - 13th International Scientific Conference on Distance Learning in Applied Informatics, Wolters Kluwer, Štúrovo, pp. 171–181.

Polasek, R. and Javorcik, T. (2019), "Results of pilot study into the application of MicroLearning in teaching the subject Computer Architecture and Operating System Basics", in Wang, F.L., Au, O., Klimova, B., Hynek, J. and Poulova, P. (Eds.), *2019 International Symposium on Educational Technology*, presented at the 5th International Symposium on Educational Technology (ISET2019), IEEE, Hradec Králové, pp. 196–201.

Polasek, R. and Javorcik, T. (2020), "Analysis of Student Behaviour in e-Learning Courses in Relation to Academic Performance", *Proceedings of the 19th European Conference on E-Learning ECEL 2020*, Academic Conferences International Limited, Reading, pp. 428–437.

Romeo MARGEA, Camelia MARGEA, Bogdan VECHE, and Călin HURBEAN. (2017), "Mobile First. Current Trends and Practices in Website Design", *Annals of Dunarea de Jos University. Fascicle I : Economics and Applied Informatics*, Dunarea de Jos University of Galati, Vol. 23 No. 3, pp. 164–173.

Romero, C. and Ventura, S. (2020), "Educational data mining and learning analytics: An updated survey", *WIREs Data Mining and Knowledge Discovery*, Vol. 10 No. 3, available at: https://doi.org/10.1002/widm.1355.

Saldaña, J. (2009), *The Coding Manual for Qualitative Researchers*, Sage, Los Angeles, Calif.

Snelson, C., Yang, D. and Temple, T. (2021), "Addressing the Challenges of Online Video Analysis in Qualitative Studies: A Worked Example from Computational Thinking Research", *The Qualitative Report*, Vol. 26 No. 6.

Solis-Martinez, J., Espada, J.P., Gonzalez Crespo, R., Pelayo G-Bustelo, B.C. and Cueva Lovelle, J.M. (2020), "UXJs: Tracking and Analyzing Web Usage Information With a Javascript Oriented Approach", *IEEE Access*, Vol. 8, pp. 43725–43735.

Srivastava, N., Nawaz, S., Newn, J., Lodge, J., Velloso, E., M. Erfani, S., Gasevic, D., *et al.* (2021), "Are you with me? Measurement of Learners' Video-Watching Attention with Eye Tracking", *LAK21: 11th International Learning Analytics and Knowledge Conference*, presented at the LAK21: 11th International Learning Analytics and Knowledge Conference, ACM, Irvine CA USA, pp. 88–98.

Tomasevic, N., Gvozdenovic, N. and Vranes, S. (2020), "An overview and comparison of supervised data mining techniques for student exam performance prediction", *Computers & Education*, Vol. 143, p. 103676.

Tsai, Y.-S., Rates, D., Moreno-Marcos, P.M., Muñoz-Merino, P.J., Jivet, I., Scheffel, M., Drachsler, H., *et al.* (2020), "Learning analytics in European higher education—Trends and barriers", *Computers & Education*, Vol. 155, p. 103933.

Tullis, T. and Albert, B. (2013), *Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics*, Second edition., Elsevier/Morgan Kaufmann, Amsterdam ; Boston.

Verhulsdonck, G. and Shalamova, N. (2020), "Creating Content That Influences People: Considering User Experience and Behavioral Design in Technical Communication", *Journal of Technical Writing and Communication*, Vol. 50 No. 4, pp. 376–400.

Yang, C.C.Y., Chen, I.Y.L., and Hiroaki Ogata. (2021), "Toward Precision Education: Educational Data Mining and Learning Analytics for Identifying Students' Learning Patterns with Ebook Systems.", *Journal of Educational Technology & Society*, International Forum of Educational Technology & Society (IFETS), Vol. 24 No. 1, pp. 152–163.

We Also Remain Active Online: Solving Global Waste Problems by Secondary School Students

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Abstract: The paper describes the environmental education teaching model, in which students actively participate in solving global environmental problems directly during formal secondary education. Education is based on the principles of personal commitment of students; effective interconnection of online and outdoor education; linking environmental education with current sustainable development goals; combining individual work of students with group problem solving; use of diverse ICT in individual phases of teaching. The model is based on interdisciplinary collaboration and connects outdoor education, information and communication technologies, individual and collaborative work of students and can be used in traditional and online education.

Keywords: environmental education, global environmental problem, waste, online education, information and communication technologies

1. Introduction

During the COVID 19 pandemic, most of our daily activities are focused on where we live. Several countries report an improvement in the state of the environment, (especially air or water), but problem of waste remains. Approximately 2 billion tons of municipal solid waste (MSW) is collected worldwide every year and this amount is constantly increasing. By 2050, humanity is estimated to produce up to 3.40 billion tons (http://datatopics.worldbank.org/what-a-waste/). According to the World Bank (https://www.worldbank.org/), an amount of money is being spent to combat this global problem, which is increasing every year (about $ 375 billion by 2025). Here, environmental education (EE) plays an important role as a basic preventive tool for environmental protection. Goal of EE is the assessment of an environmental issue and any feasible solutions it may have; in that assessment problems are analysed systematically, not only as a theory of reality but also as an action strategy to be undertaken (Magnus et al, 1997).

In Slovakia, EE is a mandatory part of education within the State Education Program, but only as a cross-cutting theme. According to this program, it points out the seriousness of the environmental problem and influences students to "participate in activities dedicated to the protection and improvement of the environment and actively participate in the elimination of its pollution" (http://www.statpedu.sk).

Unfortunately, the "stay home" period caused by the pandemic has greatly affected formal education in schools (Harris, 2020; Daniel, 2020) including EE. In Slovakia, EE was relegated to the side-lines, the priority is online teaching of educational areas at the expense of cross-cutting topics. A frequent accompanying phenomenon of online teaching is its low attractiveness to students and therefore teachers are looking for different pedagogical approaches to make the curriculum more attractive and motivating for students.

The aim of the paper is to create an EE model for lower secondary education, which combines mobile learning, interdisciplinary learning, project-based online learning and outdoor education in order to modernize, to streamline and to make waste issue more attractive to students.

We actively involve students in solving waste problem. In the model, EE is a kind of umbrella that covers and connects various social science and science subjects and applies their content directly to the practice by connecting to the daily life of students to the environment. Students discover the seriousness of the issue of waste through the mapping of illegal landfills (IL) or litter mapping (Earll et al, 2000; Valiente et al, 2020) and look for solutions to solve and prevent these problems.

2. Methodology

The proposed model of EE aimed at solving global problems (eg waste) can be implemented in the form of traditional and online education. In the work of Jakab et al (2019) the idea of linking the formal teaching of EE with the solution of students' environmental problems was outlined for the first time. The first model for teaching waste issues through project teaching, interdisciplinary learning and outdoor education (Jakab et al, 2020), outlined the possibilities of involving students in solving the problem of IL. The new model is adapted for the possibility of online education, students are more aware of their impact on the environment and are more involved in solving the problem. The model has been extended to include new teaching principles and new methodological steps, making it more comprehensive and effective. It is based on 5 logically interconnected principles:

1. The principle of personal involvement of students, which points to the possibilities of using formal education to initiate civic engagement of students in solving a specific environmental problem - waste (in the spirit: "I do care about it"). According to the results of testing the level of students in the areas of knowledge, cognitive skills, social skills and attitudes, values in the Program for International Student Assessment (PISA), it is necessary to lead students to greater civic engagement (https://www.oecd.org/pisa/pisa-2018-global-competence.htm). The weak level of involvement of Slovak students is pointed out in the report on the state of EE realized in 2021 (Bodáczová et al, 2021).

2. The principle of direct linking the content of education to the curriculum. A condition for the usability of the proposed model in formal education is a direct link between the content of education and the curriculum. The issue of waste is incorporated in the objectives and standards of the cross-cutting theme of EE (https://www.statpedu.sk/), with possible implementation in several subjects of secondary education (e.g. Geography, Biology, History, Ethics, Religion, Civics, Physics, Chemistry, Mathematics, Informatics, etc.)

3. The principle of effective connection of online and outdoor education. The model connects online (synchronous) education with outdoor (asynchronous) education taking place outside of school. Synchronous education is part of online education which is live and real-time (and usually scheduled). Classroom experience and information exchange need not only take place between students and teachers and between students (Shahabadi, Uplane, 2015). In our case, synchronous teaching is based on conference systems (e.g. Zoom, Meet, Skype, Microsoft Teams), where the teacher uses teaching methods such as description, explanation, discussion (Clark, Kwinn, 2007). Outdoor education is associated with asynchronous e-learning, which is characterized by independent work independent of the teacher or other students (Hrastinski, 2008). Students map IL on the basis of the methodology provided by the teacher (in the form of submitted materials or through a course created in the LMS system), independently and outside the teaching hours, and look for solutions to eliminate them.

4. Linking EE with current Sustainable Development Goals. As a cross-cutting topic, EE intersects the economic, social and environmental dimensions and promotes the principles of sustainable development through education. According to the 2030 Agenda, education is effective and reliable measure for achieving sustainable development and the goals that reconcile economic and social progress and a quality environment at each level (UN, 2015). We can meet the issue of waste in several goals of the Agenda 2030, e.g. 1-4, 6-9, 11-15 a 17.

5. Connecting individual work of students with group problem solving. The core of the whole model is work on student projects that combine individual work with group solutions (Eby, Dobbins, 1997).

Mapping of IL as individual work is realized in the field (outdoor education). Group work includes cooperation in defining goals and tasks, joint search for suitable methodologies, team discovery of contexts, interpretation and presentation of results, etc.

6. Effective use of diverse Information and communication technology (ICT) in individual phases of teaching. Smitek (1998) explains ICT as methods, procedures and ways of collecting, storing, processing, verifying, evaluating, selecting, distributing and timely delivery of necessary information. We mainly included in the ICT group systems for direct support of education (conference systems, LMS systems) and mobile learning, which includes the use of mobile or wireless devices, e.g. mobile phones, smartphones, handheld computers, tablet computers, laptops or personal media players (Kukulska-Hulme, Traxler, 2005). The main applications on the topic Waste are: GreenDaily (https://www.ekorast.org/projekty-pre-verejnost-a-skoly), TrashOut

(https://www.trashout.ngo/), Czech Zero Waste (https://www.czechzerowaste.cz/). Other ICTs that can be involved in model include GPS and GIS systems (Zigová et al, 2018; Jakab et al, 2019).

For the implementation of the issue of Waste into the teaching process through the proposed model, we suggest using a combination of the teaching approaches:

- Interdisciplinary learning - is the combination of two or more disciplines, preferably in a way that interacts (Cooper et al, 2001). Multidisciplinary knowledge results in a central theme (Jones et al, 1997), in our case it is waste.
- Project-based learning - is focused on teaching by engaging students in investigation. Students pursue solutions to problems by asking and refining questions, debating ideas, making predictions, designing plans and experiments, collecting and analysing data, drawing conclusions, communicating their ideas and findings to others, asking new questions, and creating conclusion (Krajcik, Blumenfeld, 2006).
- Outdoor education - is called a method of developing knowledge, skills, attitudes related to the surroundings. It is an expression of the place of teaching and the topic covered (Ford, 1986). The purpose of the outdoor activities is to give students out-of-classroom educational experiences involving direct contact with various environments. These experiences are intended to give students in-depth knowledge of environmental issues and to develop their self-confidence, environmental sensitivity, action skills, responsible action in nature, and their social relationships (Palmberg, Kuru, 2000).
- Online learning - Benson (2002) and Conrad (2002) describe online learning as access to learning experiences via the Internet and the use of technology tools, which includes content and teaching methods provided on CD-ROM, the Internet, audio, video, television, and so on.
- Mobile learning - this term refers to the use of mobile and handheld IT devices, in teaching, training, and learning (Sarrab et al, 2012). Advantages of mobile learning are that with the mobility of general portable devices learner is not fixed at predetermined location and it is accessible virtually from any place, which provides access to all the different learning materials available (Alsaadat, 2017).

3. Results

The content of education in the proposed model consists of five consecutive levels. Students gradually become acquainted with the waste problem in their surroundings. They will also get acquainted with the possibilities of solving (correcting) this problem and with the possibilities of its prevention.

Level 1 - Identification and analysis of waste problems. Level (Figure 1) is represented by key questions:

What do we know about waste and the problems that waste causes?
Who is responsible for waste formation?

The issue of waste has been a part of education since kindergartens. Lower secondary students have a certain knowledge, skills and habits. It is desirable and necessary before the actual implementation of model to repeat student´s knowledge and connect it into the global context. The aim of the level is for students to understand the impacts of human society on the environment, including waste production. Waste can represent an environmental problem not only at the local level (from littering to IL), but also at the global level. The two levels are interlinked. Waste produced locally often ends up in rivers that flow into the seas and oceans. Here, the waste accumulate and threaten sensitive ocean ecosystems. At the end of this level, students should realize that this problem directly affects them and that their actions and decisions in everyday life affect the state of the environment on Earth. In the case of online teaching, this level is implemented using conference systems and can be supplemented with interactive teaching elements using applications such as Mentimeter, Slido, Nearpod or Kahoot.

Level 2 - IL - a global environmental problem of waste at the local level. Level represents the implementation of the problem of waste from the global level directly to the local (to municipalities and cities), i.e. to the environment of students. Key questions in the level concern littering and IL:

Where are the IL in our vicinity?
What types of waste do they consist of and who could create them and why?

The level is realized through outdoor education and represents the beginning of the work of student groups on projects (project teaching). After being divided into groups, students become acquainted with the process of mapping IL. They define goals, select and divide the area of interest, create a time schedule, plan joint outputs, etc. An important step is the development of a uniform common methodology so that the mapped parameters of IL are unified between the individual groups with the possibility of mutual comparison.

This is followed by individual work of students in the field, while each student is assigned a part of the area of interest (eg cities, settlements, municipalities, streets, neighbourhoods, etc.), in which the occurrence of IL will be mapped. All data on the IL are recorded in the mapper's manual (e.g. shape, size, types of waste, its location, potential producer, etc.). Here students can use mobile phones, tablets with Trashout application (Figure 1) with IL identification and description. After the realization of individual work of students, group work again follows, which consists of connecting the mapped parts into one whole.

At the level, it is also possible to use interdisciplinary relationships, with which students apply the knowledge and skills learned so far in obtaining and processing spatial data on IL.

Level 3 – Prevention of IL and littering formation. Level represents the continuation of work on student projects through online synchronous education (Figure 1). Its goal is to focus on the prevention of NSO and littering.

The level is represented by the following key questions:

What types of waste were found in IL?
How should the individual types of waste be handled correctly?

Students should understand that free-flowing waste in the country is an environmental problem. At the same time, they should understand the importance of proper waste management, because by sorting mixed MSW we can still use the waste in the recycling process, while saving natural resources, energy and water. Students work with information from field mapping. The groups are looking for suitable alternatives for the proper management of individual types of waste, which they mapped in IL. They address how waste should be handled properly to avoid IL.

Students can use the GreenDaily mobile application (Figure 1). It is a suitable guide for proper separation of MSW. The waste sorting system is not uniform in Slovakia. The application navigates the waste generator to the colour of the garbage container (e.g. plastics, paper, glass) in his village or town and also offers options where the nearest place for handing over specific waste (e.g. medicines, electrical waste, old batteries, cooking oil or construction waste). At the same time, it provides useful information about the collection yard or stores that collect specific waste for recycling. Other applications include: Recycle Academy is an educational project and helps you to recognize recycle symbols on packages and shows the right bin for specific material (https://apps.apple.com/en/app/recycle-academy/ id1413748789? l = en).

Level 4 - Waste prevention. Level is an effort to apply voluntary modesty to students' daily lives. It is a search for answers to the questions:

What am I doing wrong and what could I do better?
How to change our behaviour and our habits to minimize waste generation as much as possible?

It is the longest part of the model in time and at the same time a test of students' willingness to change their values, behaviour and attitude, especially in relation to the environment. The purpose of the level is to apply what students have learned and to understand the need to change their own behaviour in everyday life.

For these purposes, students can use the mobile application Czech Zero Waste (Figure 1), which includes a 40-day challenge full of options and tips related to waste prevention. In it, students will learn to change consumer behaviour in the future and understand that what they buy today will be waste tomorrow.

Students can find a similar challenge of good deeds on the Eco Hero website (https://ecohero.sk/), where there is information and suggestions that everyone can contribute to a sustainable future. The Eco Activity Tracker mobile app (https://apps.apple.com/us/app/ecohero-eco-activity-tracker/id1474213908) is also available.

Level 5 - Students' personal involvement and project sustainability. The level can be implemented in parallel with the previous levels. This is a personal involvement of students in solving the problem of IL mapped within level 2. The basic motivation for a successful solution:

What can we do to solve the IL problem?
What can we do to prevent further IL?

After mapping IL, they can be reported to the relevant municipal or city office, or using the TrashOut mobile application, where landfills can be registered (https://www.trashout.ngo/). Since 2010, citizens have been able to report suggestions and problems in the environment to the self-government via the Reference for Mayor portal (Figure 1) (https://www.odkazprestarostu.sk/).

In case of interest, it is possible to continue the project through peer education, which Shiner (1999) describes as education of young people by young people. Students can share the experience gained through project by teaching the classmates and younger students in the form of contact teaching or the use of ICT, e.g. a short video on mapping, publishing, presenting or sharing the knowledge, skills and experience. Reports created by students can have a preventive effect on citizens in local or regional newspapers, television, etc.

Students can participate together with the teacher in the international educational program Young Reporters for the Environment (http://www.mladireporteri.sk/), which is part of the Foundation for Environmental Education. The result is a report that alerts and motivates citizens to correct, improve and prevent the problem. Another possibility of effective completion of student projects is the preparation and implementation of a brigade aimed at eliminating IL.

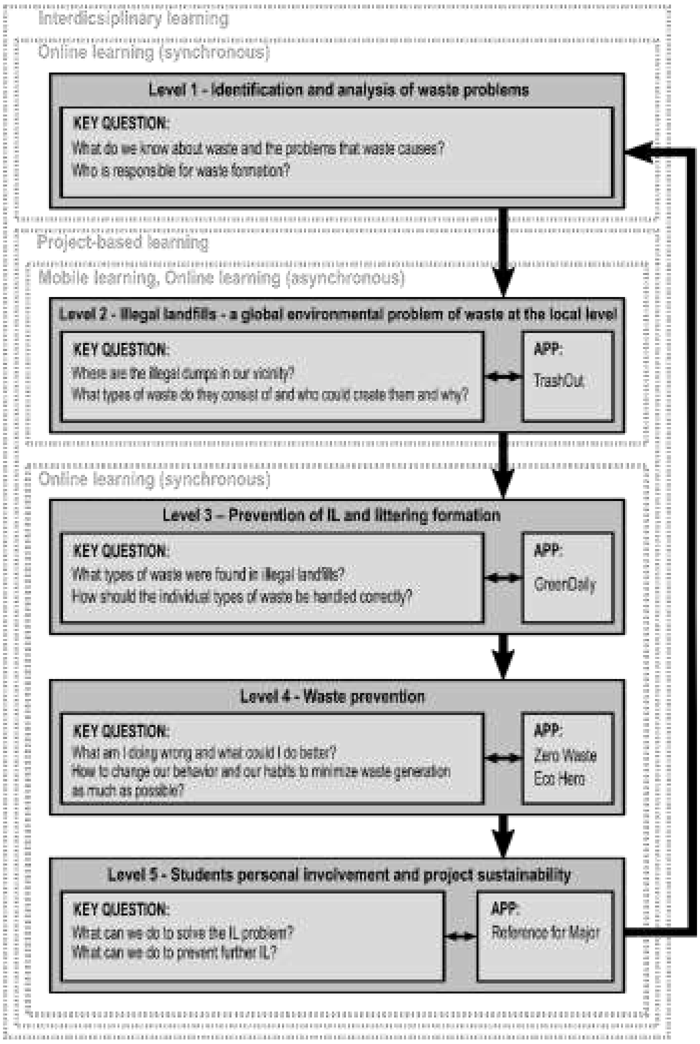

Figure 1: Model of environmental education teaching

4. Discussion

Economic development, growing production and the changing market for human consumption have led to a sharp increase in waste in the world over the last decades. Compared to the average amount of MSW per capita in the EU (489 kg) and in individual EU countries, the Slovakia belongs to the countries with a smaller amount (434 kg), but landfilling is dominated (61%). (https://www.europarl.europa.eu/). In accordance with the valid legislation, the obligatory separate collection of paper, plastics, glass and metals, later also biodegradable waste and multilayer combined materials, was gradually introduced in Slovakia from 1 January 2010. Although the share of separation is increasing every year, we are still relatively low compared to EU countries. One way is to change people's thinking by preventing waste.

EE plays a key role here. Environmental education represents a systemic view of the world that emphasizes the dynamic interconnection between personal, local, regional, national and global levels of spatial existence of a selected environmental problem. The global is still present in the local environment, with several local events entering and affecting the global environment (Selby, 2000). The most important characteristic of environmental education is probably that it makes possible to solve real problems (Layrargues, 2000). In Slovakia, the issue of waste has been a part of the content of the state educational program for the 1st and 2nd level of primary schools and for eight-year grammar schools within the cross-cutting theme of EE since 2008, and its implementation encounters several problems. According to the Analysis of the State of Formal Environmental Education in Slovakia, there are shortcomings especially in the areas of content and methods, interconnection of cross-cutting themes, available options for extracurricular activities and support for teachers. Students' theoretical knowledge shows a lower degree of connection with real life and global environmental problems (Bodáczová et al, 2021).

According to the OECD (https://www.oecd.org/pisa/pisa-2018-global-competence.htm), Slovak students in their attitudes are comparable to OECD countries with an overall PISA average. In selected issues of ethics or activism, they achieve the same or even better results than the participating OECD countries. Although we are trying to educate the young generation in the field of waste, the situation is not improving, because every year the amount of MSW per 1 inhabitant of Slovakia increases (https://www.enviroportal.sk/spravy/kat21). We agree with Boh (1994), according to which EE is expected to transcend the simple awareness of issues and should incorporate direct training for the problem of remediation. Teaching methods in science are often formal and based on theoretical studies. Currently, EE is rarely linked with the solution to local environmental problems. Environmental education materials are often general, not reflecting local environmental problems and not preparing students for coping with them. Little emphasis is put on strengthening the individual's responsibility for improving local and global environmental conditions.

The implementation of EE through the discovery of problems, identifying their impacts on the environment, finding alternatives for their solutions and involving students in solving the problem is the basis of our proposed EE model with a focus on the topic of waste.

Project teaching in secondary education in order to streamline the teaching of waste issues has been part of several studies. Susilawati et al (2017) use project-based learning method with mind maps in science learning for the topic of waste management and its solution to improve students' environmental attitudes. Lawless (2008) focuses on electrical waste and offers schools a detailed methodology called 5 Steps to Responsible E-waste Management at Your School. Zhang et al (2008) describes the possibilities of the Green School in relation to waste and proposes the introduction of School-wide recycling and guiding students to the possibilities of waste minimization. The aim of another study (Wibowo, Purwianingsih, 2021) was to analyse the creative thinking skills of vocational students on waste treatment materials by applying project-based learning. Data collection of students' creative thinking used essay test. Most studies on educating students about waste through PBL focus mainly on learning in the classroom, without the direct personal involvement of students in and out of school. The proposed teaching model is based on deepening students' knowledge of a specific environmental problem with which they personally come into contact in the environment. The model effectively combines several pedagogical approaches. In addition to PBL and outdoor education, mobile learning and interdisciplinary learning. The issue of waste as well as EE have an interdisciplinary character and affect the educational areas of several subjects. In addition to developing environmental attitudes, the model we propose has the potential to develop a wide range of other skills. Active use of ICT develops skills associated with ICT (Belisle, Rosado, 2007). When using interdisciplinary education, students develop interdisciplinary thinking, improve the ability to think critically, cognitive skills, and understand the relationships between different areas of each discipline (Ivanitskaya et al, 2002). In project teaching, students acquire 21st century skills, especially collaboration, communication, critical thinking, creativity, language skills, innovation, global relations, the use of technology, etc. (Mergendoller et al, 2006). Comparing students with and without experience with outdoor teaching reveals a difference between them, especially in the acquisition and improvement of skills. Students thus gain self-confidence, a sense of security without dependence on adults (teachers), greater initiative for involvement, knowledge of their own limits and, what is positive, spontaneous, open and willing to cooperate (Dresner, Gill, 1994).

5. Conclusion

The current "consumption" time, when people often buy what they don't need, has caused a global environmental problem of waste. With a growing population, this problem is increasing every year. Natural resources are limited, so it is necessary to learn to behave in such a way that future generations will have something to draw on.

The space for this global challenge is in the formal teaching of EE. Students' enthusiasm for solving waste or other global problems can be ensured by activating teaching methods, forms such as interdisciplinary learning, project-based learning, outdoor education, e-learning and online learning. If students develop key competencies (knowledge, abilities, skills, attitudes, habits) in a given issue, it will increase students' personal involvement in finding solutions to problems and become an excellent model and inspiration for their neighbourhood.

In this spirit, we have created an EE teaching model for lower secondary education focused on the topic of Waste. Individual levels are described with a number of training tips, including fun applications and waste websites. After the teaching of the model, the problem of waste will not be solved the next day, but we will be closer to a quality environment, because we will have conscious students ready to face waste at the local and global level in the future.

References

Agenda 2030. The 17 Goals. Available on: https://sdgs.un.org/goals

Alsaadat, K. (2017) "Mobile Learning Technologies. International Journal of Electrical and Computer Engineering (IJECE), 7(5), pp 2833−2837.

Belisle, C. and Rosado, E. (2007) Analysing Digital Literacy Frameworks. Research Report for "A European Framework for Digital Literacy" (eLearning Programme 2005-2006), halshs-00137779, Available on: https://halshs.archives-ouvertes.fr/halshs-00137779/document

Benson, A. (2002) "Using Online Learning to Meet Workforce Demand: A Case Study of Stakeholder Influence." Quarterly Review of Distance Education, 3(4), pp 443−452.

Bodáczová, M., Engeľ, M. and Sedláček, M. (2021) Čo vás v tej škole učia. Analýza stavu formálneho environmentálneho vzdelávania na Slovensku. Bratislava: Inštitút environmentálnej politiky. 27 p. Available on: https://www.minzp.sk/files/iep/2021_03_co_vas_v_tej_skole_ucia.pdf

Boh, B. (1994) Environmental Issues in Secondary Education (English). ESP Discussion Paper Series; no. 21. Washington, D.C.: The World Bank. 139 p. Available on: http://documents.worldbank.org/curated/en/382181468764386963/Environmental-issues-in-secondary-education

Clark, R.C. and Kwinn, A. (2007) The New Virtual Classroom: Evidence-based Guidelines for Synchronous e-Learning. John Wiley & Sons. 304 p.

Conrad, D. (2002) "Deep in the Hearts of Learners: Insights into the Nature of Online Community." Journal of Distance Education, 17(1), pp 1−19.

Cooper, H., Carlisle, C., Gibbs, T. and Watkins, C. (2001) "Developing an Evidence Base for Interdisciplinary Learning: a Systematic Review." Journal of Advanced Nursing, 35(2), pp 228−237.

Daniel, S.J. (2020) "Education and the COVID-19 Pandemic." Prospects 49, (2020), pp 91–96.

Dresner, M. and Gill, M. (1994) "Environmental Education at Summer Nature Camp." Journal of Environmental Education, Vol. 25, Nr. 3 pp 35−41.

Earll, R.C., Williams, A.T., Simmons, S.L. and Tudor, D.T. (2020) "Aquatic Litter, Management and Prevention – the Role of Measurement." Journal of Coastal Conservation, 6, pp 67–78.

Eby, L.T. and Dobbins, G.H. (1997) "Collectivistic Orientation in Teams: an Individual and Group-level Analysis." Journal of Organizational Behavior, 18(3), pp 275–295.

Ford, P. (1986) "Outdoor Education: Definition and Philosophy. ERIC Digest. Las Cruces, NM: ERIC Clearinghouse on Rural Education and Small Schools. ERIC Document Reproduction Service No. ED 267 941.

Harris, A. 2020. "COVID-19 – School Leadership in Crisis?" Journal of Professional Capital and Community, Vol. 5 No. 3/4, pp 321–326.

Hrastinski, S. (2008) "Asynchronous and Synchronous e-Learning: A Study of Asynchronous and Synchronous e-Learning Methods Discovered that each Supports Different Purposes." EDUCAUSE Quarterly, 31 (4), pp 51–55.
http://datatopics.worldbank.org/what-a-waste/, [27.5.2021]
http://www.statpedu.sk, [27.5.2021]
http://www.mladireporteri.sk, [27.5.2021]
https://apps.apple.com/sk/app/recycle-academy/id1413748789?l=sk, [27.5.2021]
https://apps.apple.com/us/app/ecohero-eco-activity-tracker/id1474213908, [27.5.2021]
https://ecohero.sk/, [27.5.2021]
https://www.ekorast.org/projekty-pre-verejnost-a-skoly, [27.5.2021]
https://www.enviroportal.sk/spravy/kat21, [27.5.2021]
https://www.odkazprestarostu.sk/, [27.5.2021]
https://www.oecd.org/pisa/pisa-2018-global-competence.htm, [27.5.2021]
https://www.trashout.ngo/, [27.5.2021]
https://www.czechzerowaste.cz/, [27.5.2021]
https://www.europarl.europa.eu/, [27.5.2021]
Ivanitskaya, L., Clark, D., Montgomery, G. and Primeau, R. (2002) "Interdisciplinary Learning: Process and Outcomes." Innovative Higher Education. Vol. 27, (2002), pp 95–111.
Jakab, I., Szabová, L. and Pucherová, Z. (2020) "Solving the Waste Problem by Modernizing the Secondary Education." In: DIVAI 2020 – 13th International Scientific Conference on Distance Learning in Applied Informatics: Conference Proceedings. Praha: Wolters Kluwer, 2020, pp 351–362.
Jakab, I., Zigová, M. and Pucherová, Z. (2019) Modernization of Environmental Education with the Use of Project-Based Learning, Outdoor Education, and Mobile Learning Supported by Information and Communication Technology. In Universities in the Networked Society. Springer, Cham. pp 223–248.
Jones, B.F., Rasmussen, C.M. and Moffitt, M.C. (1997) Real-life Problem Solving: A Collaborative Approach to Interdisciplinary Learning. American Psychological Association. 246 p.
Krajcik, J.S. and Blumenfeld, P. (2006) Project-based Learning. In R. K. Sawyer (Ed.), The Cambridge handbook of the learning sciences). New York: Cambridge, pp 317–334.
Kukulska-Hulme, A. and Traxler, J. (2005) Mobile Learning: A Handbook for Educators and Trainers." Open and Flexible Learning Series. London, Oxon: Routledge, pp 1–6.
Layrargues, P.P. (2000) "Solving Local Environmental Problems in Environmental Education: A Brazilian Case Study." Environmental Education Research, Vol. 6, 2000 - Issue 2, pp 167–178.
Lawless, C. (2008) "5 Steps to Responsible E-Waste Management at Your School." Learning & Leading with Technology, 36(3), pp 18–22.
Magnus, V.J., Martinez, P. and Pedauye, R. (1997) "Analysis of Environmental Concepts and Attitudes among Biology Degree Students." Journal of Environmental Education, 29(1), pp 28–33.
Mergendoller, J.R., Markham, T., Ravitz, J. and Larmer, J. (2006) Pervasive Management of Project Based Learning: Teachers as Guides and Facilitators. In C.M. Evertson and C.S. Weinstein (Eds.), Handbook of Classroom Management: Research, Practice, and Contemporary Issues. Lawrence Erlbaum Associates Publishers, pp 583–615.
Palmberg, I.E. and Kuru, J. (2000) "Outdoor Activities as a Basis for Environmental Responsibility." The Journal of Environmental Education, 31:4, pp 32–36.
Sarrab, M., Elgamel, L. and Aldabbas, H. (2012) "Mobile Learning (m-Learning) and Educational Environments." International Journal of Distributed and Parallel Systems, 3(4), pp 31–38.
Selby, D. (2000) "Global Education as Transformative Education." Zeitschrift fuer internationale Bildungsforschung und Entwicklungspaedagogik, 23/3, pp 2–10.
Shahabadi, M.M. and Uplane, M. (2015) "Synchronous and Asynchronous e-Learning Styles and Academic Performance of e-Learners." Procedia - Social and Behavioral Sciences, 176, pp 129–138.
Shiner, M. (1999) "Defining Peer Education." Journal of Adolescence, 22(4), 555–566.
Sorenson, C. (2012) "Learning Online at the K-12 Level: A Parent/Guardian Perspective." International Journal of Instructional Media 39 (4): pp 297–307.
Smitek, Š. (1998) Informační technologie v logistickém řetezci. Logistika, 3, pp 11–16.
Susilawati, A., Hernani, H. and Sinaga, P. (2017) "The Application of Project-based Learning Using Mind Maps to Improve Student´ Environmental Attitudes Towards Waste Management in Junior High Schools." International Journal of Education, 9(2), pp 120–125.
Valiente, R., Escobar, F., Pearce, J., Bilal, U., Franco, M. and Sureda, X. (2020) "Estimating and Mapping Cigarette Butt Littering in Urban Environments: A GIS Approach." Environmental Research, 183:109142.
Wibowo, G.J., Purwianingsih, W. and Kusnadi (2021) "Analyse of Creative Thinking Ability of Vocational Students after Waste Management Project-based Learning." International Conference on Mathematics and Science Education (ICMScE) 2020, Journal of Physics: Conference Series, 1806 (2021) 012148
Zhang, J., Zhang, Z. and Zheng, Y. (2009) "An Introduction of Building Green Schools." Journal of Sustainable Development, 2(1), pp 200–203.
Zigová, M., Pucherová, Z. and Jakab, I. (2018) "Innovative Model of Environmental Education in Lower Secondary Education." DIVAI 2018 – Proceedings from 12th International Scientific Conference on Distance Learning in Applied Informatics. Praha: Wolters Kluwer, 2018, pp 205–216.

Effective Learning Tools in e-Learning

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DOI: 10.34190/EEL.21.091

Abstract: Through the example of a university course in accounting, the article describes the results of using electronic space in the educational environment of a Russian university. The purpose of the article is to study the effectiveness of a new methodological approach with the use of digital technologies and an electronic educational resource developed on the Hypermetod platform by the author of the course in the educational process for studying the discipline "Accounting" at the Ural Federal University. Based on an empirical study, the author shows how blended learning can solve many problems related to the quality of university graduates training. The problem of the quality of training of future accountants includes the formation of such competencies as self-organization and independent knowledge management, the ability to search for new information and ways of processing it. The article provides an analysis of student`s performance when studying accounting with and without the use of blended learning, as well as the results of a survey of students (N = 173) studying the course. The survey showed that almost half of the respondents saw undoubted advantages in the blended model of training: improved teacher-student interaction and the possibility of learning in an individual mode. However, some students do not see the difference between the traditional classroom form of presentation and assimilation of material and the use of electronic resources. As it turned out, these students are reluctant to solve practical problems that require comprehensive knowledge and are not fully aware of the possibility of further application of their skills. Based on the obtained results, the author further determines the initial conditions for the use of blended learning when teaching accounting, comparing foreign and domestic e-learning models. The study will be useful for teachers in the field of economic sciences, who reconsider their curricula in the conditions of digitalization of universities, as it can help them to create their teaching models or to improve existing ones.

Keywords: efficient technology, teaching accounting, digitalization, blended learning, Hypermethod platform, electronic space

1. Introduction

The 21st century is characterized by the active use of Internet technologies. Internet users are in a global information space that affects all spheres of human activity. The formation of a new education system in Russia, focused on entering the world information and educational space, is accompanied by significant changes in the theory and practice of the educational process. These changes are associated with making adjustments to the content of learning technologies, which should be adequate to modern technical capabilities, and contribute to the harmonious entry of a person into the information society. E-learning is becoming more and more modern due to its rapid development and the use of advanced IT technologies. Higher education institutions are actively using the mixed learning format in their programs. Therefore, today, the problem of using new teaching methods is relevant due to insufficient study of the theoretical aspects of the use of digital technologies in teaching economic disciplines. The theoretical and methodological basis of the research was the works of domestic and foreign scientists on accounting and e-education, problems in teaching accounting, legislative and regulatory documents on higher education. The famous foreign scientists Andrews R. (2011), Burke L. (2013), Schunk, D. (2011) believe that the mass use of e-learning requires a new theoretical base that needs to be constantly updated and built on the basis of practical examples. Mayer R. (2010) analyzes examples of e-learning design and its theoretical foundations, Dunlosky et al. (2013) provided research on methods that are more effective for students, Pange A. and Pange J. (2011), Daineko et al. (2020), Bareicheva et al. (2020) shared the results of their research in the field of advanced practical e-learning developments, Hawlitschek, A. and Sven J. (2017) analyzed the impact of interactive games on the learning process. Law Kris M. Y. (2019) has made a huge contribution to the study of blended learning as an effective tool for obtaining professional skills. Gulsüm A. (2018) suggests using a gamified flipped classroom environment to increase students' motivation, their academic achievements and perception of the designed environment. The works of Russian scientists are devoted to the problems of teaching accounting with the help of innovations and modeling of teaching methods in higher education: Baranova I. et al. (2008), Sheremet A. (1997), Gurieva E. (2009), Getman V. (2008), Paliy V. (1981), Shaposhnikova A. (1982), Lapshina E. (2009), Grigorieva Yu. (2004), Kolvakh O. (2000), etc. An analysis of available sources on the problems of educational methods, in general, has shown that many authors focus on its various aspects, but so far none of the authors have proposed methods for the effective use of new digital technologies for teaching accounting, which would motivate students to study complex accounting topics and contribute to the effectiveness of achieving learning results. Today, we are seeing how quickly branches and representative offices of foreign companies are being created in all parts of the world. Thus enterprises need specialists with communication skills who can quickly navigate in an unfamiliar environment, conduct negotiations, understand the problem and make precise adjustments to production processes. Due to the emergence of digital technologies and the possibilities of new marketing research, which allow winning the competition for the consumer, enterprises need specialists who are already able to perform tasks on such a level. In this case, employers are often faced with the problem of non-compliance of the educational system's capabilities with the requirements for young specialists. Educational standards are still far from professional. The amount of knowledge required for a work position has increased significantly as a result of the rapid growth of databases that require analysis and suggestions for making effective decisions. University graduates today are more prepared theoretically and do not always know how to apply their knowledge in practice, because they are not able to work quickly with those programs that are created during their studies at universities. To reduce the gap between public education and industry, corporate universities are being created at large enterprises, where additional training of young specialists is conducted. Thus, digital literacy has become an integral part of every student and teacher. The main task of education today is the introduction of digital tools in the learning process and the modeling of a qualitative independent assessment of learning outcomes. Students should be able to demonstrate their skills, and a board of competent experts should evaluate and coordinate with the employer everything that students can do. Innovations in the field of education began to play a major role. The E-learning system has been actively implemented in Russian universities. It allows teachers to use ready-made digital materials and display them in their developments, analyze processes and make decisions

2. Data and methods

Let's consider a study on the effectiveness of the application of a new methodological approach using an electronic educational resource and digital technologies for effective learning in the educational process on the example of the course of study “Accounting”. To identify the results of training, 173 students (92 girls and 81 boys) were interviewed on the territory of the Ural Federal University using Moodle tests. A representative sample was made of students of an economic specialty who can choose "Audit" as their trajectory of training. In the future, the acquired knowledge of accounting is used in the study of the following subjects “Economic analysis”, “IFRS”, “Audit”. For these students, audit companies from the big four offer jobs as an auditor, analyst or consultant. The result of training after studying the discipline of accounting is the ability of students to keep records of assets and liabilities and prepare financial statements of enterprises. The tests contain 30 questions on the following topics: accounting methods, accounting for fixed assets, accounting for intangible assets, inventory accounting, accounting for production costs, accounting for financial results where 25 theoretical questions for multiple choice and 5 tasks for calculating the value of assets, amortization expenses, and financial results. The time allotted for testing was 80 minutes. Two groups were identified among the surveyed students: students studying accounting using a new methodological approach and students studying accounting according to the traditional approach. The calculated data were converted to a percentage ratio given the inequality of people in each stream. In the first stream, 92 people (44 females and 48 males) were accepted as 100% and in the second stream, 81 people (48 females and 33 males) were accepted as 100%. The purpose of the test was to study the students' academic performance under various teaching methods. Mastering the learning outcomes is achieved much more consciously if a student has the motivation to acquire them. To determine the effectiveness of the use of digital tools in the course of study, 70 students (39 females and 31 males), studying according to a new method using an electronic educational resource and digital technologies were interviewed using Google forms. The survey included 3 detailed questions with the proposed answers on the topic of students' understanding of the application of accounting knowledge in the learning process in other subjects and in their future profession, as well as identifying preferred tasks for mastering the discipline, which are contained in the electronic source. The subject of the study is the discipline “Accounting”, which is taught in UrFU in the field of economics for bachelors in the 2nd year. The volume of lectures is 34 hours, the volume of practical classes is 34 hours, 76 hours are allocated for independent work.

3. Results

The test results showed that using a new method including an electronic educational resource and digital technologies, motivation to study the discipline increases and as well academic performance of students. Table 1 presents the results of the exam in accounting for students studying by various methods with and without the use of electronic and digital technologies.

Table 1: Final exam results in accounting

Percentage of correct answers to the test questions	Group without the use of additional digital tools, N/%	Group with the use of additional digital tools, N/ %	Changes, N/ %
80-100	23/25	41/51	18/26
60-79	37/40	17/21	-20/-19
40-59	17/19	23/28	6/9
<40	15/16	0/0	-15/-16
Total	92/100	81/100	-11/0

Table 1 shows that the use of digital technologies has made it possible to motivate students to acquire knowledge in a more accessible format, to increase full marks by 26%, and to reduce unsatisfactory results by 16%. The decrease in good results by 19% is explained by an increase in full marks by a larger percentage. The 9% improvement in satisfactory results is explained by a decrease in unsatisfactory results.

Recently, many students have had no motivation to study the subject due to a lack of understanding of the purposes this subject is taught to them for. If students do not understand the value of the knowledge they acquire, they have no motivation to study the subject. In addition to interactive training, students should have an understanding of where knowledge of accounting can be useful to them in their future profession. For this purpose, a survey was conducted and the results are presented in table 2.

Table 2: Evaluation of the motivation to study the subject

No	Answers to the question: "Why do I need accounting?"	Answers of students studying without the use of additional digital tools, N/%	Answers of students studying with the use of additional digital tools, N/%
1.	I do not know	-	2/3
2.	To gain new knowledge	23/25	9/11
3.	To master my financial reporting skills	64/70	59/73
4.	To use accounting data as information basics in my future profession	5/5	11/13
	Total	92/100	81/100

Table 2 shows that the majority of students (73%) understand that studying the subject will allow them to master the skills of preparing financial statements. 13% of students see the prospect of using accounting data for analysis and management decision-making. 11% of students surveyed see the study of accounting as an opportunity for obtaining new knowledge that may be useful to them in their future profession, and about 3% of students (a smaller part of students) do not yet know why they need accounting knowledge. Since digital methods have been included in the learning process relatively recently, it is necessary to identify the most effective and preferred technologies from the users' point of view. For this purpose, multiple-choice surveys were formed, the results of which are presented in Table 3.

Table 3: Identifying the preferred types of assignments in an electronic resource

No.	Question / answer options	Answers N/%
1.	Which formats of classes/tasks are more effective for you to understand new material:	
	Lecture,	29/41,7
	test,	18/25
	discussion,	35/50
	tasks with feedback,	47/66,7
	case tasks,	35/50
	work with tables,	29/41,7
	group work?	58/83,3
2.	Which digital tools are most interesting when studying accounting:	
	kahoot	41/58,3
	mentimetr	12/16,7
	Quiziz, jeopardylabs	23/33,3
	Google tests	18/25
	sli.do	12/16,7

According to the results in table 3, the following can be stated: when studying "Accounting", students are more interested in solving tasks in groups (83,3%) and in tasks with feedback (66,7%). Group work allows you to discuss complex issues with your classmates as colleagues and find a common solution. Feedback is provided using support from a teacher-mentor. The discussion and case tasks (50%) are interesting because the knowledge acquired at lectures can be applied when discussing economic issues and solving business problems. Working with Excel tables (41,7%) allows students to present solutions in the form of tables and graphs that can be transferred to PowerPoint and demonstrate the course of the solution and the chain of reasoning. Tests (25%) are used by students as simulators to keep their knowledge in good shape.

The survey of students showed that the quiz stimulates the study of the course (33,3%), because when answering the quiz questions, the spirit of competition makes it possible to show not just knowledge, but also additional skills of rapid response, correct choice and desire to answer the question posed. Google tests (25%) help to identify gaps in knowledge and immediately get the right answers. Menti.com and Sli.do (16,7%) allow a teacher to see the average level of understanding among the students.

After analyzing the positive data that were obtained, it is possible to define the most acceptable structure of the lectures and practical tasks for high motivation to learn and acquire professional skills. It is preferable to start the lecture with a survey of the previous topic using Kahoot programs, sli.do, quizizz. A test should contain 7-10 questions of open and closed types. It is necessary to identify the winners and reward them with bonuses. This will make it possible to motivate students to repeat the material they have passed and prepare the audience to acquire new knowledge based on previous ones. The lecture material is read for 30-40 minutes with a presentation where the main issues are identified. At the end of the lesson, a survey is made a test for understanding new material in Google forms or on the Hypermetod platform. After the completion of the test students can get acquainted with the correct answers. The first 5-7 practical classes are conducted exclusively with the use of theoretical material from the lecture with different sources of literature where students can find additional material themselves. Students get acquainted with the chart of accounts, double- entry, balance sheet, assessment of balance sheet items, solve problems to determine the initial cost of fixed assets and intangible assets, learn to calculate depreciation of fixed assets, the actual cost of materials and finished products. All solutions are attached to the Hypermetod platform for assessment. Then students are divided into groups and try to solve case tasks for the formation and accounting of the cost of investing money in various projects and calculating financial results. At this point, they should use theoretical material not only learned at the lecture, but also from additional sources for determining direct and indirect costs, calculating wages and deductions, taxes related to expenses, distribution of general economic expenses and sales expenses. During 3-4 practical classes, the teacher works as a mentor and helps to find information that is necessary to distribute roles within the team, to make a plan for solving the task, to find sources of additional information, to show samples for processing results, and advises on complex issues. Students defend their projects and receive additional points, which are added to the credit of independent work. After the case championship, there is an analysis of practical tasks for the program to determine the financial results from other types of activities. Such motivation of students allows them to pump up professional skills and achieve the results that are necessary when studying the subject of economic analysis and in the further practical activities of students.

4. Discussion

According to the research of Kozhukhov V. and Pankov V. (2020), Lakshina E. (2009), Ivashkevich V. (2010), Russian business needs higher schools that prepare graduates who are ready to start solving current problems immediately. The high theoretical level of students' training in comparison with the functional one does not give a momentary readiness to carry out practical activities in the workplace. The rapidly developing process of restructuring education has led to a contradiction between innovation and tradition in accounting education. Interactive digital technologies of accounting training allow students to learn professional terms in direct connection with practical tasks related to production; to develop problem-search thinking; to form professional judgment; to expand the possibilities of self-control of the acquired knowledge. The active role of innovative technologies in education is that they not only perform the functions of tools used to solve certain educational tasks, but also stimulate the creation of new forms of learning and education. Thus, it can be stated that the inclusion of digital technologies in the educational process of training auditors and consultants creates opportunities to improve the quality of educational services, but at the same time requires changes in the content and methods of training.

4.1 The use of digital tools

The following programs are used for conducting an interactive survey: menti.com, sli.do, quizizz.com., Kahoot, jeopardylabs.com., Google forms. In the age of digitalization, it is necessary to saturate the materials of lectures and practices with interactive technologies. To do this, a teacher needs to use programs for conducting surveys and various simulators. The convenience of the programs lies in the fact that students answer questions from their computers and the generalized processed information is seen on the teacher's screen during the lesson. The teacher can stop the survey and explain which answers were incorrect and why. One can also analyze a topic in detail if there were many incorrect answers. Students' motivation increases when, at the end of the survey, the program shows leaders and speed of answers to the questions posed. Mentimetr.com allows a teacher to see the spectrum of disparity or uniformity of responses, sli.do is convenient because you can enter it using a QR code. Quiziz.com is convenient because students can answer questions in their own mode, without waiting for their classmates after each question. Kahoot is convenient for conducting quizzes with different types of questions (single or multiple-choice, true or false), each quiz can be accompanied by music. Jeopardylabs.com allows students to choose their own topic and question depending on the number of points they want to get; Google forms allow a teacher to give homework in the form of a test. To increase motivation to solve accounting problems, the teacher, together with the audit company, developed a case in which it was proposed to calculate the initial cost of fixed assets and intangible assets, the shortage of materials in stock, the amount of the bonus, the cost of production, the cost of financial instruments and profit based on real data of the enterprise. Students were asked to split into teams and solve the case in a certain time and demonstrate their solution in the form of a presentation.

4.2 The use of electronic educational resources

To study the discipline, an electronic course "Accounting", has been developed on the Hypermetod platform, which includes lectures, test questions, presentations for lectures, practical tasks with solutions and tests. Lectures are held online, so their recording appears after each lesson. Students have the opportunity to view lectures at convenient time. After each practical task, students must complete the task at home and pass it for assessment. After studying lectures, students' complete tests for self-assessment. This type of work in a mixed-mode allows students to revise the material at any time. Also on the Hypermetod platform there is a link to the online course "Fundamentals of Accounting", developed by St. Petersburg Polytechnic University on the open Coursera platform, which contains additional materials. Students who want to deepen their knowledge on the topic of accounting that interests them can register on the Coursera platform and attend the course at any time. Main accounting classes are held in an interactive format.

In addition, to get admission to the exam, students need to do a home review work in which they show the acquired skills in drawing up accounting entries, posting transactions on accounts and determining the final balance, compiling a generalizing register of the turnover balance sheet, the balance sheet at the beginning and at the end of the period. The students showed interest in the correct preparation of the balance sheet following the rules that they studied during the lectures.

The culmination for understanding the basics of accounting was a lecture by a representative from an audit firm on the importance of financial reporting for investors and founders of companies, as well as credit institutions. The students showed their knowledge in the field of accounting, namely in the assessment of fixed assets, accounting for receivables and payables, profit calculations and basic economic indicators. It was especially interesting to apply their knowledge when calculating a case task for extending the loan terms to an enterprise which asset value in the balance sheet did not coincide with the cost of their sale. The students offered solutions on the possibility or impossibility of prolongation of the loan agreement with the bank based on the proposed financial statements. At the end of the lecture, it was concluded that reporting becomes more valuable and useful after conducting audits, since enterprises do not always present reliable information in the reports.

The introduction of electronic forms of education and digital technologies is one of the most important areas for improving the students' training in a modern university. These teaching methods are aimed at joint educational activities with active interaction of the teacher and students. The main methodological innovations in the educational process today are associated with the use of electronic resources and digital technologies. The new method of teaching the discipline gives an understanding of how to apply the achieved learning results in practice, which motivates students to achieve high results that can be demonstrated to the employer and to get an offer for a vacant position.

5. In conclusion

Recently, teachers have begun to actively use modern digital technologies in their courses. Platforms with a large number of built-in programs began to appear, which allow students not only to read and view academic assignments, but also to communicate on forums, share their achievements and evaluate their fellow students. Not only online schools, but also full-time departments at universities began to show great interest in online learning. With the development of IT technologies and the advent of web cameras, teachers can record their lectures independently and upload them to platforms where presentations and assignments on the subject are laid out. Digital technologies allow us to present materials for lectures and practical classes more efficiently. Thus, the upraise of e-learning and new digital tools has become one of the most significant stages in the development of educational technologies available to students with their growing educational needs. The need to improve access to educational opportunities has allowed students who want to get education at a certain educational institution to go online and start their studies through a virtual connection.

The author's methodology of teaching the discipline “Accounting” reveals new opportunities for studying the subject with high efficiency of the acquired skills and their use in professional activities. Thanks to the gradual improvement and development of E-learning systems, many forms of online learning have appeared. There is a possibility of implementing the so-called Rapid E-learning tools (for example, the transition from PowerPoint to Flash), business stimulation, modeling, simulation, audio, video, as well as a wide range of interactive elements of the educational process. The author's next article will be devoted to a more in-depth study of these technologies.

References

Andrews, R. (2011) “Does E-Learning Require a New Theory of Learning? Some Initial Thoughts*”, Journal for Educational Research Online*, Vol 3, No. 1, pp 104–121.

Baranov, I. I., Sokolov, YA. V. Pantina, I. V. (2008) *Ocenka znanij studentov po special'nosti*, M: Buhgalterskij uchet i audit.

Bareicheva, M., Larionova, V., Stepanova, N., Davy, Y. (2020) “Educational games in training”, Proceedings of the 14th European Conference on Game Based Learning, ECGBL Fotaris, P. (ed.). Academic Conferences and Publishing International Limited, pp 47–54.

Burke, L. (2013) “Educational and Online Technologies and the Way We Learn”, *International Schools Journal*, Vol XXXII, No. 2, pp 57–65.

Daineko, L, Larionova, V, Yurasova, I, Davy, Y, Karavaeva, N (2020) “Educational process digiltalization in Ural Federal University,” in Proceedings of the 19th European Conference on e-Learning, ECEL2020, edited by B. C. Busch, M. Steinicke, & T. Wendler, pp 146–153.

Daineko, L., Davy, Y., Larionova, V., Yurasova, I. (2019) “Experience of using project-based Learning in the UrFU Hypermethod e-Learning System”, in ECEL 18th European Conference on e-Learning, pp.145-150.

Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., Willingham, D. T. (2013) “Improving Students’ Learning with Effective Learning Techniques: Promising Directions from cognitive and educational psychology”, *Psychological Science in the Public Interest*, Vol 14, No. 1, pp 4–58.

Getman, V.G. (2008) “Problemy perekhoda v vuzah Rossii na mnogourovnevuyu sistemu podgotovki buhgalterov i auditorov”, *Vse dlya buhgaltera,* No. 12, pp 1-17.

Grigor'eva, YU.YU. (2004) “Rol' distancionnyh tekhnologij v povyshenii effektivnosti srednego professional'nogo obrazovaniya”, *Voprosy internet-obrazovaniya*, No. 19, [online], www.vio.uchim.info/Vio_19/cd_site/articles/art_1_5.htm.

Gülsüm, A. (2018) “The effects of the gamified flipped classroom environment (GFCE) on students’ motivation, learning achievements and perception in a physics course”, *Quality & Quantity*, Vol 52, No. 1, pp 129–145.

Gur'eva, E.I. (2009*) Modelirovanie v buhgalterskom uchete. Elektronnyj resurs*, TOGU. Habarovsk.

Hawlitschek, A., Sven J. (2017) “Increasing the effectiveness of digital educational games: The effects of a learning instruction on students’ learning, motivation and cognitive load”, *Computers in Human Behavior*, Vol 72, pp 79–86.

Ivashkevich, V.B. (2010) “Novoe v soderzhanii i prepodavanii uchetnyh disciplin v ekonomicheskih vuzah i fakul'tetah”, *Audit i finansovyj analiz*, No. 5, pp 366-367.

Kol'vah, O.I. (2000) “Situacionno-matrichnaya buhgalteriya kak odno iz sredstv razvitiya teorii ucheta v usloviyah sovremennyh programmno-informacionnyh tekhnologij”, *Audit i finansovyj analiz*, № 3, pp.15-40.

Kozhuhov, V.L., Pankov, V.V. (2020) “Intellektual'nye tekhnologii i budushchee buhgalterskoj professii”, *Mezhdunarodnyj buhgalterskij uchet,* No. 3 (465), pp 286-296.

Lapshina, E.V. (2009) “Innovacionnye processy v buhgalterskom obrazovanii”*, Vestnik universiteta,* No. 2, pp 1-25.

Law Kris, M.Y. (2019) “Student enrolment, motivation and learning performance in a blended learning environment: The mediating effects of social, teaching, and cognitive presence”, *Computers & Education*, Vol 136, pp 1–12.

Mayer, R (2010) *Cognitive Theory of Multimedia Learning*, Cambridge Handbook of Multimedia Learning, NY: Cambr. Univ. Press, pp 31–48.
Palij, V. F., Sokolov, YA. V. (1981) *ASU i problemy teorii buhgalterskogo ucheta,* M.: Finansy i statistika.
Pange, A., Pange, J. (2011) "Is E-Learning Based on Learning Theories? A Literature Review", *World Academy of Science, Engineering and Technology*, Vol 5, No. 8, pp 56–60.
Schunk, D. H. (2014) *Learning Theories: An Educational Perspective*, Boston, MA: Pearson HE, Inc. Siemens G.
Shaposhnikov, A. A. (1982) *Klassifikacionnye modeli v buhgalterskom uchete* , M.: Finansy i statistika.
Sheremet, A.D. (1997) *Novye trebovaniya k buhgalteru i podgotovka professional'nyh buhgalterov vysshej kvalifikacii*, Materialy po attestacii professional'nyh buhgalterov, M.: TEIS.

School Leadership Strategies Facilitate the Emerged Transition From f2f to Blended Learning

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DOI: 10.34190/EEL.21.101

Abstract: In the unprecedented circumstances following the pandemic from March 2020 onwards, novel challenges appeared regarding both the effective Schools leadership and management and the accomplishment of pedagogical and learning objectives from distance. This new reality pushed for the adoption of innovative practices but at the same time uncovered underlying weaknesses. The teachers' role, students' and parents' presence in the digital context environment has been redefined at the Experimental School of the University of Thessaloniki (PSPTh), Greece. Under the School's coordination and the teachers' collaboration, the school community members had to work together to (co)design the e-school's virtual framework in the best possible manner. Distributed leadership supported overcoming obstacles, giving school members a sense of belonging to a community that was left with no option. Pre-existing relationships and strategies related to blended learning at school, helped in building the distance (for a long period) of emotional connection and laid new foundations. The authors explored the factors that shaped the transition from the face-to-face School to the Virtual School community taking into consideration school staff's and students' expectations, intentions and strengths and weaknesses as well. They based on an empirical research with observation and data collection, both from the school principal's diary as well as other quantitative and qualitative data, they have recorded the transition from f2f-education to blended learning (BL) with synchronous and asynchronous distance education. Moreover, they identified the need to overcome the new obstacles. The effective use of ICT, the level of familiarity with web-based platforms, the adoption of participatory processes and exploitation of collaborative e-tools for communication, training, studying, and teaching and learning with the continuous training, were the crucial points that shaped the new educational reality. A well-organized strategy emerged as a prerequisite for achieving the goals of the administrative, organizational and educational coordination and leading of schools from distance.

Keywords: school leadership, shared leadership, Covid19, emerged blended learning

1. Introduction

In the special circumstances due to the pandemic from March 2020 until today, requirements have arisen both for a successful distance leadership and management of Schools. The new data pushed for the adoption of innovative practices but at the same time showed underlying weaknesses. Due to the sudden pandemic developments, the educational community moved erratically from conventional to distance education without prior planning, coordination and organization. Thus, although the Distance Education (DE) is by definition open to all, it was impossible to be accessed by a large number of students and teachers due to the lack of infrastructure and digital media in Schools Institutes, but also the inability (during that period) of the National School Network.

The lack of teachers' training and knowledge of digital environments resulted in a teacher-centered and procedural teaching process without clear teaching and learning objectives and without emphasis on the quality of results, pedagogical standards and transformation of information into cognitive. Digital media, synchronous and asynchronous, became necessary tools for maintaining contact between teachers and students. Finally, the lack of familiarity of the school community (students, teachers, parents) with the DE, which was a source of various reactions, acted as a brake factor on the successful conduct of the process. Therefore, emergency remote teaching does not constitute an integrated educational system, neither has it had a satisfactory support system, nor it utilizes specially designed material or implementation of interactive activities.

During our attempt to systematize and optimize the transition from face-to-face (f2f) to digital, synchronous and asynchronous DE, at the Experimental School of the University of Thessaloniki (PSPTH) the role of teachers, students and parents was redefined in digital frame. Under the coordination of the school leadership the members of the school community had to work together in order to (co)form the e-school. *Distributed leadership* was an ideal model for overcoming obstacles, while giving members involved a sense of belonging to a community.

The pre-existing relationships between teachers, students and parents helped to overcome the long-distance emotional gap and laid new foundations. The authors explored the factors that shaped the transition from the physical to the virtual school. Based on empirical research, observation and data recording, both in the school diary and in the research diaries, as well as in quantitative and qualitative findings, they recorded the educational process and the impact of synchronous and asynchronous teaching in learning.

The main elements that shaped the new school reality were the better use of technological tools and exploitation of ICT, the participatory processes, the familiarity with the platforms and the communication and collaborative tools, and the continuous training courses on ICT use for teachers and students. The strategy and the vision of the School have emerged as prerequisite issues to achieve the goals of the administrative, organizational and educational distance coordination of the School, in order to reduce the possibility of negative outcomes. The new approach is evaluated positively without missing any problems until it is achieved.

2. Theoretical framework: Learning theories and educational praxis in distance education

Learning theories are the background of every teaching process in which the teacher is called to use the learning provided through mental structures (Piaget, 2007) and information resources in order to achieve knowledge, transfer and skills development of learners. During the teaching practice the theoretical approaches are: a) implemented, b) checked for their correctness, c) given feedback, d) improved, e) changed, and f) accepted or rejected. Since teaching cannot and should not be one-dimensional, inevitably the adoption of a single theoretical basis seems impossible to meet the wide range of teachers' and learners' needs and expectations. Therefore, the effectiveness of learning theories is different and depending on the *subject matter taught*, the *students* and the *conditions* of teaching. Teachers must select from the theoretical data those that they can convert and format according to the respective parameters into pedagogical knowledge and practice while they apply them in the educational process with critical thinking (Koliadis, 1996). Moreover, regarding the Secondary Education (SE), it is customary to treat the educational process as a critical, interactive, pluralistic and creative practice aimed at multifaced and complex literacy. For such an approach it is necessary to adopt a theoretical framework according to the requirements of learning theories appropriate for the needs of cognitive objects. Activities of interdisciplinary and experiential approach, pre-planned activities of graded difficulty, frontal but also collaborative teaching, project method, techniques of individual and collaborative work, creative writing, dramatization, discussion, role playing, creative and synthetic essays, activities with an emphasis on creativity and innovation that require communication and collaboration, self-observation and hetero-observation, utilization of new technologies are some of the choices. In such activities, the *objectivity* gives way to interpretation and didactics is disconnected from the regulatory process of transmitting a knowledge package and linked to alternative teaching methods in the light of parallel continuous knowledge production within the classroom.

In the above context, c*onnectivism* introduces a new perspective that promotes participation and openness by redefining the role of teacher and student (Siemens, 2004). The concepts of Distance Education (DE) form the necessary background for corresponding curricula. Concepts such as distance, interaction, accessibility, structure flexibility, interaction, dialogue, community, cognitive and social presence compose the multidimensional physiognomy of DE (Mavroidis et al., 2014). Their adoption by an educational organization presupposes the understanding of the necessity and their consolidation in an efficient way in order to form a learning framework supportive of its other characteristics. The system of interaction among students, teacher and the educational material, inextricably linked to communication, is a parameter of the effective learning process. The concepts of *communication* and *interaction*, being well-known pedagogical practices in f2f learning, constitute a sufficient background for the construction of the distance learning process. Of course, it needs to be fully understood that in the context of the DE, their absence dangerously destroys its foundations.

Garrison et al. (2000) proposed a learning model with three sub-linked, interconnected and interactive parameters of the learning process in an asynchronous digital environment: cognitive, social and didactic, (integrating the interactive interface of the members of the educational community in an interactive and collaborative context). On the occasion of the above modeling, an attempt was made (in PSPTh) to implement it gradually in the synchronous DE, using appropriate means of communication. The new pedagogical plan, the e-teaching and e-evaluation in which communication, emotional expression and strengthening of relationships are sought in order to maximize the learning benefit of students (Arbaugh, 2007) and their degree of satisfaction with the learning process (Swan & Shih, 2006). They act as a lever to promote exploratory learning, reflection and practical utilization of new knowledge, while the learning process is not only driven by the teacher, but is a consequence of choices of the students themselves (Garrison et al., 2001; Garrison & Cleveland-Innes, 2005). The development of this educational model according to Anderson (2016) is in line with the basic principles of connectivism (Siemens, 2004), which begins with the use of diverse sources of information and the collection and interconnection of information. In this context, students interact not only with the teacher and the educational material but also with each other by using participatory digital tools (Kaplan & Haenlein, 2010) to share information, interact and shape social relationships (Porter, 2008) aiming to combine the digital technology with educational, learning and social interaction.

3. From theory to educational praxis: School leadership from distance

The innovative organizational and administrative operation of PSPTh during the period of the *pandemic DE* with emphasis on distributed leadership can be a model of administrative and organizational restructuring of Secondary Education (SE) institutions with the added value of achieving flexible and efficient schemes. At the same time a) the development of *educational methodology*, b) the advanced *ICT exploitation* and c) the promotion of *innovation* are the trigger for similar institutional plans with the added value of the continuous teachers' professional development. Finally, didactic and learning innovation can become the background of a new educational approach with added value the students' autonomous activation towards heuristic learning and the acquisition of the way to learn both in the classroom, physical or virtual, and independently (Lionarakis, 2001). All the above-mentioned innovations that were implemented in PSPTh, compose a chain of dynamic changes for the benefit of the learner, the educational community and the wider society (Smith & Lovat, 2003). Based on the belief that the support of the leadership of the educational process contributes to its successful completion, we believe that the decentralized administrative organization and distributed leadership of the PSPTh can contribute as a model to the smooth operation of the DE in the Secondary Education (SE). Although SE institutions do not have and cannot have administrative autonomy (Katsaros, 2008), they can achieve a flexible administrative structure supporting the distance cooperation of education executives with the educational community. Distributed leadership, as a microcosm of administrative decentralization, is the answer to this question. PSPTh is able to provide effective administrative know-how while disseminating the synchronous administrative concept of scientific and professional development of teachers. As it concerns the selection of online applications that is chosen by the school leadership and staff for the Educational Praxis from distance there are practical criteria according to Bates (as mentioned in Sofos et al., 2015): a) innovation, b) teaching and learning methods and techniques, c) organizational impact that determines whether the changes required to utilize the selected online media are time consuming and / or costly (cost, speed), d) accessibility because if not taken into account, carries the risk of excluding a large part of the students from the online teaching practice, e) interactivity, that provides the students with easy and effective interaction with each other, with the instructor and with the educational material. According to the above criteria, in PSPTh selected synchronous and asynchronous platforms provided by the ministry of Education (eclass.sch.gr, eme.auth.gr and Webex) in parallel with email accounts for all students and teachers at national network of Education (www.sch.gr). Also, two teams with two expert IT teachers in each of them including the principal of the school formed the IT-support teams for synchronous and asynchronous tele-education. There were social groups (viber, messenger) with the principal and the vice principal of the school for immediate response, announcements etc. after parent's approval. Each Class had its own e-group and similarly there were parents' groups. All the above teams in combination with the teacher's e-group facilitated any difficulties that needed urgent solving that emerged in the synchronous classes.

4. Educational and learning process from distance

By definition, DE advocates that education is a universal right and therefore aims to provide equal educational opportunities. As Lionarakis (2005) characteristically states, as a compelling request in the 21st century, the highest quality and open education for all is proposed. In order to ensure openness, it is necessary to have universal access to new technologies and free universal participation in the DE. However, in practice there are formal restrictions on the application of the ideal of open education arising from economic, social, political or even geographical factors. An important innovation that stands out for the distance learning and learning process is the *flexible learning (Agile Learning),* which is based on redesigned workflows and is in line with the fluidity of the modern digital age more than traditional linear teaching (Kotini & Tzelepis , 2017). This practice, which is implemented in PSPTh in the right context and by experienced teachers, nurtures learning motivation promotes the achievement of goals and achieves improvement. *Flexible learning design* and its implementation are re-checked, evaluated and corrected according to the learners' particularities, providing knowledge commensurate with their interests (Tomlinson, 2004) and highlighting their inclinations. Learning takes place during implementation, learning difficulties are identified in a timely manner and addressed through redefining the learning approach, communication skills are cultivated, self-action and creativity are developed. All these form a background for the emergence of excellence, which is also redefined in terms of the 21st century. *Flexible learning* has many benefits for the educational community, as it responds to its growing and ever-changing needs (Hew & Brush, 2007). It is in line with the revised role of the teacher, who renounces the authority of the teacher and becomes a facilitator and supporter, responding to new educational data, new teaching methods and evolving learning tools. Also, the learning self-regulation (Korombili & Togia, 2015) is in line with the differentiated teaching that takes into account the particularities of the students, their interests and measures similar activities and evaluative approaches. However, the educational community of PSPTh was not fully prepared for such an innovation before emergency remote teaching, since there was lack of similar experiences and relevant culture. The success of flexible learning methods in PSPTh required a review of the educational purposes, the educational schedules, the material, the teaching approaches and the evaluation methods. This requirement was achieved with teachers' training in this direction so that the learning acquires an added value.

5. Teachers and students in the framework of distance education

The acceptance of the students' inhomogeneity must be considered as a whole in every educational process, especially in multicultural societies. Once the learning profile has been clarified, it is imperative that it is taken into account throughout the educational design, as it evolves and differs from the students' experience and familiarity of the students with ICT tools. The demographic characteristics, which determine the compatibility of technology, lie mainly in gender, age, educational level, level of digital literacy of students, their educational needs, social and economic background, cultural issues. All these characteristics must be taken into account when choosing the ICT tools and the wider educational design, as they affect the degree of response of the team to the provided motivations and learning objectives.

Basic digital literacy and basic related skills are required to precede engagement in DE to avoid digital exclusion. The use of ICT tools, even if limited to basic applications (word processing, presentation, web browsing, e-mail, etc.), ensures access to the digital learning environment and the development of information retrieval, evaluation and utilization strategies. At the same time, soft digital skills at the social and interpersonal level guarantee the interaction, digital communication and sharing. Therefore, the basic prerequisite technological knowledge and digital skills are supporters of the individualized educational process and participation in collaborative learning processes.

The combination of DE and f2f learning requires prior educational design in infrastructure, connectivity and digital equipment. In order for this design to be effective it needs to be framed by teachers with training, experience, digital skills and it is necessary the appropriate configuration of the educational material, the selection of easy-to-use digital tools and the digital laboratory support within the classrooms.

In DE although technology is a building block with an impact on openness and accessibility, the students' educational experience is also related to purely pedagogical, didactic and learning parameters. The rich and up-to-date educational material, their active involvement and equal participation in the shaping of the learning process, the synchronous and asynchronous internet cooperation, the psychosocial integration in the educational context, the interaction, the essential communication with the classmates and the teacher, make the teaching experience qualitatively superior and the learning effective. Therefore, each school should take care of defining the organizational framework so as to favor the coordination, monitoring, encouragement and support of students. The teacher who with his/her knowledge and pedagogical equipment must promote and facilitate the learning process of his/her students plays an important role beyond the curriculum and the digital media used for its implementation. Finally, a catalytic factor of high teaching experience is the selection of appropriate case-by-case evaluative approaches and feedback methods, which must have improving results.

All students of SE inevitably have shaped views and beliefs about teaching and learning, either consciously or empirically and experientially. Their accession to the DE usually breaks down some of these entrenched perceptions and leads to their revision, adjustment and enrichment. The strategic plan of such an educational "emergent program" must take into account these previous views, as it is certain that they will affect its successful or not outcome. The transition from the estimated pre-existing educational concept to the new one is preferably made gradually with the technology support and promotes exploratory personalized learning and personal involvement in the learning process. Maintaining many of the positive elements of f2f learning through close collaboration in an appropriate digital learning environment and not limited to the mere provision of educational content, it is possible to normalize the transition within the DE.

The physical distance between teacher and student in the online lessons implies the necessity of declaring the presence of the former during the educational and learning process. The teacher, being one of the four pillars of DE, must constantly interact with the other three, the students, the educational material and the medium He/She is in charge of stimulating the pre-existing knowledge and prior experience of the learners in such a way so as to achieve the learning objectives by designing and implementing or even adapting to their learning profile activities through which he/she declares his/her presence. The cooperation between teacher and student, their interaction, the emotional involvement, the cultivation of trusting relations are the guarantees of success of an online course. In addition to all this, it is imperative for him/her to use the appropriate technology in order to *promote communication and interaction*. *Motivation, support* and *guidance, psycho-emotional reinforcement* and *continuous synchronous* and *asynchronous communication* function as indicators of the instructor's presence and offer the learner the positives of participatory learning without denying his/her autonomy and the possibility of self-regulation. Moreover, its multidimensional role is an important parameter for the success of DE (Iliadou & Anastasiadis, 2010).

In the Synchronous and asynchronous DE, the teacher is called to use different teaching approaches. Its role in each case lies in shaping the terms of the learning environment in such a way that they complement each other and enhance their effectiveness. The teacher must flexibly transform and organize the teaching framework according to the form of education, testing new interaction strategies on a case-by-case basis. In f2f teaching and learning, it’s easy to implement activities related to the development of dialogue and argumentation, the practice of verbal and representational skills, group collaboration. In DE, respectively, activities are selected to enhance the learners’ interaction with each other and with the educational material by utilizing digital media and tools (such as forums, chat, social media, etc.).

6. Educational material in distance education

According to Lionarakis (2001) the educational material (EM) is a basic parameter of DE and according to Giosos and Kuchumba (2004), the educational material of the DE is a "prefabricated and stored teaching". As it progresses, the framework of DE evolves and expands and the theoretical principles and research data that shape it are enriched. It is constantly reformed and updated according to the needs and expectations of those involved in the learning process.

The design of educational material and interactive activities, the active involvement of learners, their support, guidance by the teacher, are crucial parameters for creating effective learning communities. At the same time, the framework of the PSPTh can be the foundation of a wider open DE in the field of formal and non-formal education, such as the implementation of European programs, school activities, interdisciplinary collaborations, remedial teaching, teacher training, inclusion structures.

On the occasion of the utilization of innovative technological proposals of the PSPTh, the creation of similar digital material and the implementation of policies of openness and accessibility in the DE can mobilize students and promote exploratory learning with remarkable learning outcomes. A basic precondition is of course the appropriate pedagogical planning and the interactive distance teaching approach in order to highlight the innovation and to promote the systemic change in the schools.

The DE removes the limitations of conventional educational approaches by properly drawing and implementing strategies and methods of teaching and learning. Therefore, DE is a valuable helper of education and a supporting factor in the dissemination of teaching and learning in synchronous and asynchronous digital environment, and their relationship is characterized as two-way. The design of teaching in both f2f learning and blended/distance learning is a *combination of the content with the students’ characteristics*.

With the main aim of the *students’ active participation* in the distance learning process and the achievement of the learning objectives, the necessity of interaction between them and with the educational material becomes clear. Therefore, in order to ensure the students’ accessibility, it is necessary to check in advance whether the selected technological tool is accessible and available to them. The more specialized the equipment required, the less likely it is that learners will have access. The inexpensive access to the technical equipment presupposes at the same time its time-consuming learning, even though short training courses included in the wider curriculum. In summary, the choice of a non-specialized technological tool, with low cost and easy learning works in a supportive way for the students.

However, there is a number of risks, such as the violation of privacy, the inability to protect intellectual property, the addiction to them (Vlachopanou & Papadakis, 2020). A safety valve is the active role of the teacher who as a supervisor guides the students. This role requires a web and digital literacy device to be able to use appropriate tools to ensure the proper use of ICT which are inevitably incorporated into educational practice.

7. Training actions for distance education

As a result of the above, it is considered extremely important to strengthen the reciprocity in the school educational reality. The administrative, organizational, didactic and learning models adapted to the needs of the DE strengthening the ability to combine the curricula with the challenges that arise. The first and main way to enhance this reciprocity is the participation of experienced and trained in the open education systems members of the school community. With trained teachers, students, parents and with the subject of DE at a theoretical and practical level, the required familiarity of all with its basic principles, methodology and digital tools can be achieved (Manousou et al., 2021) and to strengthen its most effective and beneficial implementation.

At the same time, the know-how of PSPTh can work remuneratively by undertaking not only an educational role in matters of DE but also an organizational corresponding distance actions (seminars, workshops, conferences, high-speed trainings, etc.) by utilizing advanced technologies, implementing strategic choices and methods. In addition, as the PSPTH has experience and knowledge in the design of usable educational material based on the principles of the DE, its contribution to its drafting, promotion and teaching and in general the development of appropriate technology and methodology for the implementation of the DE in the SE is a significant reward for the educational community.

Finally, the development of collaborations of PSPTh with other Schools and Institutes at national and European level isa huge benefit for the wider educational community. Dissemination of knowledge, promotion of research in the field of DE and the experimental application of new methods and tools enhance reciprocity by providing the educational community with up-to-date scientific and research data. In this way, not only the improvement of the provided work of the teachers will be achieved, but also the improvement of the students' performance. (Burns, 2011). Being PSPTh the pioneer educational institution, it can only introduce equally alternative and innovative structures and proposals for the achievement of the goals of the school DE in the education of all levels.

8. Conclusions

For the last year, PSPTh, being a distance education provider (DEP) based on the principles of accessibility, has focused on strategic points related to administration, learning and training processes, research and innovation, educational identity and concern for its human resources. According to the Editorials (Lionarakis 2014; 2016; 2019) a strategic plan with emphasis on flexibility and the transformation of the organizational and administrative structures of an educational institute, which adopts the model of the distance teaching and learning, can guarantee quality development. Therefore, it is necessary to formulate a common vision, as characteristically stated by Lionarakis (in Costopoulou, 2012), of all partners in the educational process (students, teachers, education executives, administrative staff and parents). Based on this, the reorganization of the administrative structures, the improvement of the internal evaluation, the upgrading of the curricula, the innovation, the expansion and utilization of the infrastructures, the coverage of the learning needs of the students are roughly a plan of administrative and educational operation in terms quality.

Both the bibliographic study and the empirical approach certify the emergence of a new educational reality. Synchronous and asynchronous distance learning during the pandemic period was the first trumpet of the advent of new data and a sample of the possibilities and characteristics of the evolving learning process. Distance teaching and learning and the collaborative learning model combined with the abundance of information and digital media compose a mosaic that begins to be roughly described and theoretically framed by the dynamically evolving digital educational approach.

PSPTh as an experimental school by introducing the educational community to its innovative elements, modern pedagogical concepts and practices, can mark the beginning of an educational reality with expanded characteristics analogous to the changes of the times. By putting its know-how in the DE and its previous experience in the service of the wider educational community, which is eagerly looking for ways of effective continuation and enrichment of the learning process, it is able to contribute decisively to the modernization of the educational framework.

References

Anderson, T. (2016) *A Fourth Presence for the Community of Inquiry Model*?. Virtual Canuck. https://virtualcanuck.ca/2016/01/04/a-fourth-presence-for-the-community-of-inquiry-model/

Arbaugh, J. B. (2007) "An empirical verification of the Community of Inquiry framework". *Journal of Asynchronous Learning Networks, 11*, 73–85.

Burns, M. (2011) *Distance Education for Teacher Training: Modes, Models, and Methods.* Washington DC: Education Development Center Inc. Retrieved on 11-5-2021.

Costopoulou, A. (2012) *History, present and perspectives of the Hellenic Open University through the eyes of its protagonists* (Postgraduate Thesis). Hellenic Open University, Patras.

Garrison, R., and Cleveland-Innes, M. (2005) "Facilitating cognitive presence in online learning: Interaction is not enough". *American Journal of Distance Education,* 19 (3), pp 133-148.

Garrison, R., Anderson, T. and Archer, W. (2000) "Critical thinking in a text-based environment: Computer conferencing in higher education". *The Internet and Higher Education, 2*, (2-3), pp 87-105.

Garrison, R., Anderson, T. and Archer, W. (2001) "Critical thinking, cognitive presence and computer conferencing in distance education". *American Journal of Distance Education, 5* (1), pp 7-23.

Giosos, I. and Koutsoumba, M. (2004) "Theoretical approaches to the design and development of educational material in Open and Distance Education". In Lionarakis A. (Ed.), *Open and Distance Education. Pedagogical and Technological Applications,* Volume D, pp 39-52, Patras: Hellenic Open University.

Hew, K. F. and Brush, T. (2007) "Integrating technology into K-12 teaching and learning: Current knowledge gaps and recommendations for future research". *Educational Technology Research and Development, 55*(3), pp 223–252.

Iliadou, Ch. and Anastasiadis, P. (2010) Communication between professor-counselor and students in distance learning: Opinions of students in the context of TH.E. 65 HOU. *Open Education: The Journal of Open and Distance Education and Educational Technology, 6* (1 & 2), pp 29-45.

Kaplan, A. M. and Haenlein, M. (2010) "Users of the world, unite! The challenges and opportunities of Social Media". *Business Horizons,* 53, pp 59-68.

Katsaros, I. (2008) *Organization and administration of education.* Athens: Ministry of National Education and Religions-Pedagogical Institute.

Koliadis E. (1996) *Learning Theories and Educational Practice*, Volume A: Behavioral Theories. Athens: Private edition.

Korombili, S. and Togia, A. (2015) *Information Literacy*. Athens: Association of Greek Academic Libraries. Available at: https://repository.kallipos.gr/handle/11419/2701

Kotini, I. and Tzelepis, S. (2017) "Flexible Software Development and Flexible Learning. The two sides of the same coin". *Proceedings of the 11th Panhellenic Conference of Informatics Teachers,* Chalkida 5-7 May 2017. Available at: http://pdkap.sch.gr/2017/erevnitikes-ergasies/

Lionarakis, A. (2001) "What distance education are we talking about? Main Presentation". In: A. Lionarakis (Ed.), *Proceedings of the 1st Panhellenic Conference on Distance Education* pp 185-195. Patras: Hellenic Open University.

Lionarakis, A. (2005) "Open and distance education and learning processes". In A. Lionarakis (Ed.), *Open and Distance Education. Pedagogical and Technological Applications,* pp 13-38. Hellenic Open University.

Lionarakis, A. (2014) *Open Education: the magazine for Open and Distance Education and Educational Technology, 10* (1), 3-4. doi: https://doi.org/10.12681/jode.9870

Lionarakis, A. (2016) *Editorial. Open Education: the magazine for Open and Distance Education and Educational Technology,* 12 (1), 3-4. doi: https://doi.org/10.12681/jode.10231

Lionarakis, A. (2019) Editorial. *Open Education: the magazine for Open and Distance Education and Educational Technology, 15* (2), 4-6. doi: https://doi.org/10.12681/jode.22078

Manousou, E., Ioakeimidou, S., Papadimitriou, S. and Briefcase, A. (2021) "Challenges and good practices for the training of teachers in Distance Education in Greece during the pandemic". *Open Education: the magazine for Open and Distance Education and Educational Technology, 17* (1), pp 19-37.

Mavroidis, H., Giosos, I. and Koutsoumba, M. (2014). "Overview of theoretical concepts in distance education". *Open Education: the magazine for Open and Distance Education and Educational Technology, 10* (1), pp 88-100. doi: https://doi.org/10.12681/jode.9814

Piaget, J. (2007) *The Psychology of Intelligence* (translate in greek Eleni Veltsou). Athens: Eds. Kastaniotis

Siemens, G. (2004) *Connectivism: A Learning Theory for the Digital Age*. Retrieved 17/4/2021, from https://jotamac.typepad.com/jotamacs_weblog/files/Connectivism.pdf

Smith, D. and Lovat, T. (2003) *Curriculum: Action on Reflection* (4th edition). Sydney NSW: Social Science Press.

Sofos, A., Kostas, A. and Paraschou, B. (2015) *Online Distance Education. From Theory to Practice.* [e-book]. Retrieved on 3/6/2021 from: https://repository.kallipos.gr/handle/11419/182

Swan, K. and Shih, L. F. (2005) “On the nature and development of social presence in online course discussions”. *Journal of Asynchronous Learning Networks, 9* (3), pp 115-136.

Tomlinson, H. (2004) *Educational leadership: Personal growth for professional development,* Vol. 3., Sage

Vlachopanou, P. and Papadakis, S. (2020) The role of Social Media in collaborative learning and the performance of distance education students. *Open Education: the magazine for Open and Distance Education and Educational Technology,* 15 (2), pp 124-143. doi: https://doi.org/10.12681/jode.14897. Retrieved June 2, 2021, from https://ejournals.epublishing.ekt.gr/index.php/openjournal/article/view/14897/19013

Educational Videoblog as an Auxiliary Learning Resource: Opportunities and Limitations

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DOI: 10.34190/EEL.21.062

Abstract: The main idea of the paper is inspired by the author's desire to clarify the balance between effects and risks of using of educational videoblogs as one of the resources for organizing of the learning process. The format of educational videoblogs, which has been intensively developing on popular video hosting sites in recent years, has turned out to be popular among the mass audience. Using of educational videoblogs for the purpose of learning provided the teachers potential opportunity to speak about complicated scientific topics in a simple and clear language. So, it is not surprising that the fashion for active using of educational videoblogs in the process of learning appeared in universities and colleges long before the beginning of the Covid-19 pandemic and the total quarantine. And it is possible to assume that sharp digitalization of education system in the situation of strict quarantine measures will make this fashion even stronger. However, there are still a lot of complicated questions about using of educational videoblogs in the process of learning. What are the real opportunities and risks of using of videoblogs in the process of learning? What educational tasks can be solved by using of videoblogs and which of them should be solved by other tools? Are there any negative consequences of using of videoblogs in the process of learning? This paper is devoted to the description of a sociological research, which was conducted for clarification of these complicated questions. The research was conducted by the author in 2020 and was organized for the clarification of real possibilities and limitations of using of educational videoblogs as an auxiliary learning resource. The initial hypothesis of the research was that the intensive use of educational videoblogs not only opens wide opportunities for the education system, but also creates several serious risks and problems. Using the data of his own research, the author tests this hypothesis and describes the specific possibilities and limitations of the use of educational videoblogs in the process of learning.

Keywords: videoblog, vlog learning, YouTube, digitalization, questionary survey

1. Introduction

The main purpose of this paper is to assess possible prospects and risks that can be created by intensive using of educational videoblogs in the process of learning. The importance and relevance of such research intention appear because contemporary social science challenges some complicated difficulties in assessment of effects of active implementation of information technologies in the process of learning. Now it looks like digitalization of learning process has become an important and inevitable trend in the development of the education system. Remarkable fashion for active using of various digital technologies in the process of learning could be easily traced in schools, colleges, and universities long before the transition of educational activities into distant forms at the time of quarantine measures in 2020-2021. And it also looks obvious, that now, after months of distance learning, the desire of educational organizations to use a variety of digital technologies in the process of learning can grow. But the problem is that understanding of real effects and risks of intensive using of digital technologies in the process of learning remains a matter of debate of debates. What opportunities can be provided by using of digital technologies in the process of learning? Are there any proofs, that active using of digital technologies corresponds to the real needs of students? What risks can be created by active using of digital technologies in the process of learning and how we can reduce them? Can we be sure that the growing fashion of schools, colleges, and universities for using of digital technologies only optimizes the process of learning and does not threaten its effectiveness? Unfortunately, even a rather superficial analysis of the current scientific literature demonstrates that there are still no clear answers on all these fundamental issues.

The purpose of this paper is to use the analysis of particular case of using of digital technologies in the process of learning to make a step in understanding of these questions. The central theme of this paper is the balance between opportunities and risks, which appear because of organization of process of learning with using of one particular case of digital technologies – educational videoblogs. It is important to emphasize, that educational videoblogs can be described as an interesting and remarkable case. Videoblogs, which are usually described as some author's video channels on the Internet (Gundarin et all, 2018), appeared as an entertainment format in the middle of 2000s, but later they transformed into more serious and complicated kind of digital content. Today we see a remarkable trend of emergence of educational videoblogs, which periodically mention serious scientific topics or even focus only on the representation of such content. Popularity of these videoblogs created an opportunity for presentation of educational content in a simple, visual and interesting format, which can be potentially attractive for students. So, there is no surprise, that using of such educational videoblogs as an auxiliary resource in the process of learning has become popular in many educational organizations. However, the revision of current sociological and pedagogical research practice demonstrates, that it is almost impossible to find a clear vision on positive and negative effects of their using in the process of learning. So, we are going to use the data of our own research to assess the possibilities and limitations appearing because of using of educational videoblogs in the process of learning. Understanding of this particular case will provide more information for clarification of effects of using of digital technologies for learning in general.

2. Literature review

Even a rather cursory review of current scientific literature demonstrates that the topic of using of educational videoblogs in the process of learning is not completely new for social science. This topic was mentioned in many remarkable articles and books, which appeared in recent years and focused both on the analysis of fundamental theoretical issues (Esarey, J. and Wood, 2018) and on the description of particular empirical cases (Arndt and Woore, 2018). It is noteworthy that using of videoblogs in the process of learning was also mentioned in the reports on previous ECEL conferences (Hautopp and Ejsing-Duun, 2019; Frants, 2020). Nevertheless, despite the large number and versatility of publications in this area in recent years, at least one important aspect of the topic, has remained undeservedly deprived of the attention of scientists.

The experience of our analysis of scientific literature allows us to conclude that the topic of using of educational videoblogs in the process of learning is most often mentioned in one of the three research destinations:

- Metatheoretical analysis of complex transformations of the education system under the influence of the development of information technologies. Actually, the topic of using of educational videoblogs appears in such papers rather indirectly. The authors of such papers mention using of such videoblogs as one of the details in the transformation of the learning process under the influence of digitalization (Lentz and Ducharme, 2015; Mohammed and Kinyo, 2020, Pajchert et all, 2020)
- Analysis of promising areas for using of videoblogs in the process of learning. The authors of such papers describe various possibilities of using of videoblogs to solve narrow pedagogical problems: the formation of interest in a complicated topic (Lanskikh et all, 2019), explanation of a difficult topic on illustrative material (Berger and Pan, 2018), the organization of self-study (Moghavvemi et all, 2018) and other tasks.
- Analysis of specific cases of using videoblogs to reveal specific topics of learning. The authors of the relevant papers describe the possibilities that appear because of using of videoblogs for solving important learning tasks: increasing the efficiency of assimilating new knowledge (Liu, 2016), presenting material in an unusual and visual format (Alharbi, 2019), developing specific professional skills (Campbell et all, 2019) and others.

Of course, we are far from thinking that focusing research interest in these areas is wrong. Such an arrogant conclusion is fundamentally wrong, at least because each of these research areas answers important scientific questions and allows us to understand the essential details about using educational videoblogs in the process of learning. But at the same time, we believe that the focus of research only on these areas can not provide full understanding of effects of using of educational videoblogs in the process of learning and remains some important questions without answer. And the key question of this paper about the balance of opportunities and risks of using of educational videoblogs in the process of learning receives significantly less attention from researchers. So, we can assume, that current research practice makes it possible to understand exactly how educational videoblogs can be used for solving of certain educational tasks but allows us to get only a superficial and hypothetical ideas about the positive and negative consequences of their using.

At the same time scattered hypotheses about the impact of using of educational videoblogs in the process of learning, that can be found in scientific literature, demonstrate, that active use of this digital instrument can create not only promising opportunities, but also tangible risks. Some researchers are optimistic about this and note that using of videoblogs in the process of learning can lead to beneficial effects: increasing visibility of the learning process, greater involvement of the audience in the process of learning new knowledge, etc. (Perrett and Minhas, 2016; Shoufan, 2019). Other authors formulate more skeptical views on the issue and suggest that the active use of videoblogs in the process of learning becomes a source of negative effects, such as the loss of emotional contact between students and teachers, a high probability of the formation of false and distorted knowledge, inappropriate entertainment of the process of mastering new knowledge and etc. (Jung and Lee, 2013; Reynoso and Aguirre, 2016). Even though discussions on relevant topics are relatively rare and most often base only on logical assumptions, we suppose, that existence of polemical views in this area is remarkable and indicative. These debates demonstrate that using of videoblogs in the process of learning can indeed have ambiguous and complex consequences. And this assumption will become a basis for our further analysis.

Our initial hypothesis is that the intensive use of educational videoblogs not only opens wide opportunities for the education system, but also creates several serious risks and problems. We suppose that using of educational videoblogs as an auxiliary educational tool allows us to make the process of learning more visual, simple and interesting for students. However, careless using of this tool in the process of learning can contradict real needs of students and lead to negative consequences: excessive entertainment of learning, loss of audience interest and a decrease in the overall efficiency of mastering new knowledge.

3. Research design and methods

The validity and correctness of our hypothesis were tested on the data of our own sociological research. This research was conducted on the basis of Ural Federal University in Yekaterinburg, Russia, in 2020. The research was organized for diagnostics of students' requests for potential using of educational videoblogs in the process of learning. Specifying the real needs and demands of students, we hoped to get information about which direction of educational videoblogs in the process of learning could bring promising results, and which would contradict the real needs and create problems. The research was organized in a form of a questionary survey among students of Ural Federal University. According to the purpose of the research, the questionnaire included a serious of questions about common habits of Internet-behavior of students, their habits of using of videoblogs and their readiness for potential using of such videoblogs as a part of educational process. In fact, we were going to understand, what practices of using of videoblogs became common for students and evaluate, if these practices correspond with potential using of educational videoblogs for the process of education or not.

The research was carried out among university students aged 18 to 24 years: a total of 126 people were interviewed, selected according to a quota age and sex sample (a detailed sample model is presented in Table 1). The sizes of quotas were determined in accordance with the official information about the number and, gender and age structure of students of the Ural Federal University at the beginning of 2020.

Table 1: Sampling of the research

Age	Gender		Total
	Male	Female	
18-19	15	17	32
20-24	47	47	94
Total	62	64	126

It is important to clarify that the research was carried out in 2020 before the start of the Covid-19 pandemic and the introduction of strict quarantine measures, which forced the university to significantly change the format of the educational process. So, the obtained data reflects the mood of students that existed before the educational process was transferred completely online, and the role of the videoblogs in the organization of process of learning increased. Probably, this should be noted when interpreting the results: it seems obvious that such large-scale transformations in the learning process could affect the mood of students quite significantly.

4. Results and discussions

Analysis of data that were collected during research allowed us to formulate several important conclusions.

First of all, the analysis has demonstrated, that the basic idea of using of videoblogs in the process of learning was familiar and interesting for students. At least, we can say, that we did not find many fundamental opponents of such a decision among the participants of the research. The overwhelming majority of participants of the research told, that they were accustomed to using videoblogs and spent a significant proportion of their time on the Internet on them. As can be seen at Figure 1, more than 80 percent of respondents spent at least one hour every day for watching of videoblogs. And 79% of them confirmed their interest to watching educational videos. It is also notable, that more than a half of respondents (63%) told, that they would like the practice of using of such videoblogs in the process of learning in the university. Combining these separate results, we can conclude, that most of the students liked the idea of using of videoblogs and were ready to discuss certain ways of their using. And at the level of common judgments, most of them expressed approval of this idea.

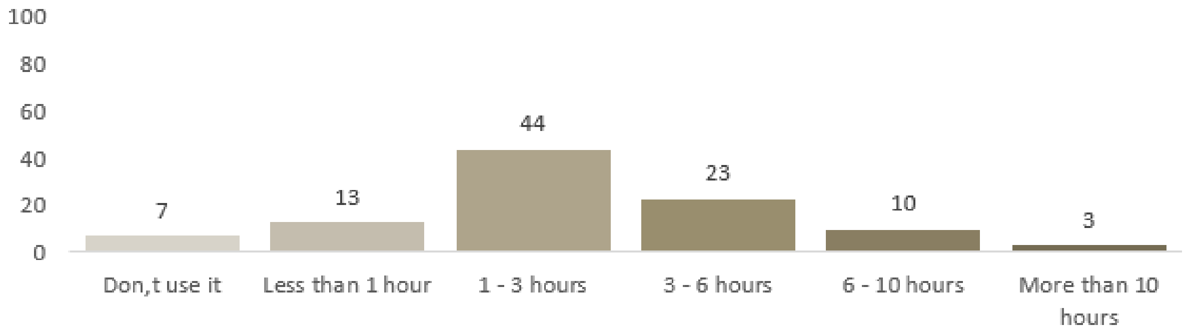

Figure 1: How much time do you spend for watching of videoblogs every day? (% of total number)

However, the analysis has also demonstrated one another important trend. More than 80% of the respondents insisted that videoblogs should be used only as a rare auxiliary material that could complement other pedagogical, not to replace them (the distribution of answers to the corresponding question is presented in Figure 2). They were ready to see videoblogs only as a secondary resource of learning, not as the main one.

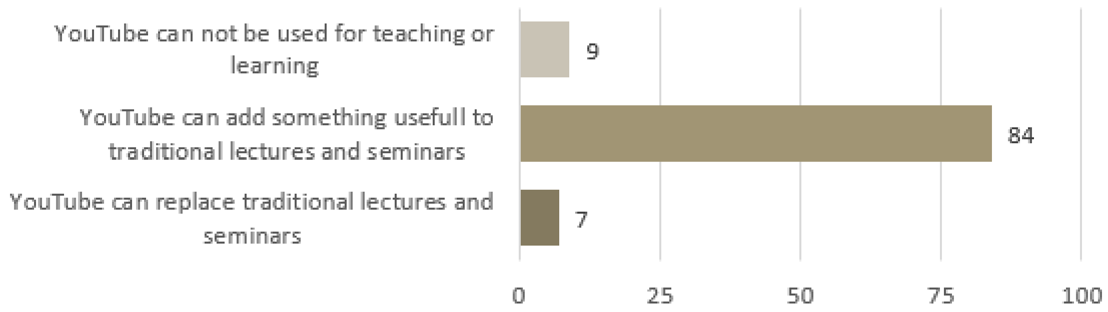

Figure 2: What do you think about using of videoblogs in the process of learning? (% of total number)

Furthermore, that 74% of the respondents expressed said "Rather no" or even "Absolutely no", replying to the direct question "Would you like the idea of replacing of lessons in the classroom for watching of educational videoblogs, created by professional specialists with better skills, than your teachers have?" (That can be seen at Figure 3). In other words, possibility of too active using of educational videoblogs in the process of learning would rather most of them. They didn't agree to consider a videoblog as a primary source of knowledge on a professional topic, even if this videoblog would be created by a recognized authoritative scientist who thoroughly understands the relevant topic. As we can see, they would prefer communications with university teacher in a traditional way. In fact, these answers indicated that students were interested only in a limited use of videoblogs in the process of learning. Even though they liked the very idea of using video blogging in this direction, most of them saw clear (and rather narrow) boundaries for such use.

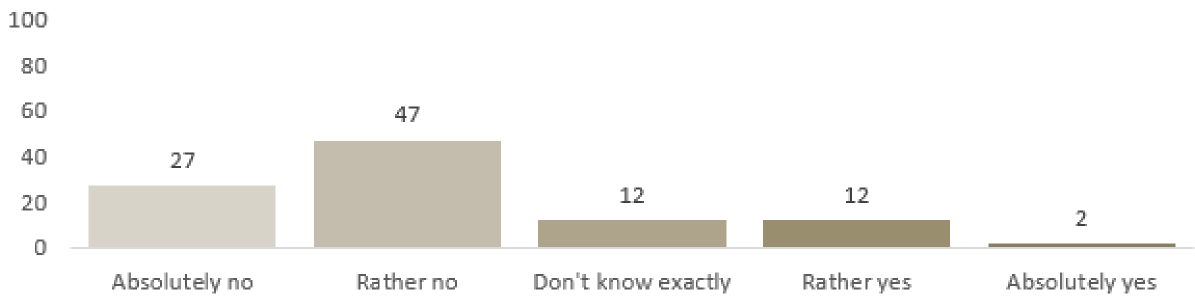

Figure 3: Would you like the idea of replacing of lessons in the classroom for watching of educational videoblogs, created by professional specialists with better skills, than your teachers have? (% of total number)

There were several key negative effects, which were mentioned by the respondents. The questionary included direct question about it: *"What negative effects will happen, if one or several disciplines in your university will be taught with the help of videoblogs?"* (this question was addressed for all the respondents). As can be seen at

Figure 4, many students felt worries, that excessive using of videoblogs will turn the process of learning into a routine watching of educational videos, which could quickly become boring and reduce motivation. Another mentioned problem was that extensive use of videoblogs could lead to the loss of emotional contact with the teacher and the opportunity to ask him a question directly during communication at a lecture or seminar. Finally, many respondents believed that videoblogs could contain less quality and reliable information than textbooks or scientific articles, so relying on them in the process of learning was fraught with distorted or even false ideas.

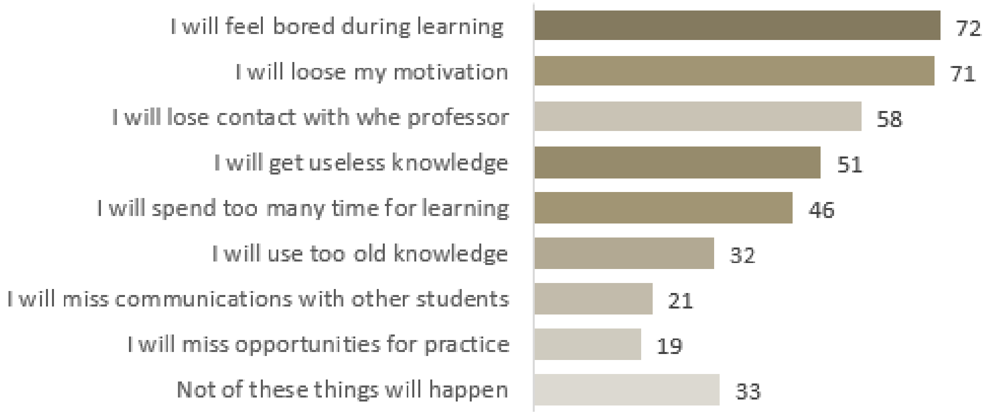

Figure 4: What negative effects will happen, if one or several disciplines in your university will be taught with the help of videoblogs? (% of total number)

It should be emphasized here that gathered data provided a clear vision of particular areas of learning process in which using of videoblogs would correspond students' demands most of all. The analysis demonstrates that most of those students who liked the idea of using of videoblogs in the process of learning assigned them a purely supportive role in this process. Here we can look at the answers on the question *"For what purposes you would prefer to use videoblogs in the process of learning?"*. The answers for this question demonstrate, that most of the respondents wanted to see videoblogs as a visual aid (62%), a resource for additional practical knowledge on the subject being studied (51%), or a source of alternative points of view, helping to comprehend the studied material from non-standard positions (44%). The rest of the areas of using videoblogs in the process of learning were much less consistent with the request of students.

In general, the results of the analysis indicated that videoblogs have a promising but complex potential of using as a learning tool, reliance on which can have both advantages and disadvantages. Thus, the analysis allowed us to conclude, that using of videoblogs as an auxiliary resource of process of learning corresponds with needs of students and can make the process of acquiring new knowledge more interesting and diverse. At the same time, too extensive use of videoblogs and their transformation into the primary resource of learning can lead to a violation of the quality of the educational process and a decrease its effectiveness. In general, we can say that the hypothesis that was formulated in the beginning of the paper was rather confirmed: using of the educational videoblogs in the process of learning carries both positive effects and risks.

5. Conclusions

The key idea of this paper was to assess the balance between the opportunities and risks of using of videoblogs as an auxiliary tool in process of learning. Our analysis has shown that the idea of using of videoblogs as part of the learning process is promising: it meets the needs and habits of the student audience and opens up a number of promising opportunities for presenting educational material. At the same time, the more active using of videoblogs in the learning process is fraught with rather negative consequences: such a decision contradicts the real needs of students, and its implementation can lead to the broadcast of unverified information and the loss of the teacher's emotional contact with the audience. In other words, the available data allows to conclude, that using of videoblogs in the l process of learning requires caution and delicacy. They can be useful supportive tools, but careless attempts to substitute them for other learning tools may have more negative consequences.

Acknowledgements

The reported study was funded by Russian Foundation for Basic Research, project number 20-011-00683

References

Alharbi, M.A. (2019) Integration of video in teaching grammar to EFL Arab learners. *CALL-EJ, 20(1)*, pp. 135-153.

Arndt, H.L., Woore, R. (2018) Vocabulary learning from watching YouTube videos and reading blog posts. Language Learning and Technology, 22(3), pp. 124-142.

Berger, E, Pan, E. (2018) Relationship of Blog and Video Usage Patterns to Academic Performance in Undergraduate Mechanics. *International journal of engineering education, 34(6),* pp. 161-177.

Campbell, L.O., Heller, S., DeMara, R.F. (2019) Implementing student-created video in engineering: An active learning approach for exam preparedness. *International Journal of Engineering Pedagogy*, 9(4), pp. 63-75.

Esarey, J., Wood, A.R. (2018) Blogs, Online Seminars, and Social Media as Tools of Scholarship in Political Science. *PS - Political Science and Politics*, 51(4), pp. 811-819.

Frants, V.A. (2020) Video blogs as a tool for forming a cultural dialogue between foreign and local university students. *Proceedings of the 19th European Conference on e-Learning. (ECEL 2020)*, pp. 190-197.

Gundarin, M.V., Zotova, A.I., Ilina, I.Y., Nakhratova, E.E., Makarova, I.V. (2018) Video blog advertising: Feedback analysis. *International Journal of Engineering and Technology(UAE) 7(3.14 Special Issue 14),* pp. 336-339

Hautopp, H., Ejsing-Duun, S. (2019) The use of visualisations and video productions in online game-based learning. *Proceedings of the 18th European Conference on e-Learning. (ECEL 2019)*, pp. 192-199.

Jung, I., & Lee, Y. (2013). YouTube acceptance by university educators and students: a cross-cultural perspective. *Innovations in education and teaching international, 52*(3), pp. 243–253.

Lanskikh, A., Skuratov, A., Symaniuk, N. (2019) The possibility of using the video blog as a modern teaching tool. *Proceedings of 12th International conference of education, research and innovation (ICERI2019),* pp. 10273-10275

Lentz, C., Ducharme, J. (2015) Creative successful online courses with emerging technologies. *International Journal of Interdisciplinary Studies in Communication, 9(1)*, pp. 1-8

Liu, M.-H. (2016) Blending a class video blog to optimize student learning outcomes in higher education. *Internet and Higher Education. 30,* pp. 44-53.

Moghavvemi, S., Sulaiman, A., Jaafar, N. I., & Kasem, N. (2018). Social media as a complementary learning tool for teaching and learning: the case of YouTube. *The International journal of management education, 16*(1), pp. 37–42.

Mohammed, S., Kinyo, D.L. (2020) Constructivist theory as a foundation for the utilization of digital technology in the lifelong learning process. *Turkish Online Journal of Distance Education. 21(4),* pp. 90-109

Pajchert, B., Kaczmarczyk, D., Gurba, K. (2019) Video blog as an educational tool in Poland *Proceedings of 12th International conference of education, research and innovation (ICERI2019),* pp. 10372-10376.

Perrett, J., Minhas, W. (2016). YouTube: A vehicle for international collaboration. Proceedings of the 15th European conference on e-learning (ECEL 2016), pp. 547-554.

Reynoso, N. P. M., & Aguirre, A. J. R. (2016). Youtube: an educational tool? *ICERI2016 Proceedings*, pp. 2778-2786.

Shoufan, A. (2019). What motivates university students to like or dislike an educational online video? A sentimental framework. *Computers & education, 134*, pp. 132–144.

Using Gamification and Flipped Classroom for Remote/Virtual Labs for Engineering Students

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DOI: 10.34190/EEL.21.082

Abstract: Providing students with a virtual and remotely accessible version of in-person labs as well as virtual and interactive tutoring is a continuous challenge during the pandemic. The paper outlines the design, development, and implementation of 6 virtual experiments for mechanical engineering students, which combines gamification principles and flipped classroom. The virtual labs allow the students to measure the data from the experiment as they would in reality. Instead of having a lecturer showing how to calculate the results based on an example, the students are guided through the theory like a computer game. The game has a step-by-step process which allows the student to find the correct solution themselves. The more they progress through the game the fewer guides and hints they receive. While at the beginning the students answer simple multiple-choice questions, later the students' progress to "minigames" where they place building blocks into the correct position to build an equation or a Freebody/kinetic diagram. The paper evaluates the feedback received from the students as well as compares this with the in-person version of the lab. The paper explores the option to adapt existing software to create a low-cost gamification and flipped classroom experience.

Keywords: gamification, flipped classroom, virtual labs, remote lab, virtual lab, enquiry-based learning

1. Introduction

Practical laboratories are an important part of university education given that they allow students to link the theory to real world examples (Heradio, de la Torre and Dormido, 2016). Especially in engineering disciplines, laboratories allow students to observe and manage differences between the theoretical concept and the observation in reality (Viegas *et al.*, 2018). However, providing students with a virtual and remotely accessible version of in-person labs as well as virtual and interactive tutoring is a continually challenging requirement during the pandemic (Bonfield *et al.*, 2020). A virtual lab for mechanical engineering students (Statics and Dynamics module) has been designed to ensure that students who are unable to return to university due to travel restrictions have a similar learning experience to the students who are able to return to campus. The virtual lab includes six experiments and is a copy of an in-person lab. Subsequently the term virtual lab refers to all six virtual experiments and interactive tutorials. In addition to demonstrating theoretical concepts, the aim of practical laboratories is to introduce the students to measurement errors, uncertainty and broader experimental design issues (Heradio, de la Torre and Dormido, 2016). Hence, it is crucial that students can measure data from the experiment in the virtual lab as they would do in-person. The interactive tutorials within the virtual lab guide students through the theory in the same way an instructor would do in-person. The virtual lab combines gamification principles and flipped classroom techniques (Gueye and Exposito, 2020), which are the two most promising new learning techniques (Parra-González *et al.*, 2021).

The paper contributes to the literature by presenting the evaluation of the students' feedback of a virtual lab based on a survey. The rest of the paper is structured as follows: After the overview of the relevant literature, the in-person and the virtual lab are described and their integration into the module. Next, the survey design is illustrated. Last the results of the survey are presented and discussed.

The literature on virtual labs is vast. Brinson (2015) concluded based on a systematic literature review that 65 % of all studies claim that the learning outcome was better for virtual and remote labs compared to in-person labs. 24 % of the studies reported that the learning outcome was equal for both lab types. Brinson (2015) also noted that studies focus their comparison of both lab types either on evaluating content knowledge and understanding through quizzes or on qualitative data of students/instructor perception. This paper solely focusses on the last option (i.e., qualitative data). Heradio et al. (2016) published an overview of recent developments of virtual labs in control engineering and how they compare to in-person labs. They concluded that the number of studies reporting that in-person labs are better than virtual labs is continuously decreasing over the past years. Heradio et al. (2016) anticipated that cross-institutional lab sharing will become more important in the future to reduce shared cost and increase utilisation. Heradio et al. (2016) suggested the introduction of haptics or game principles to increase the interactiveness of virtual and remote labs. Gamification is regarded as one of the most promising learning technique (Parra-González *et al.*, 2021) (Alhammad and Moreno, 2018). The aim of gamification is to increase the student's motivation, engagement and productivity (Subhash and Cudney, 2018), which are one of the most important elements in educational environments (Elfeky, Masadeh and Elbyaly, 2020). Gamification usually does not require actual games to be included into the learning environment, the focus should rather be on integrating game design elements into the learning environment (Subhash and Cudney, 2018) in order to transmit similar feelings (Alhammad and Moreno, 2018).

One of the earlier papers that investigated the combination of game principles and virtual and remote labs is Dziabenko et al. (2011). They concluded that combining the two teaching methodologies can provide significant benefits. However, they also stressed the importance of not just integrating learning content into a standard game but to also adjust the game to meet the learning objectives. The research on gamification in education is continuously increasing since 2013 (Subhash and Cudney, 2018).

While gamification was first applied in marketing and business sector (Alhammad and Moreno, 2018), it is now most commonly used in computing subject areas (Subhash and Cudney, 2018). Gamification is most frequently used at university or in companies as in-house training (Alhammad and Moreno, 2018). Based on the systematic literature review by Subhash et. al (2018), most studies report an improved attitude, engagement, motivation and students performance. The most frequently used game elements are badges, leader boards, levels, feedback and points (Subhash and Cudney, 2018). Subhash et al. (2018) published a comprehensive overview of the current state of the art in gamification for higher education, which highlights the growing interest in gamification. A review of gamification techniques with a focus on software engineering can be found in Alhammad et al. (2018).

2. Description of the lab

2.1 Description of the experiments

The lab is part of the Statics & Dynamics module (first year, second semester) for Mechanical engineering students. The lab includes the following six experiments:

1. Epicyclic Gear Train: The goal of the experiment is to measure the ratios of angular speeds of input and output gears for four different combinations of engagement. The students use an epicyclic gear train with two assemblies for the experiment. In the theory part, the students calculate the gear ratios theoretically and compare the results with the experiment.

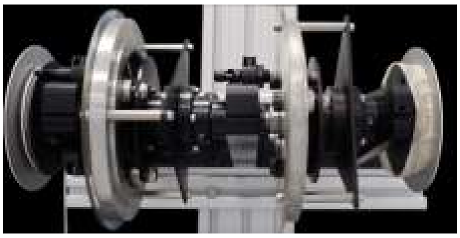

Figure 1: Epicyclic gear train

2. Rolling Down - Inclined Plane: In this lab, the students measure the time required for two cylinders, which have a different diameter, to roll down an inclined plane. The students use these values to calculate the acceleration and validate them against the theory.

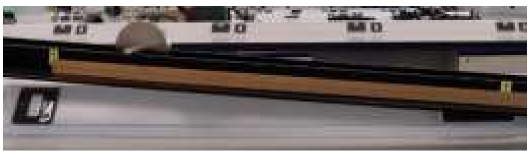

Figure 2: Rolling down - inclined plane

3. Toppling Sliding - Inclined Plane: The objective of this experiment is to measure and theoretically determine the effect friction and aspect ratio of a cylinder have on whether the cylinder topples or slides down an inclined

plane. The students increase the inclination of a metal and rubber plane to determine when a cylinder topples or slides depending on the aspect ratio. They verify their observations based on the theory.

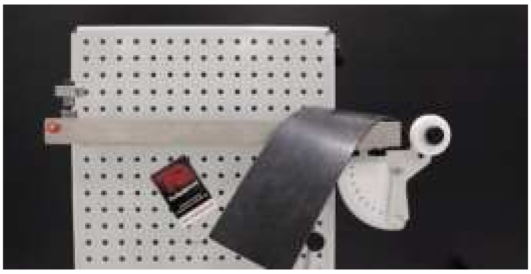

Figure 3: Toppling sliding - inclined plane

4. Three Bar Linkage - Crank Connecting Mechanism: The students determine the velocities and angles in a crank-connecting rod mechanism. They are provided with a three-bar linkage and are asked to construct a vector triangle and to determine the vector equations in order to calculate the velocities. The students compare the velocities with the results from a geometrical construction.

Figure 4: Three bar linkage - crank connecting mechanism

5. Four Bar Linkage: Similar to the previous experiment, the students determine the velocities and angles, but this time using a four-bar linkage instead of a three-bar linkage.

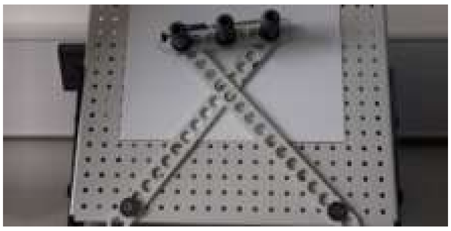

Figure 5: Four bar linkage

6. Energy Methods: The students are given a spring-mass-pully arrangement to measure the relationship between the hanging mass (scale pan with and without weights), the tension in the spring, the stiffness of the spring and the spring extension in static and dynamic cases. They calculate theoretically the force balance in static equilibrium and compare this with the measurements. Afterwards, they calculate the energy methods for dynamic loading and compare this with the observations from the experiment.

Figure 6: Energy methods

2.2 Description of the virtual experiments

The virtual lab highlighted in this study is integrated into a web based application (runs in web browser) and can be classed as a remote access-simulated resource based on the classification in Heradio et al. (2016). A web based application has been chosen to avoid the problems of desktop programs such as being less portable (e.g.

require specific operating system) and less secure (e.g. access user's hard disk and establishes internet connection to other servers) (Heradio, de la Torre and Dormido, 2016). The goal was to keep the virtual version of the experiment as close as possible to (or better than) the in-person version of the experiment. The virtual lab allows students to measure the data from the experiment as they would in reality. For example, they use a stopwatch (or their smartphone) to measure the time it takes a cylinder to roll down a plane (Exp. 2), or they use a protractor to measure the angles in the Three Bar Linkage - Crank Connecting Mechanism (Exp. 4) and Three Bar Linkage - Crank Connecting Mechanism (Exp. 5). The use of slow-motion cameras allows the students to have a better insight into the mechanics of the experiment which is difficult to conceptualise at real speed in-person). For example, in the Toppling Sliding - Inclined Plane, they use slow-motion footage to determine the exact frame the cylinder starts sliding/toppling. Multi-cam videos allow the students to see all aspects of the lab at the same time. For example, in the Energy Methods experiment (Exp. 6), the students can see in three parallel shown videos the tension in the spring, the spring extension, and the movement of the weights.

The theory part of the lab is explained by adopting an enquiry-based learning approach (e.g. never telling the solution to a student. The student is guided to the right answer with hints as required). Given that multiple-choice questions might be boring after a while, the virtual lab uses gamification techniques to keep the lab interesting. The students, for example, use building blocks to create freebody diagrams or equations.

To build up the confidence of the students, the level of difficulty is constantly increasing. For example, in the Epicyclic Gear Train experiment (Exp. 1) in the first stage students only have to answer simple questions such as 'in which direction a gear is turning?' Then they are guided step-by-step through calculating the step-down ratio for the first time and then by the 3rd and 4th time, they have to calculate the step-down ratio without any help.

2.3 Description of the organisation of the labs

At first, our intention was to run fully online labs. The students would have been split into groups to encourage them to support each other and explain the content in their virtual groups. In the end, all students would have the chance to ask questions in live and online Q&A. Competition would have been introduced by having leader boards showing the students with the most accurate measurements and the teams with the most points to encourage students to convince their teammates to take part in the virtual lab as well.

However, given that the government advice changed and students were allowed to return back to campus, we decided to offer a modified in-person version for students who are able to return to campus and a simplified fully online version to students who are unable to return to campus or can only return to campus in time to do half of the in-person labs. Given that we had to reduce the time the students can spend on each experiment, we decided to apply flipped classroom teaching principles by encouraging the students to do the virtual lab online before the in-person lab to ensure that they are familiar with the task and could use their time more efficiently in the lab.

Before Covid-19, the students had 40 minutes per experiment and would work in groups of usually 3 students. Given that the Epicyclic Gear Train experiment (Exp 1) is more complicated than the others, one instructor supported two groups of students conducting the experiment. The other two instructors supported the remaining 10 groups doing experiments 2 to 6.

A significant number of changes had to made to manage the risk of spreading Covid in the in-person lab such as: (i) the students had to work alone or if it cannot be avoided in pairs, (ii) the students only get 30 min per experiment instead of 40 minutes to allow for extra time to clean the equipment and to check whether the students had a Covid test in the past 7 days, (iii) four instead of three instructors supported the students.

Hence, the Covid version of the in-person lab might be more difficult for the students due to the reduced time and that they had to work alone in most cases. However, we tried to compensate for this by offering the virtual labs and by increasing the instructor to student ratio (now: 2-5 students per instructor, before 6-18 students per instructor).

The virtual lab including the script for the videos was created by the instructor who supported the Epicyclic Gear Train experiment this year and in the previous year. After explaining the experiment and the theory 24 times in the previous year, the instructor used a similar set of questions to guide students to an answer using enquiry-based learning techniques and therefore the theory was explained to each student in exactly the same way. The same script was used to explain the theory in the virtual version of the Epicyclic Gear Train experiment. Many students recognised the instructor when they met her in the in-person lab and the sentences used to explain the theory of the virtual lab and in-person lab of the Epicyclic Gear Train were so similar that several students stopped the instructor midway through a question or sentence because they remembered the entire explanation or answer based on the first few words of the sentence or question. Given that the instruction in the virtual and the in-person lab of the Epicyclic Gear Train is exactly the same, it was possible to compare the methods of delivering them (online vs. in-person) without having different instruction types affecting the results.

3. Survey design

3.1 Purpose

The aim of the survey was to evaluate the student's perception of the virtual lab and compare this with the in-person lab. The online survey combined open-ended questions and Likert scale feedback. To ensure that the students were confident to give honest feedback the survey was fully anonymous and no personal identifiable information has been collected. The survey has been reviewed and deemed appropriate by the Ethics Review Sub-Committee at Loughborough University (2021-5123-3838). The survey was analysed by the first author, who also created the virtual lab, using the programming language Python. The figures have been visualised using the python libraries seaborn (Waskom *et al.*, 2014) and matplotlib (Hunter, 2007).

3.2 Participants

The virtual lab was ungraded and not a mandatory part of the Statics & Dynamics module (first year, second semester) for Mechanical engineering students. Hence, the 154 students could choose whether and when they want to the virtual lab. Each experiment of the virtual lab was completed by at least 21 students during term time. Only the students who completed all virtual labs were asked to fill out an anonymised online survey. The link for the survey could be found on the virtual learning environment page where the students have access the virtual lab. 18 of the students filled out the survey between 13th May 2021 and 25th May 2021. Note: After the survey was conducted at the end of term three times as many students completed the virtual lab just in time for the in-class test.

4. Results

4.1 Student experiences

4.1.1 Level of difficulty of the virtual lab

Figure 7 highlights the perceived level of difficulty of each experiment of the virtual lab. Most students felt that the difficulty of the virtual lab was appropriate. No student selected strongly disagree for any of the experiments and only none, 1 or two students disagreed that the level of difficulty of the virtual lab was appropriate.

The easiest experiment seems to be the rolling down – inclined plane (Exp. 2) and toppling/sliding - inclined plane (Exp. 3) with 78 % and 76 % of the surveyed students agreeing or strongly agreeing that the level of difficulty was appropriate while none or one of the students selected disagree. The tasks of the Three Bar Linkage - Crank Connecting Mechanism (Exp. 4) are the same as for the Four Bar Linkage (Exp. 5); only the apparatus is different. Hence, fewer hints have been given in the later experiment even though the maths of the experiment is more complicated. This learning curve seemed to be too steep for two of the students who both selected strongly agree and neutral for experiment 4 but disagree for experiment 5. No student found the experiment 5 easier than the experiment 4. Hence, we probably should still have given the same number of hints in the 5th experiment to help students who struggled too much.

Overall less than 10 % of the students disagreed that the level of difficulty of the virtual lab was appropriate.

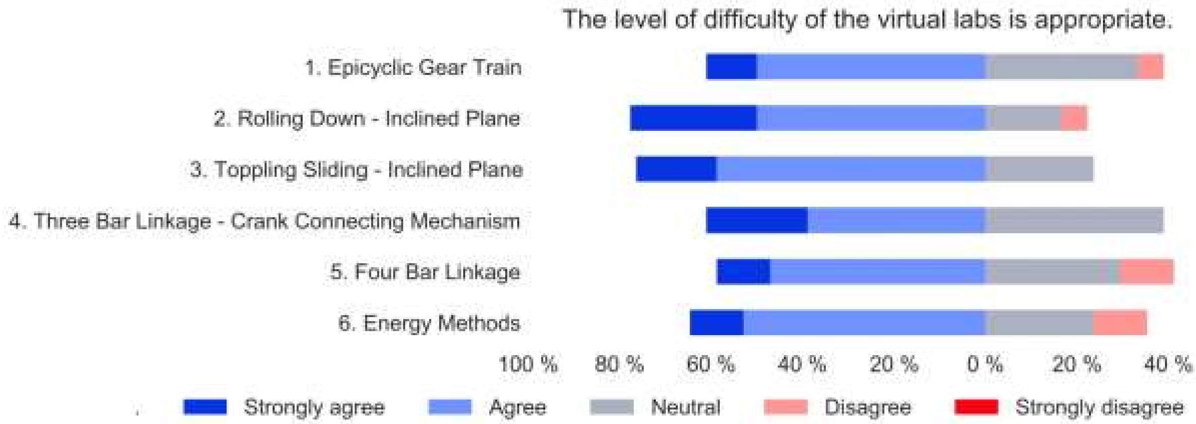

Figure 7: Level of difficulty of the virtual labs is appropriate

4.1.2 General questions

Some students seem to struggle to finish the in-person lab within the time (Agree + Strongly agree: 33 %) and 60 % students agreed and 27 % strongly agreed that the virtual lab gave them more time to understand the theory.

4.1.3 Open ended feedback questions

In the last part of the survey, the students had the chance to comment on what they liked and did not like about the virtual labs. Most commonly mentioned by the students was the ability to do the virtual labs from anywhere at any time for as much time as required:

> *"The opportunity to spend as much time as I needed [..]" (anonymous)*
>
> *"[...] being able to do them any time convenient for me." (anonymous)*
>
> *"had the freedom to do them at any time [..]" (anonymous)*
>
> *"Ease of access at any time" (anonymous)*
>
> *"Being able to access the material as a student who couldn't return to […] this term was very useful […]" (anonymous)*
>
> *"How accessible it was" (anonymous)*

Most students mention favourable the ability to interact with the tool instead of only watching videos as well as the variety of questions styles:

> *"I like[..] test yourself bits" (anonymous)*
>
> *"[...] there is still a lot you have to do yourself." (anonymous)*
>
> *"It was a great interactive tool. [..] Really appreciated!" (anonymous)*
>
> *"Range of different style questions made it interesting […]" (anonymous)*

Some students mentioned that the virtual lab increased their ability to do the in-person lab:

> *"[...] gave confidence that I knew what do do during the in person labs" (anonymous)*
>
> *"I was able to understand you lab material also easier" (anonymous)*
>
> *"[…] Every virtual lab increased my confidence and understanding of the experiment." (anonymous)*

Other students mentioned the theory parts of the virtual lab positively including the hints:

> *"I likes the explanation" (anonymous)*
>
> *"They were straightforward and indicated the steps to solving the problems correctley" (anonymous)*
>
> *"Clear and Concise!" (anonymous)*

"[…] and in my opinion the different labs were explained quite well" (anonymous)

"In the planetary gear experiment the explanation was really easy to follow and it gradually became less spoonfed which was good for practice." (anonymous)

"Each experiment was explained very well." (anonymous)

Even though it was not our intention that students to do the virtual labs while they are in the in-person lab, one student benefited from doing so:

"It followed the lab sheets with the same order so it was easy to complete both at the same time. There was an opportunity at every stage to check whether you've made a mistake." (anonymous)

One student mentioned that it was difficult to motivate themselves to do the virtual lab given that the in-person lab was too difficult. However, once they were able to convince themselves to do the virtual lab, they were able to understand the theory.

"I was a bit struggled for motivation to complete them which might be because I didn't really understand much in the normal labs [i.e. in-person labs]. […] Every virtual lab increased my confidence and understanding of the experiment." (anonymous)

The negative feedback about the virtual lab was rather limited. While a lot of students were happy with the explanations in the virtual lab as shown before, one student wished to have a more in-depth explanation. Hence, it might be an option to include optional explanations that go beyond the scope of the lab but might be of interest for some students.

"No indepth explanations" (anonymous)

Two students preferred using the equipment hands on in the lab.

"When in person you get to use the equipment and learn how it works which you do not get from the virtual labs" (anonymous)

"Prefer face to face learning" (anonymous)

Another student found the virtual labs are too time consuming.

"very time consuming to complete all parts" (anonymous)

Overall, the open feedback of the students was positive. It clearly highlighted the appreciation of the students to be able to do the virtual labs at any time, for as long as required, and in any place. The interactiveness of the virtual lab as well as the offering a variety of question styles was positively mentioned by the students. The students again seem to like to use the virtual lab to learn the theory and most but not all where happy with the explanations. One student also highlighted that the gradually increasing difficulty in the Epicyclic Gear Train (Exp. 1) experiment helped their understanding. Overall, the virtual lab increased the confidence of the students to do the experiment.

5. Conclusion

The survey showed that the students clearly benefited from the virtual lab. They appreciated the ability of doing the virtual lab anywhere, at any time and for as long as required. The students also highlighted that the interactives of the virtual lab improved their leaning experience. The students benefited of flipped classroom techniques given that the virtual lab gave them the confidence that they knew what to do in the in-person lab. All students apart from one found that the amount of explanation given was appropriate. Hence, we might add optional explanations to the virtual lab that go beyond the scope of the lab to allow keen students to gain additional information.

Ethical Review and Reporting Criteria: The survey has been reviewed and deemed appropriate by the Ethics Review Sub-Committee at Loughborough University (2021-5123-3838).

References

Alhammad, M. M. and Moreno, A. M. (2018) 'Gamification in software engineering education: A systematic mapping', *Journal of Systems and Software*. Elsevier Inc., 141, pp. 131–150. doi: 10.1016/j.jss.2018.03.065.

Bonfield, C. A. *et al.* (2020) 'Transformation or evolution?: Education 4.0, teaching and learning in the digital age', *Higher Education Pedagogies*. Routledge, 5(1), pp. 223–246. doi: 10.1080/23752696.2020.1816847.

Brinson, J. R. (2015) 'Learning outcome achievement in non-traditional (virtual and remote) versus traditional (hands-on) laboratories: A review of the empirical research', *Computers and Education*. Elsevier Ltd, 87, pp. 218–237. doi: 10.1016/j.compedu.2015.07.003.

Dziabenko, O. and García-zubia, J. (2011) 'Remote Experiments and Online Games: how to merge them?', in *2011 IEEE Global Engineering Education Conference (EDUCON) – 'Learning Environments and Ecosystems in Engineering Education' Amman, Jordan*, pp. 1102–1107.

Elfeky, A. I. M., Masadeh, T. S. Y. and Elbyaly, M. Y. H. (2020) 'Advance organizers in flipped classroom via e-learning management system and the promotion of integrated science process skills', *Thinking Skills and Creativity*. Elsevier, 35(November 2019), p. 100622. doi: 10.1016/j.tsc.2019.100622.

Gueye, M. and Exposito, E. (2020) 'University 4.0: The Industry 4.0 paradigm applied to Education', *IX Congreso Nacional de Tecnologías en la Educación, Oct 2020, Puebla (Mexico), France. hal- 02957371*.

Heradio, R., de la Torre, L. and Dormido, S. (2016) 'Virtual and remote labs in control education: A survey', *Annual Reviews in Control*. Elsevier Ltd, 42, pp. 1–10. doi: 10.1016/j.arcontrol.2016.08.001.

Hunter, J. D. (2007) 'Matplotlib: A 2D Graphics Environment', *Computing in Science Engineering*, 9(3), pp. 90–95. doi: 10.1109/MCSE.2007.55.

Parra-González, M. E. *et al.* (2021) 'Gamification and flipped learning and their influence on aspects related to the teaching-learning process', *Heliyon*, 7(2), p. e06254. doi: 10.1016/j.heliyon.2021.e06254.

Subhash, S. and Cudney, E. A. (2018) 'Gamified learning in higher education: A systematic review of the literature', *Computers in Human Behavior*, 87(May), pp. 192–206. doi: 10.1016/j.chb.2018.05.028.

Viegas, C. *et al.* (2018) 'Impact of a remote lab on teaching practices and student learning', *Computers and Education*. Elsevier, 126(July), pp. 201–216. doi: 10.1016/j.compedu.2018.07.012.

Waskom, M. *et al.* (2014) 'seaborn: v0.5.0 (November 2014)'. doi: 10.5281/ZENODO.12710.

Network Interaction as a way of Innovative Development of the University: Case of Ural Federal University

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DOI: 10.34190/EEL.21.066

Abstract: Commitment to academic leadership and university's ambitions to occupy its niche in the global educational space, on the one hand, are an engine of the rapid digital transformation of the university. On the other hand, this requires the university to find new ways of innovative development and new opportunities for implementing advanced digital technologies in the educational process. In response to the global challenges Ural Federal University (UrFU) made two important decisions. The first one is to increase networking with the world's leading universities for providing digital content of high quality. The second one is to expand educational opportunities for students by using external educational resources ensuring individualization of their learning paths. Following these targets Ural Federal University has launched a project "Coursera for Campus" and granted access for students to a special university learning program which included more than 150 online courses and about 40 specializations from Russian and foreign universities. This program met the needs of educators in modern digital content for using in existing curricula for credits and allowed student to master online courses for self-development. In this paper we present the results of the project including the description of a model of using online courses in the educational process and analysis of students' success, their difficulties and opportunities conducted with the help of Coursera analytics tools. Overall, the results have showed a sufficient online courses' completion rate (on average, 85% and 59% for compulsory and supplementary courses correspondingly), high test scores (average score is equal to 84 from 100) and considerable satisfaction of students. The main difficulties are related to accessing the learning program on Coursera, mistranslation of courses' content from foreign languages to Russian and insufficient level of students' time-management for completion courses on time.

Keywords: higher education, network interaction, educational technologies, online-courses, Coursera, individualization

1. Introduction

In the age of the Fourth Industrial Revolution and digital transformation of economics, higher education faces the global challenges connected with technology changeover and new requirements of the labor market. Adapting to a rapidly evolving innovation environment universities are forced to transform themselves, change the university management system by implementing digital technologies and create such educational space where thousands of students get all opportunities for their professional and personal development.

Faced with the global competition universities all over the world pursue the following goals: providing opportunities for students to build individual educational paths, expanding the network interaction with leading universities, developing online and distance learning, designing new approaches to teaching and learning to improve the quality of education and enhance students' motivation, increasing the economic efficiency of educational services through the introduction of digital technologies. Now, the educational process is expanding beyond the university looking for new learning opportunities, mentorship and support using networking, external educational resources, and affinity spaces (Canals, Burkle, Toft, 2018; Lapshina et al., 2020; Hawra et al, 2020). The next step in transformation of the education system is the creation of network universities, which are based on long-term cooperation with Russian and foreign universities (Moscow 24, 2021; Munusamy, Hashim, 2020). Many of the world's leading universities are not just limited to networking, they are creating online universities (Oganesyan, 2017). Networking among universities supports internationalization and improves the quality of learning thanks to the exchange of best practices and increased motivation due to individualization of learning path. Such cooperation allows students to study online at foreign universities or master individual courses for self-development (Munusamy, Hashim, 2020).

To increase the competitiveness of Russian universities at the global education market a new state program "Priority 2030" was launched by the Russian Ministry of Science and Higher Education in 2021. This program is aimed at the transformation of existing approaches to higher education, dissemination of the best practices in research, education and innovation and creation of favorable conditions for the development and successful realization of personal potential. Within the framework of this program more than 100 universities will receive financial support for implementing their projects of digital transformation and innovation development.

Ural Federal University (UrFU) is one of the leading and innovative Russian universities rapidly progressing in the national and world university rankings. Participation in this competition for UrFU is a real test of the chosen strategy that opens up prospects for further development. UrFU has significant experience in implementation of online learning technologies in the educational process and digital transformation of the university management system. This allows to create an open educational environment where students, academic community, partner universities, business companies are involved. By introducing online-courses into the educational process, UrFU is building an ecosystem where everyone gets ample opportunities for lifelong learning and participating in joint projects that solve real life problems from business.

For further development Ural Federal University (UrFU) made two important decisions. The first one is to increase networking with the world's leading universities for providing digital content of high quality. The second one is to expand educational opportunities for students by using external educational resources ensuring individualization of their learning paths. Following these targets Ural Federal University has launched a project "Coursera for Campus" and granted access for students to a special university learning program which included more than 150 online courses and about 40 specializations from Russian and foreign universities. This program met the needs of educators in modern digital content for using in existing curricula for credits and allowed student to master additional online courses for self-development. Blended learning was used for the educational process. More than 500 students from different institutes of UrFU took part in this project. Most of them mastered two and more online courses. This is a important example of the innovative transformation of the university as the first step towards the creation of a network university. The experience of UrFU can be used by other universities towards the innovative development and digital transformation.

In this paper the results of the project are presented. The urgency of the study stems from the growing need in networking of universities and improving the educational process by international knowledge exchange. An object of the study is the Ural Federal University. A subject is the network interaction of the universities via the international platform of open education. The research is aimed at examining the experience of UrFU in using online courses of Russian and foreign universities in the educational process and analyzing students' success, their difficulties, and opportunities. The hypothesis is that the inclusion of online courses from leading universities in the curricula allows students to get positive experience of virtual academic mobility and acquire new skills and knowledge in the chosen professional field. The tasks of the study are the following:

- to study the concept and features of a network university
- to analyze the possibilities of network interaction via Coursera platform
- to justify the model of using online courses in the educational process
- to analyze statistic data on students' activity and achievements
- to examine students' satisfaction with online courses by reviewing their feedback

2. Theoretical bases

A network university is an institution which comprises universities from different countries to seek international partnership and achieve common goals in the field of higher education and research. Advantages of the network structure are its flexibility and adequate response to new challenges of a rapidly changing environment that is necessary for sustainable development in the digital world (Shuklina, 2017; Koksharov, Zagainova, 2020). The network approach allows rational use of resources and cost reduction, focus on the key competencies of each member, involvement of the most qualified specialists and effective information exchange (Oganesyan, 2017). Creation of a network university is provided by building horizontal links between the universities, sharing best practices in teaching and research, and delivering joint educational programs. Innovative development of higher education institutions is achieved by effective exchange of resources with partners (Canals, Burkle, Toft, 2018; Moscow 24, 2021; Oganesyan, 2017; Koksharov, 2020).

There are many university networks at both global (e.g., Worldwide Universities Network, International Network of Universities, etc) and regional (e.g., Balkan Universities Network Mediterranean Universities Union, etc) levels. Most of them unite research-intensive universities providing financial and infrastructural support to foster research collaboration and facilitate academic mobility. Some of the networks focus their efforts on the partnership in education to promote internationalization of education, joint programs (Double Degrees) and student and staff exchanges. Certain universities try to combine both directions. Thus, Brazil, Russia, India, China, and South Africa established the BRICS network university which provides high quality education, cooperates with employers and the scientific community, attracts leading researchers and teachers. It is planned that at the first stages of the network university development, the countries will be represented by 9-12 universities that have a certain authority (Degtereva, Chernysheva, Trofimova, 2019; Koksharov et al, 2021).

There are 4 types of network university (Shuklina, 2017):

- 1. Distributed University: it is characterized by a developed infrastructure of educational and scientific resources.
- 2. Geographically distributed University: it provides educational services through the branches.
- 3. Virtual University: it delivers educational programs using e-learning and distance learning technologies.
- 4. Electronic Network University: it is characterized by innovative strategic partnership in education and research.

The most promising direction of networking development is the virtual university which implies virtual mobility of students by including online courses of different universities in the educational program. This offers the prospect of creating and delivering joint online programs (Online Degrees) which became in high demand during COVID 19 pandemic. In this case students are granted the opportunity to study via online platforms from anywhere in the world and at their own time and pace. (Oganesyan, 2017; Koksharov et al, 2021). The highest level of the network university is electronic network university. The knowledge transfer and resources sharing between universities is of important need for providing a qualitative leap in the education system development (Francoa, Pinhob, 2019).

Many universities begin their path towards the virtual network university with including online-courses of other universities in the educational process and implementing different models of online-learning. The comparative study of the efficiency of such models as exclusively online-learning, blended learning, traditional learning with using online-courses as additional content has shown that there is no statistically significant difference between these models, but for those disciplines where the communicative component prevails the blended learning gives better results (Larionova et al, 2018; Chirkov et at, 2020). The blended learning model ensures flexibility and accessibility of learning for those students who have to balance work and study (Canals, Burkle, Toft, 2018). Moreover, it has proven its effectiveness during the emergency transition of all universities to distance learning (Larionova et al, 2020). However, there is a few problems connected with the technical equipment of universities, the readiness of teachers to use new technologies, students' concern, and their low motivation, (Shuklina, 2017), cultural diversity (Francoa, Pinhob, 2019).

Nevertheless, online learning technologies offer great benefits to all parties. MOOCs are now common practice along with lectures, practical classes, books from the library, etc. Students get opportunities to expand their learning experience and study at leading universities building their individual paths (Larionova et al, 2020). At the platforms of open education, they can easily find and learn what they are really interested in and what they need to for professional development (Canals, Burkle, Toft, 2018; Candrlic, Jaksic and Poscic, 2020; Cecchinato and Foschi, 2020; Gabriel, 2020; Gnaur, Hindhede, and Andersen, 2020). At the same time the role of teacher significantly changes. They are entrusted with such functions as coordinating the cognitive process in a virtual environment, designing new pedagogical approaches, choosing more effective learning technologies, advising in an individual curriculum planning, and managing educational projects. All this requires the development of new competences for teaching and using digital technologies (Degtereva, Chernysheva, Trofimova, 2019; Joyce, Simakov, 2020; Balida, Encarnacion, 2020; Daineko, Reshetnikova, 2020). Overall, the university benefits from network interaction with the leading universities and digital transformation of the educational process.

3. Methodology

The project Coursera for Campus program was launched at UrFU on February 2021 after signing a partnership agreement between the university and the platform. according to the agreement UrFU was granted 1500 licenses for teachers and students with unlimited access to 7672 online courses from different universities. The pilot project in the spring semester of the 2020-21 academic year involved 541 students from several institutes of UrFU and 52 teachers. At the start the project a special learning program was built on the Coursera platform. It included 172 online courses and 42 specializations. The catalog of courses in the program was formed according to the request of the heads of educational programs for the needs of the existing curricula considering the features of each educational program. Students were offered 1-2 compulsory courses for mastering during the semester and a free choice of additional courses as electives. Individualization of training was ensured by choosing the level of complexity of the course (intermediate / advanced) and the university - the developer of the course (for one discipline it was possible to choose courses from different universities in Russian or English).

The blended learning model was chosen to deliver programs using Coursera courses. Teachers supported the training of students on the platform, partly delivered face-to-face lectures, practical classes, and consultations, carried out regular monitoring of students' progress and conducted the final examination on the disciplines. Students were able to earn some credits by completion of the online courses depending on their workload and learning outcomes. These credits have been taken into account during the final exam.

A hotline was launched for organizational and technical support of students and teachers. Technical specialists assisted in registering students on the platform and finding the right course. Administrators provided support to students through the mailing service on the Coursera platform and regularly (every week) downloaded statistical reports from the platform. These reports contained data on student registration on the platform, their enrollment in courses, their activities, progress, and course completion, as well as information about acquired skills and competencies. Feedback from students was also collected through the platform in the form of course ratings, comments in forums and chats, and detailed feedback from individual students. All data was cleared and depersonalized before processing. To analyze empirical data, the authors used system analysis, methods of collection and processing of statistic data and tools of mathematical statistics.

4. Results and discussion

The use of online courses in the educational process in UrFU has significantly increased during the last 3 years. The number of students who took internal online courses has increased almost 5 times, and in the academic year 2019/2020 it was about a third of all UrFU students. The number of students who mastered external online courses increased by more than 2 times and accounted for about a sixth of UrFU students. So, the experience of UrFU in online teaching and learning was sufficient for quick project launch. Moreover, the local normative base related to using online courses in the educational process was created and approved by the rector of the university beforehand. During the COVID 19 pandemic there was launched Coursera for Campus for free that allowed all participants to test the platform (Larionova et al, 2020).

Coursera is an online platform that provides access to online courses from different universities and companies around the world (Coursera, 2021). Cooperation with more than 200 leading universities ensures the relevance and significance of the skills acquired. Upon completion, the student receives a diploma confirming the successful completion of the course. The effectiveness of using Coursera online courses is confirmed by a promotion, a salary increase or a gaining new position. The main advantage of learning on an online platform is the flexibility and accessibility of knowledge and skills acquisition. The best students can prove themselves in solving practical problems from employers, using the knowledge gained. They gain important practical experience, and the employer can already invite students from the student's bench to solve certain project tasks.

During the spring semester students have mastered 195 courses from 6 Russian universities (National Research University "Higher School of Economics", Saint Petersburg State University, Moscow Institute of Physics and Technology, Peter the Great St. Petersburg Polytechnic University, National Research Tomsk State University, National Research Nuclear University MEPhI), 28 foreign universities (California Institute of the Arts, Columbia University, Duke University, École Polytechnique, Emory University, Georgia Institute of Technology, Indian Business School, Johns Hopkins University, Lund University, Macquarie University, Michigan State University, The Hong Kong University of Science and Technology, University at Buffalo, University of Alberta, University of California, University of Colorado, University of Illinois at Urbana-Champaign, University of London, University of Maryland, University of Michigan, University of Minnesota, University of New South Wales, University of Virginia, Wesleyan University, Yale University, Yonsei University), and 12 IT companies (Amazon Web Services, Atlassian, Autodesk, Deep Teaching Solutions, DeepLearning.AI, E-Learning Development Fund, Facebook, Google, IBM, LearnQuest). A map of the network partnership in the project “Coursera for Campus” is shown in Figure 1.

Figure 1: A map of the network partnership in the project "Coursera for Campus": UrFU is marked in red, partner universities in blue

Most courses which were chosen by the heads of educational programs were created by universities from USA (53%). One third of courses belonged to Russian universities. The rest courses were distributed among universities from Canada (4%), Australia (3%), China (3%) and Great Britain, France, India, South Korea and Sweden (1%).

As for the distribution of courses by the knowledge domain the most demanded courses related to Computer Science (67 courses and 985 active enrollments) and Art and Humanities (11 courses and 785 active enrollments). Courses on Data Science attracted a little less learner (35 courses and 352 active enrollments), followed by courses on Business (28 courses and 249 active enrollments) and Informational Technologies (14 courses and 116 active enrollments). Substantially less number of students mastered courses on Personal Development (6 courses and 37 active enrollments), Physical Science and Engineering (11 courses and 21 active enrollments), Language Learning (11 courses and 17 active enrollments), Health (10 courses and 13 active enrollments). And very few students chose courses on Social Sciences (4 courses and 5 active enrollments) and Math and Logic (2 courses and 2 active enrollments). The distribution of online courses by the knowledge areas is presented in Figure 2.

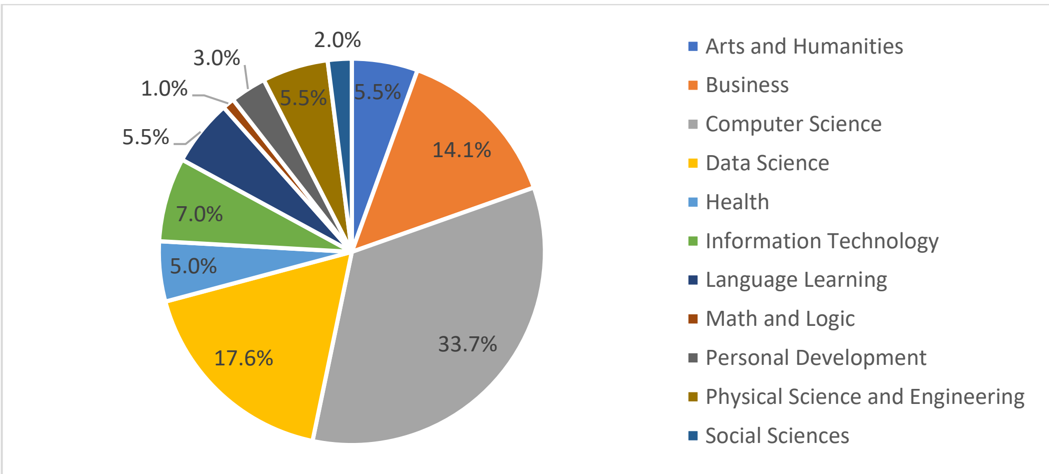

Figure 2: The distribution of online courses by the knowledge areas

As a rule, students of different UrFU institutes took online courses which correspond their educational programs. For example, the courses on Business were mainly taken by students of the Institute of Economics and Management, and the courses on Computer and Data Sciences were taken by students of the Institute of Radio

Electronics and Information Technology. But their choice of supplementary courses was based on the personal preferences of learning area.

The most important metric is the rate of courses' completion by students at the platform. The analysis has shown that a lot of students (42%) succeeded in completion of 4 and more courses, about 11% of students completed 3 courses, and 13,5% managed to get certificates for 2 courses. 10% of students have not passed the final examination, and 23% of students have got only one certificate (see Figure 3). If calculate a completion rate, on average, 85% of students completed the compulsory courses and 59% of students succeeded in completion of supplementary courses. The difference in completion rates for compulsory and supplementary courses reveals the difference in the external motivation and personal engagement of students. Nevertheless, the completion rate is higher than for learners who paid for access to the course at Coursera platform (the average completion rate is 55.4%).

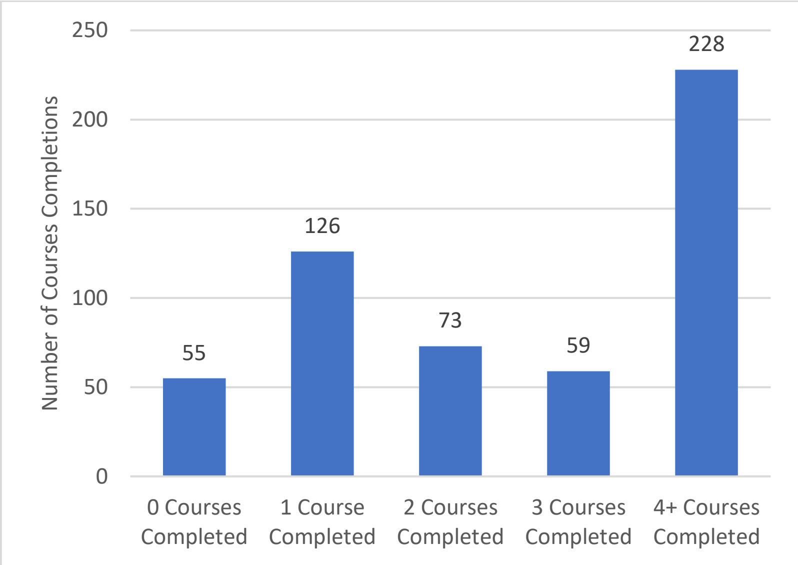

Figure 3: Completions of courses by student of UrFU at Coursera platform

The next step in the analysis is to study the features of the process of mastering courses by students. This can bring out difficulties that students faced and their typical behavioral pattern. As it is shown in Figure 4 the enrollments of students at the courses were uneven. Most of students enrolled at the required courses the end of spring semester (most of students have registered in May) and had to master them in a shorter period of time. It was to be supposed that the students faced to organizational problems when registered on the platform. They should have used their corporative e-mail to learn courses for free, but some of them registered by their personal e-mail address and could not connect the learning program. Another problem was the procrastination of students and their low motivation to learning. They are not used to plan their study and learn independently. It was one of the main problems in distance learning during the pandemic.

Therefore, the period of mastering different types of courses varied from 6 hours to 28 hours of working time at the platform Figure 5-7 show the average total time of mastering different skills by students. The most time-consuming were the skills in marketing and Business Analysis, Computer Programming and DevOps, Statistical Programming, Machine Learning and Probability & Statistics. These are the skills of the most demand in the digital economy conditions.

But the total time of mastering skills includes not only working time at the platform. Students needed to undertake some additional work to be a success in learning. Thus, to calculate the whole workload on mastering courses the working time at the platform was multiplied by 1,5 considering the preparatory independent work of students. So, the number of credits corresponded to the workload during mastering courses was equal to the students' working time at the platform multiplied by 1,5 and divided by 36 hours (one credit is equal to 36 hours in the Russian practice). These credits confirmed by certificates were accepted at the final exams.

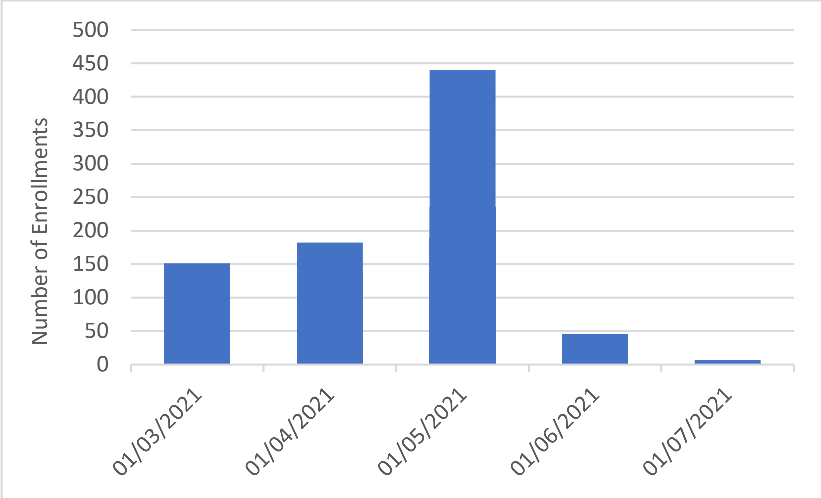

Figure 4: Enrollment of students for the courses

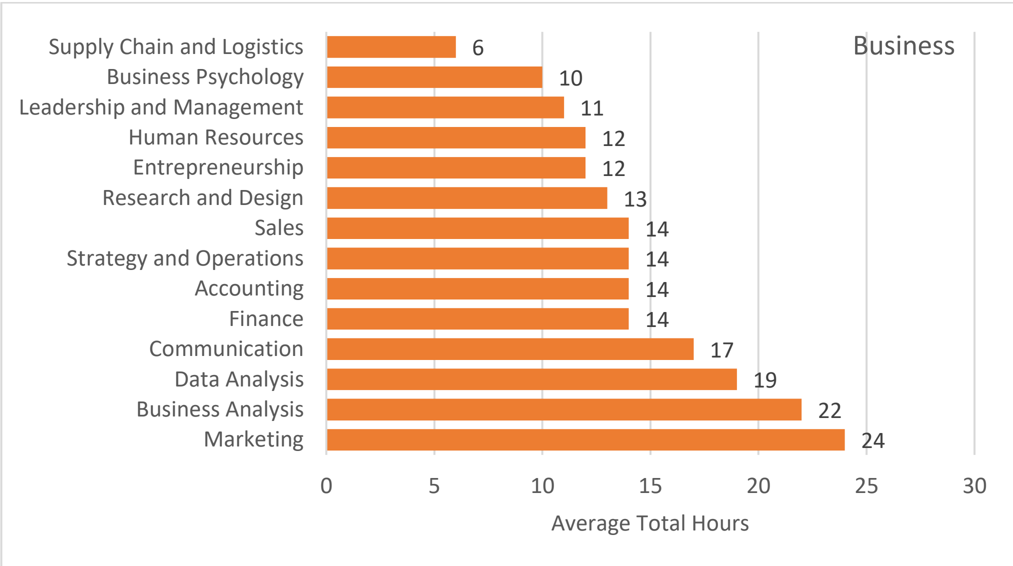

Figure 5: The average total time of mastering different skills in business

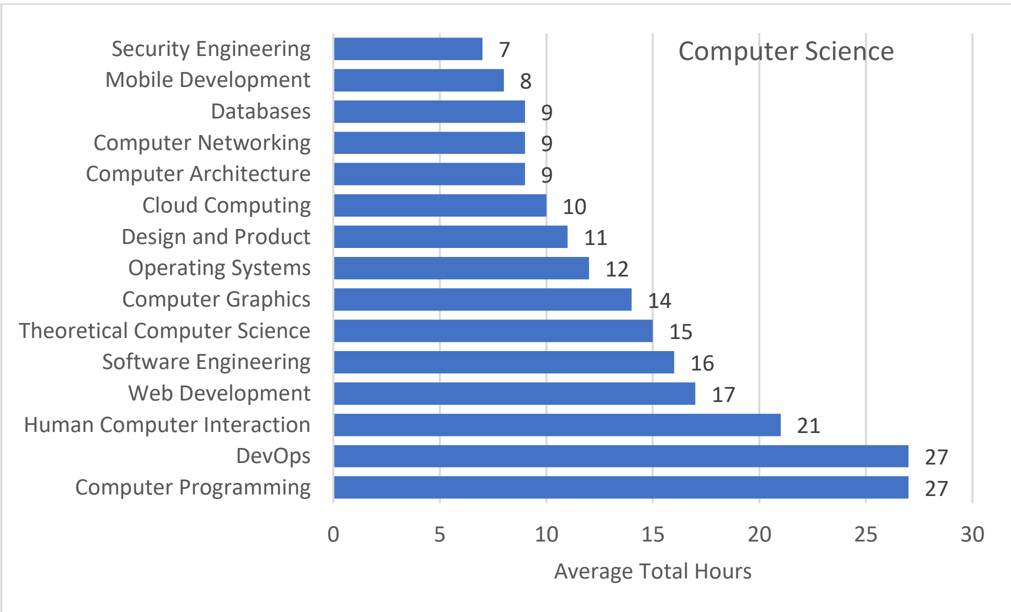

Figure 6: The average total time of mastering different skills in computer science

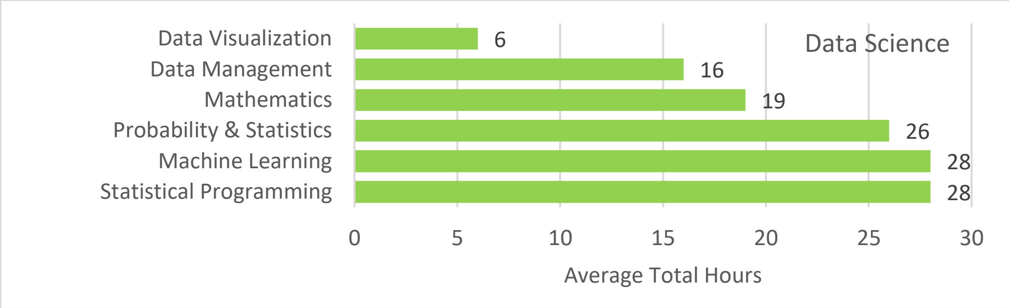

Figure 7: The average total time of mastering different skills in Data Science

To analyze the progress of students in mastering courses a frequency distribution chart was built based on the students' results of assessments (see Figure 8). As it is clearly seen from the chart while online learning at the platform students have passed about 16 thousand tests and got the highest score in more than half of assessments. This might be explained by the fact that all attempts of passing tests were taken into consideration. Many students made several attempts to get the highest score (see Figure 9). The analysis has shown that 74% of tests were passed at the first attempt, 14% of tests - at the second attempt, 10% of tests – at the third and fourth attempts, and a few tests required a greater number of attempts, but this was negligible. Overall, in 69% of assessments students have got excellent results, in 23% of assessments – good and satisfactory results, and only in 8% of cases students failed. This results in high academic performance of students and successful completion of courses. The average tests score with all attempts is equal to 84 points from 100. Taking into account only the last attempts the average score rises to 95 points from 100.

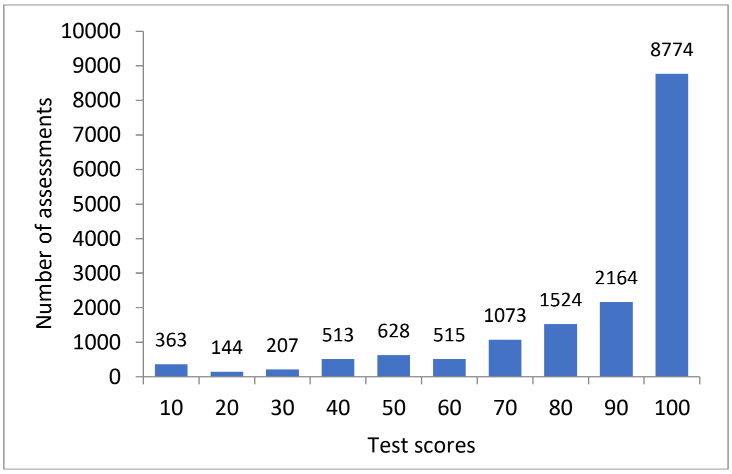

Figure 8: Frequency distribution chart of the assessment results

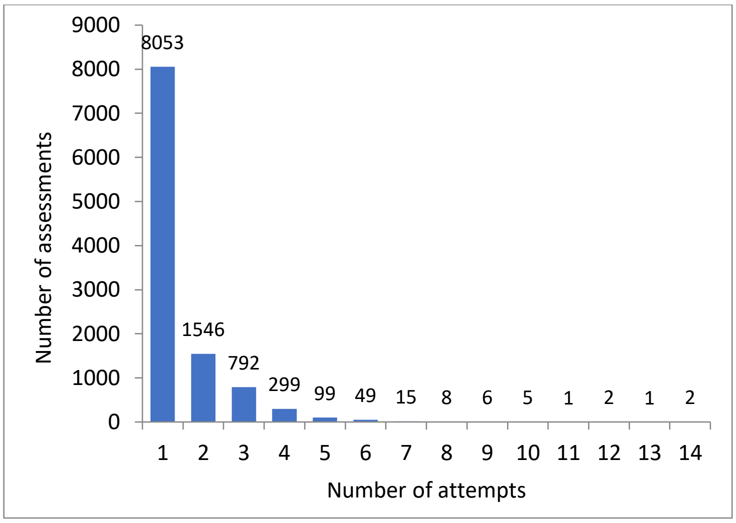

Figure 9: Frequency distribution chart of the attempt number of passing tests

High learning outcomes of students were confirmed by teachers of corresponding subjects as well. The following feedback was received from 47 from 52 teachers via a short questionnaire:

- 1. Students have learned the materials of online courses well (79% of teachers agreed with this statement).
- 2. Online courses make the learning process more interactive (84% of teachers agreed).
- 3. Students became more motivated (91% of teachers agreed).
- 4. Online courses allowed students to develop new skills (78% of teachers agreed).
- 5. Students have got the experience of academic mobility (88% of teachers agreed).

However, teachers also noted about certain disadvantages of online learning. Some teachers pointed out the following shortcomings:

- 1. It was easy to find online courses corresponded to my discipline at Coursera platform (61% of teachers disagreed with this statement).
- 2. Online courses contain adequate assessment tools (53% of teachers disagreed).
- 3. I trust the Coursera certifications which confirm students' learning outcomes (76% of teachers disagreed).
- 4. Students were able to master courses from leading foreign universities in different languages (58% of teachers disagreed).

At last, the satisfaction of students with online courses and blended learning was studied. For this purpose, we analyzed the feedback from students via forums and chats at the platform, launched a short questionnaire, and gathered individual reviews. The star rating of courses by students gave 4.6 from 5 on average that shows their high satisfaction with the courses. Students pointed out that the courses were interesting and helpful for them. Some students were excited to pass tests in courses and get new practical skills. 384 students responded the questionnaire which consisted of 5 assessment scales concerning their work at the platform: navigation, interface, flexibility, perception, and learning materials. The average grades on a five-point scale were: navigation - 3, interface - 4, flexibility - 4, perception - 4, educational materials - 5. However, the use of online courses in the educational process was quite new for students, so they noted the following difficulties:

- 1. Problems with registration at the platform and seeking the required course
- 2. Inaccurate translation of video-lectures from English to Russian
- 3. Delayed assessments
- 4. Some difficulties with following deadlines while mastering courses

These difficulties have been overcome, and students were able to quickly adapt to the new format of training. On the whole, they met it positively that was confirmed by individual reviews of 24 students. Let us give at the end of the paper a review of one student from Institute of Economics and Management of UrFU:

> *“Completing the courses on Coursera platform helped me to understand better some topics related to my specialty. The lectures were informative and accessible, and their presentations were very interesting for me. Also, tests and additional tasks after the video-lectures helped me to assimilate the material better. During learning the courses, I’ve learned much new, understood something better, revised the known information and consolidate my knowledge. The courses I took were useful to me, and the learning process gave me pleasure and satisfaction.*
>
> *Lecturers presented information in an accessible way. There are many courses on Coursera platform that would be interesting to take within the framework of our specialty, as well as for self-development. The platform is easy to navigate and has a clear interface. It would be interesting to take more courses from different universities all over the world.”*

5. Conclusions

UrFU have got the first successful experience of cooperation with international universities via Coursera platform. The project "Coursera for Campus", which was launched at UrFU in the spring semester of 2020-21 academic year, showed great opportunities that open up for the university the networking with the leading Russian and foreign universities. The introduction of online courses from 6 Russian, 28 foreign universities and 12 IT companies into existing curricula in a blended learning model has made it possible to expand the educational opportunities of students, individualize their educational paths and gain experience of virtual academic mobility. This experience was the first step of UrFU on the way to the network university, and the difficulties and problems faced by students and teachers gave impetus to the further transformation of educational activities. The results of the project have shown high students' performance, a sufficient completion rate of courses and significant satisfaction of students and teachers with the use of online courses in the educational process. Students were quickly involved in the learning process delivered by teachers from foreign universities and developed a variety of professional or personal skills. As a result, the development of UrFU in the direction of expanding network interaction between universities via Coursera will be strengthened, that will allow achieving synergistic effect from cooperation with leading Russian and foreign universities both in the field of education and research (UrFU, 2021).

The experience gained by UrFU can be adopted by other universities in Russia and allows them to develop themselves in the same direction. At the regional level, Ural Federal University can expect to attract new partners both from Russian universities and business companies, and at the global level - strengthening the university's brand and long-term relations with foreign universities.

References

Balida, A. R. and Encarnacion, R. (2020) "Challenges and Relationships of e-Learning Tools to Teaching and Learning", Proceedings of the 19th European Conference on e-Learning (ECEL 2020), pp 48-56. DOI: 10.34190/EEL.20.114

Canals, L., Burkle, M. and Toft, R. (2018) "Universities of the future: several perspectives on the future of Higher Education", International Journal of Educational Technology in Higher Education [online], https://educationaltechnologyjournal.springeropen.com/universitiesofthefuture

Candrlic, S. Jaksic D. and Poscic, P. (2020) "Do e-Learning Activities Increase Students' Academic Satisfaction?", Proceedings of the 19th European Conference on e-Learning (ECEL 2020), pp 80-88. DOI: 10.34190/EEL.20.039

Cecchinato, G. and Foschi, L. C. (2020) "Learning-Teaching Innovation of a University e-Learning Course?", Proceedings of the 19th European Conference on e-Learning (ECEL 2020), pp 89-94. DOI: 10.34190/EEL.20.052

Chirikov, I., Semenova T., Maloshonok N., Bettinger E., Kizilcec R.F. (2020) "Online education platforms scale college STEM instruction with equivalent learning outcomes at lower cost", Science Advances, Vol. 6, Issue 15, art. no. eaay5324. DOI: 10.1126/sciadv.aay5324

Coursera (2021) [online], https://www.coursera.org/

Daineko, L. and Reshetnikova, O. (2020) "Project Method - an Effective Instrument for Developing Competencies of Future Professionals", Proceedings of the 20th Professional Culture of the Specialist of the Future (PCSF 2020) & 12thCommunicative Strategies of Information Society (CSIS 2020), pp 221-230.

Degtereva, E., Chernysheva, A. and Trofimova, A. (2019) "Network University as a tool for the integration of higher education in the BRICS countries", Natural-Humanitarian Studies, No 23 (1), pp 25-28.

Francoa, M. and Pinhob, C. (2019) "A case study about cooperation between University Research Centers: Knowledge transfer perspective", Journal of Innovation & Knowledge, Vol 4, Issue 1, pp 62-69.

Gabriel, S. (2020) "Suddenly eLearning: A Qualitative Study of University Students During COVID-19", Proceedings of the 19th European Conference on e-Learning (ECEL 2020), pp 198-204. DOI: 10.34190/EEL.20.106

Gnaur, D., Hindhede, A. L. and Andersen, V. H. (2020) "Towards Hybrid Learning in Higher Education in the Wake of the COVID-19", Proceedings of the 19th European Conference on e-Learning (ECEL 2020), pp 205-211. DOI: 10.34190/EEL.20.093

Hawra, A. et al. (2020) "Measuring the Perception of Knowledge Gained During the Virtual Learning: Business Research Method Course Case Study", Proceedings of the 19th European Conference on e-Learning (ECEL 2020), pp 1-9. DOI: 10.34190/EEL.20.143

Joyce, E., & Simakov, A. (2020) "Trends in the development of higher education in Russia. Education", The science. Scientific Personnel, No 2, pp 213-216.

Koksharov, V. (2020) "The Pandemic Is a Chance to Revise the Principles of the Organization of the Higher School Network", University Management: Practice and Analysis, No 24(3), pp 5-6.

Koksharov, V. and Zagainova, E. (2020) "How University Management Changes During the Pandemic", University management: Practice and analysis, No 24 (2), pp 6-14.

Koksharov, V. et al. (2021) "The Pandemic as a Challenge to the Development of University Networks in Russia: Differentiation or Collaboration?", Voprosy obrazovaniya / Educational Studies Moscow, No 1, pp 52-73. DOI: 10.17323 / 1814-9545-2021-1-52-73

Lapshina, S. et al. (2020) "Increasing the Competency Requirements of University Graduates in the Digital Economy", ICERI 2020 Proceedings, pp 1708-1713.

Larionova, V., Brown, K., Bystrova, T., Sinitsyn E. (2018) "Russian perspectives of online learning technologies in higher education: An empirical study of a MOOC", Research in Comparative and International Education, Vol 13, Issue 1, pp 70-91.

Larionova V.A., Semenova T.V., Murzakhanova E.M., Daineko L.V. (2021) Ekonomicheskie aspekty vynuzhdennogo perekhoda na distantsionnoe obuchenie, ili Kakuyu tsenu zaplatili vuzy za distant [Economic Aspects of Emergency Transition to Distance Education, or The Price of Going Online in Higher Education]. Voprosy obrazovaniya /

Educational Studies Moscow, No 1, pp. 138–157 https://vo.hse.ru/data/2021/03/16/1399060284/Larionova,%20Semenova,%20Murzakhanova,%20Daineko.pdf

Moscow 24 (2021) "Putin suggested discussing the creation of network universities in Russia" [online]. Available at: https://www.m24.ru/news/obrazovanie/26032021/158382?utm_source=CopyBuf

Munusamy, M. and Hashim, A. (2020) "The internationalisation of higher education: a networking based conceptual framework", An International Journal of Asia-Europe Relations, Vol 6, Issue 1, pp 35-53.

Oganesyan, A. (2017) "New forms of university cooperation: international networks of universities", RUDN Journal of Economics, Vol 25, No 3, pp 354-366.

Shuklina, E. (2017) "Network University as a factor of regional development", 4th International Multidisciplinary Scientific Conference on Social Sciences and Arts, SGEM2017, 24 - 30 August, 2017, Conference Proceedings, Book 3, Vol 5, 359-366 pp.

UrFU (2021) "The university and Coursera will jointly promote educational programs" [online]. Available at: https://urfu.ru/ru/news/34685/

Can Zoom Replace the Classroom? Perceptions on Digital Learning in Higher Education Within IT

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Abstract: The Covid-19 pandemic has forced institutions of higher education to create digital learning environments replacing physical classrooms. The transition to digital teaching has been both abrupt and challenging for many lecturers and students. While communication and interaction between lecturer and student or among students are possible digitally, there is a difference between sitting physically next to your fellow students versus staring into a "black screen". This paper investigates experiences of online learning among students in higher education during lockdown. We conducted an online survey (n=200) among students in Norway studying for a bachelor's degree in information technology (IT). We emphasize students' experience of the digital learning environment through questions on attendance and participation in live lectures, use of recorded videos, use of chat and camera and their motivation for digital learning. The findings show that students to a large or very large extent (85%) follow live lectures, at the same time they also prefer that there are video recordings of the lectures. Furthermore, we see that the students are highly or very highly (65%) motivated for digital live lectures. Concerning student engagement, such as asking questions to the lecturer and answering questions from the lecturer in the Zoom-chat, we see that the answers vary greatly. They are distributed almost equally on the whole scale from a very small degree to a very high degree. Among our relevant contributions, we have learned that recording lectures is overwhelmingly considered positive among students and should be practiced when possible. Students rarely if ever turn on their cameras during lectures and do not expect others to show their faces. In general, among our respondents Zoom online lectures seem to work well, despite limitations to interaction and participation.

Keywords: digital learning environment, Zoom, live online lectures, higher education, online survey

1. Introduction

During spring of year 2020, the world had to react fast to a new virus. Generally called Covid-19, the pandemic led to widespread lockdowns in most countries. This meant that many educational institutions had to move from classroom teaching to online platforms in a very short time. The sudden transition to digital teaching has not only been a major transition for students, but also for lecturers, who at short notice had to rework teaching plans, tasks and activities related to teaching (König et al, 2020). This was challenging for many, a completely new situation and there was no time for preparations. This also raised other challenges. Students lost their jobs and had to move home to their parents or other locations. Some were without a suitable place to stay to attend digital lectures and work with school tasks. Compared to a classroom, where everyone sees each other and there is physical proximity, in digital lectures participants are anonymous and can hide behind a screen.

Digital teaching has recently become a topic in the public discourse. One example is a newspaper debate post written by a 25 years old Norwegian student (Pedersen, 2021). She encourages her fellow students to turn on their camera during lectures and write as following "I was shocked when I opened Teams for the first online lecture. There I saw only myself and the teacher". Another article (Svendsen, 2021) describes a study conducted within a higher education institution in Norway, which shows that seven of ten students turn off the camera. Moreover, students with "black screens" experience a lower learning outcome compared to those with camera on. Compared to a traditional classroom-setting, the amount of interaction is in many cases much lower and in some cases absent. We find this interesting and aim to provide some insights to this limited area of knowledge. In the present paper we ask the following research question:

How do IT students experience digital online education replacing in-person classes during Covid-19 lockdown?

To provide an answer to this question we have conducted an online survey among students within a higher educational institution in Norway (n=200).

2. Related work

From one day to the next at the start of lockdown, lecturers and students had to get used to a new life, with many challenges and a steep learning curve. A recent study (Zhou et al, 2021) investigates differences and similarities among lecturers and academic managers. The results show that both groups believed that digital technology could be beneficial to students and their motivation to adopt new approaches differed significantly. Various studies have investigated digital and remote learning, for instance online lectures, in comparison with in-person learning, like in a classroom-setting. Heldt et al (2021) found that in-person learning to a large extent is preferable over remote learning. This can be linked to general enjoyment, concentration during lectures, and participation in discussions.

As a result of Covid-19, online learning in higher education has suddenly become a centre of attention for many. This transition required that teachers in a short time acquired new knowledge and adapted the teaching to a new context (Scherer et al, 2021). New teaching methods and changes from a classroom setting can be experienced differently among students and lecturers. A study conducted in Germany (Klapproth et al, 2020) after teachers were required to do distance learning due to Covid-19, showed that they experienced medium to high levels of stress and most of them experienced technical barriers, but most of them felt able to cope with the stress. Female teachers also experienced significantly more stress than men. A study conducted by Gudmundsdottir and Hathaway (2020) emphasizing Norwegian and US teachers, shows that although teachers were inexperienced and unprepared for online teaching just before the pandemic, they were moderately prepared to use various digital tools, and there was a willingness for online learning to work for both themselves and students.

Hjelsvold et al (2020) has conducted a study in Norway, to study how lecturers experienced the transition from location-based teaching (face to face) to online teaching, after the pandemic. Almost all lecturers in the Computer Science (CS) field experienced a positive change. More than half of the CS lectures reported that they had previous teaching experience online, while almost three quarters reported having sufficient or partially sufficient competence required for the change. The main challenge was related to pedagogical challenges. The findings also show that some lecturers also highlighted characteristics of online teaching as better than campus-based teaching.

König et al (2020) investigated the impacts of Covid-19 from a teacher's perspective, through an online survey among early career teachers conducted in Germany in 2020. More precisely, investigated the role of digitization in an educational context during the lockdown situation. Findings from the study show that tools for information and communication technology, especially digital teacher competence and teacher education opportunities for learning digital competence, are instrumental in adapting to an online teaching context. Moreover, most of the participants reported that they had introduced new learning content, as well as assigning tasks and giving feedback to the students. Challenges that require ICT integration, such as online teaching and assessment, were overcome to a lesser extent.

A study taking the student perspective of useful digital technology in teaching and learning (Heldt et al, 2021) reveals 11 digital values ranging from flexibility of time and place, ease of organizing to learning in more visual forms, among other with use of video and drawing applications, and the opportunity to see (replay) lecture recordings afterwards. This testifies to the possibilities that lie in digital teaching, compared to traditional classroom teaching. Serhan (2020) found that a main positive aspect of online education perceived by university students was the flexibility it gives. The students experienced they could fit their studies better to their schedules, could attend from the comfort of your own home or wherever they wanted, and not have to show their faces all the time. However, asked how well they learned and engagement most students were negative towards the effects of using Zoom instead of a classroom setting. 61% disagreed on that Zoom improved their learning, while 10% agreed it did. Similar results were given regarding Zoom and building confidence in the subject and class content. The students also responded that Zoom had a negative effect on participation and engagement during a lecture, for example in discussions and interactions with the teacher or other students.

Raaen et al (2020) conducted an online survey among students working on a bachelor capstone project in IT. Because of Covid-19, they had to move their work and collaboration into digital environments, from one day to the next. The findings show that this sudden change had a significant perceived negative effect on collaboration, communication, and results – from a student perspective. Despite such a negative experience, the results in the form of grades were unaffected by the situation. This indicates that the students felt stressed and affected by the situation, but in practice handled this stress well.

However, the lockdown situation has led to challenges for both teachers and students. In many cases, students have not received the same training as teachers in terms of how to cope with the abrupt transition from classroom teaching to digital lectures. A study from Neuwirth et al (2020) comes with some practical suggestions on how to set up the teaching in a good way, as well as to activate the students. They propose a model and present various proposal that help maintain and improve the quality of student engagement, as well as the activity in the virtual classroom. Examples can be related to engagement of students by turning on their cameras, using the chat-function and discussions between students before and after lectures by answering questions related to the subject.

Castelli and Sarvari (2021) report challenges among most students, 90%, not turning on their cameras during synchronous sessions. The university where the research was done had a policy of making it optional but encouraging having the camera on since not having it on diminishes the educational experience. The students (n=276) were given a survey about why they chose not to turn on their cameras. Some of the main reasons had to do with their appearance, people in the household or the physical location being seen behind them, weak internet connection, that it was the norm, and that they felt people were looking at them the whole time. Castelli and Sarvari (2021) also refer to having cameras on being a benefit for both the teacher and student because of the nonverbal communication. Teachers are more satisfied when being able to see nonverbal responsiveness. Some report the feeling of "speaking to themselves" or "talking into a void" when students do not have their camera turned on.

3. Method

This paper uses an online survey as the source of data, focusing mainly on the quantitative results. However, we have also chosen to present some qualitative findings, through comments from the respondents. The purpose is to give a fruitful impression of the students' experiences. Findings beyond the citations in this paper will be presented in a forthcoming research paper.

3.1 Data collection

We conducted an online survey to reach as many students as possible. The respondents in this study are Bachelor students in information technology (IT). To get in touch with the students we presented our study during a lecture and briefly explained the purpose. Then, we published a link to the survey questionnaire and encouraged them to participate. We also clearly stated that participation is both anonymous and voluntary and that you can cancel at any time if desired. The survey was conducted in January-February 2021 and closed with 200 respondents. Not all respondents answered all the questions and therefore there are not 200 answers to each question. The completion rate was 85% and the typical time spent completing the survey was 8 minutes and 46 seconds.

3.2 Survey design

We developed the survey questions based on collaboration, communication and experiences linked to digital teaching, focusing on the changes after Covid-19. The survey consisted of 14 questions where several of the questions had sub-questions. We used a Likert scale, ranging from 1 (best) to 5 (worst). Several open-ended questions were also included, so that the respondents could offer qualitative comments and fruitful insights. We strive for a simple design, with precise and clear questions. A pilot test was also carried out in advance, precisely to ensure that the questions were understandable to the target group. A few adjustments were made after the pilot test.

3.3 The respondents

The respondents participating in the survey were Bachelor students in IT. 30% of those who conducted the survey were women, 69% were men and 1% did not want to state their gender. In terms of age, the distribution is as follows: 18-24 years = 48%; 25-34 years = 46%; 35-44 years = 5.5% and 45 years or older = 0.5%. 59% are in the 1st year of studies, 12.5% are in the 2nd year, 28% are in the 3rd year and 0.5% have answered "other". We also asked whether the students had paid work alongside their studies. Here, almost 35% answer that they do not work alongside their studies, approx. 30% work 1-10 hours a week and approx. 30% work 11-20 hours a week. 8% of the participants work more than 20 hours a week. In addition to this, we were interested in whether the students had a suitable place to sit when attending digital lectures. The results show that just under 80% always have a suitable place to sit, 20% sometimes and about 3% never.

3.4 Data analysis

From the survey we received both qualitative and quantitative data. This paper focuses mainly on the quantitative data. We chose to visualize the Likert data using divergent stacked bar charts (Heiberger and Robbins, 2014). These let readers view the balance of opinions at a quick glance. Further, we split all answers by the gathered background data. This included age, gender, year of study, hours of work outside studies and access to suitable workspace. These plots are not included, as they show no significant differences among the groups. Because the survey was originally in Norwegian, the authors have carefully translated each question and response option to English.

4. Findings

In this section we will present the findings of our study. Section 4.1 covers live online lectures versus recordings, Section 4.2 covers student motivation for digital learning and the last section, Section 4.3, covers students' perception of teachers in an online context.

4.1 Live online lectures versus recordings

The findings presented in Figure 1 show that the students to a large (29%) or very large extent (56%) follow live lectures, at the same time as they also prefer that there are video recordings of the lectures. The fact that recordings are made does not affect the motivation to participate live, and it is to varying degrees that the students look at the recordings when they have participated in a lecture.

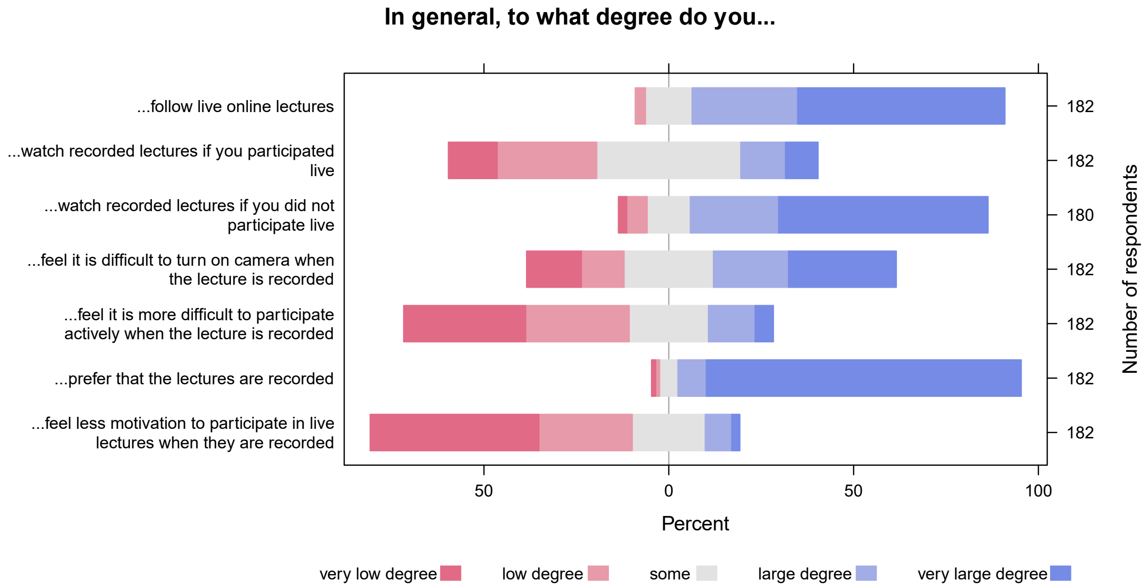

Figure 1: Answer distribution to questions about attendance in live online lectures as well as use of recordings

On the other hand, we see that those students who have not participated in live lectures, to a very large extent look at the video recording afterwards. As for the use of camera during lectures that are recorded on video, 15% say that it to a small or no degree makes it more difficult, 12% to a small degree, 24% to a medium degree, 20% to a large degree and 29% to a very large degree. Consequently, the majority answer that they find it difficult to have the camera on during recorded lecture. We further find that students do not find it more difficult to actively participate in the lecture, using audio and chat, when they know that it is recorded on video.

4.2 Student motivation for digital learning

Another key theme in this study was related to students' motivation. As Figure 2 shows, we see that the students are highly (35%) or very highly (30%) motivated for digital live lectures, but that very few of them have video on. Live lectures can be broken up with discussions, for instance by using the breakout-rooms function in Zoom.

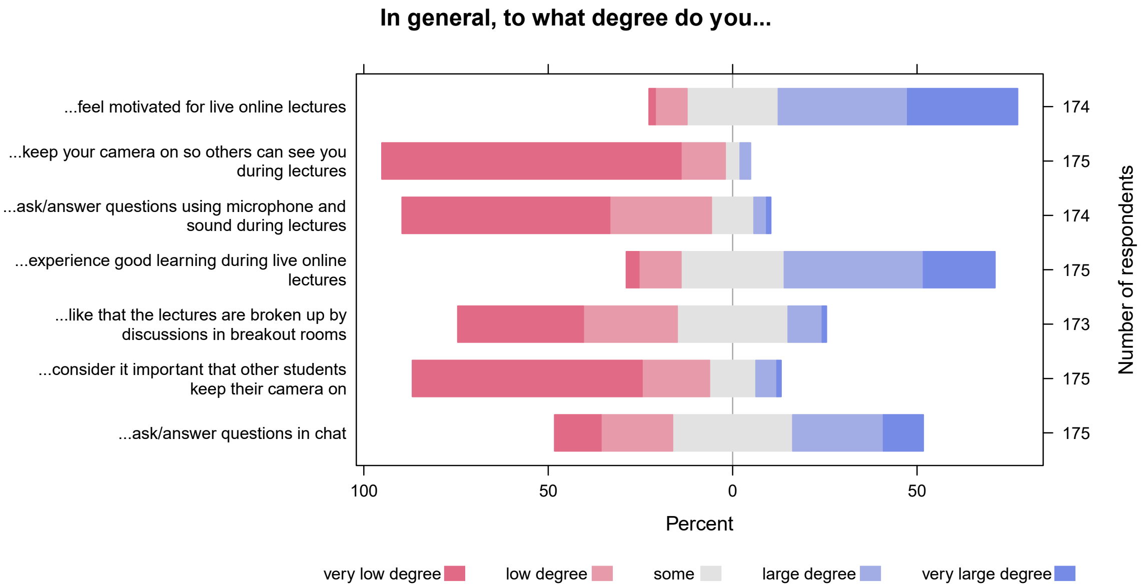

Figure 2: Answer distribution to questions about student motivation and active participation during live online lectures

The majority (almost 60%) of the respondents do not like it at all, while 30% like it to some extent. Only 10% like the use of breakout-rooms to a large or very large extent. Regarding learning that students receive through live lectures, we found that most students experience a medium to very high degree of learning.

When it comes to student engagement, by asking questions to the lecturer and answering questions from the lecturer in the chat in Zoom, the answers are distributed almost equally on the whole scale from a very small degree to a very high degree. In contrast to this, we see that very few ask questions or answer questions from the lecturer using sound/computer microphone.

4.3 Students' perception of teachers in an online context

Moving on to how students experience the engagement among lecturers during digital lectures, shown in Figure 3.

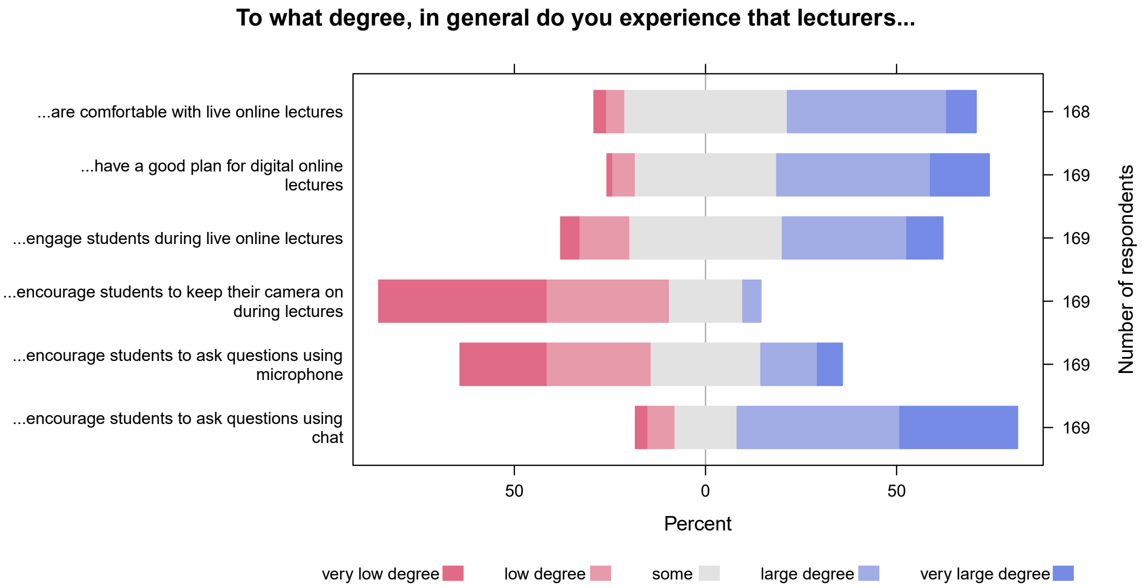

Figure 3: Answer distribution to questions about students' perception of teacher motivation for and competence with live online lectures

Regarding the extent to which the students experience that the lecturer engages the students during live lectures, we found that the majority experience from medium to very high degree. Few people believe to a very small or small degree. If we compare to traditional lectures in a classroom setting, we see that the students experience the lecturer's engagement in Zoom in varied ways. The majority answer from a small degree to a high degree. In general, they also experience that the lecturer has a good plan for live lectures, but that they do not encourage the students to turn on their own camera. 44% of the respondents answer that lecturers to a very low degree encourage students to turn on their video camera, 32% to a small degree and only 5% of the respondents state the lectures to a high degree encourage to turn on the camera.

On the other hand, they experience that the lecturer encourages the students to ask questions through the chat in Zoom. In contrast to this, students are less encouraged by the lecturer to ask questions by using sound/microphone. On the question related to the extent to which students experience that the lecturer enjoys digital live lectures, the findings show that the students largely experience that they like it.

5. Discussion

Returning to the research question in this paper: How do IT students experience digital online education replacing in-person classes during Covid-19 lockdown?

5.1 Live online lectures versus recordings

Lectures remain, now in digital form, a format the students know from before the lockdown. A lecture is an event in a student's study day which provides structure and an incentive to "get out of bed". These are usually followed by exercises, which now also are digital. We see that the great majority of students to a high or very high degree attend the online lectures indicating they see their importance and value. Even though they can watch the recording later, the great majority of students report they are not less motivated to watch live lectures. When the students are at home, thus without a physical study environment provided by the school, the lecture becomes one of the most concrete remaining parts of education, and an important regular event to structure study days around.

The great majority of students want the lectures to be recorded and it becomes especially important if they are unable to attend lectures. Those who have attended the lectures have less motivation to see the recording, which is reasonable if they grasped the concept the first time. It is also likely that students choose other resources for repetition. The internet provides many options for learning, and while the lecturer sets the expectations and framework it is good study technique to choose from a variety of sources.

As also found by Castelli and Sarvary (2021) most of our students choose not to turn on their cameras. However, we see an interesting distinction made by the students between participating actively and turning on the camera while the lectures are recorded. On the one hand, most of the students do not perceive the lectures being recorded as preventing them from participating, but on the other hand a great number of students find this as a reason to why it is difficult to turn on their cameras. They may understand active participation as simply attending and using the chat function in Zoom.

5.2 Student motivation for digital learning

In general, the students are motivated for digital learning and feel that they are learning well. They take advantage of the added flexibility as we have seen in previous work (Serhan, 2020), such as by participating as much as they are able and watching recordings if they cannot attend the live sessions. Our participants claim that their motivation to participate real-time does not suffer by having access to recordings. However, motivation suffers in other areas. All forms of interaction seem more difficult. From simply showing your face, and thus facial expressions, to actively speaking in an online lecture, the students avoid and dislike this. And while in a physical class relatively few may feel comfortable speaking in public in many of our classes, none choose to show their faces or speak by voice digitally.

Breaking up lectures to allow students to talk in smaller groups (breakout rooms) is also highly unpopular. Interestingly, we find that a large majority does not actually care if other students keep their cameras on during lectures. As such, the author of the opinion piece asking fellow students to turn on their cameras (Pedersen, 2021) seems to be in a small minority. This should maybe not be surprising. Students are used to only seeing other's backs during lectures, so they might see faces as a distraction. Participating in text-based chat is easier and somewhat more popular, but even this is limited. Thus, interaction and active participation is much more difficult online than in a physical environment. Exactly which consequences this has for general learning outcomes is not clear from our data. However, *active learning* is considered fundamental to learning within the field of pedagogy (Biggs, 1999). While this concept includes much more than being active during lectures and workshops, this is an important part. Thus, it is very likely that the lack of participation documented here will lead to some level of reduced learning.

5.3 Students' perception of teachers in an online context

The sudden transition to digital teaching has led to a major change for many lecturers. They had to acquire new knowledge and adapt the teaching to a new context almost overnight (Scherer, 2021). Such a change can affect the quality of teaching and the students' experience. As most students do not turn on their camera and taking into consideration what Castelli and Sarvary (2021) refers to regarding how teachers experience this, one could assume the teacher's motivation for holding a lecture could be lower. Our respondents are mostly happy with the teachers' performance, in contrast to some previous work that show teachers either unprepared or uncomfortable with digital teaching (Klapproth et al, 2020; Gudmundsdottir and Hathaway, 2020). Possibly because teachers within the field of IT are naturally experienced at using or learning new digital tools. Students too might be more comfortable with the tools because they are IT students.

In general, the respondents experience that the lecturer has a plan for live lectures and are prepared. The lectures also encourage the students to ask questions through the chat-function in Zoom, but to a less extent ask the students to turn on their computer camera. Digital teaching can be more monotonous and most of the attention is directed towards the lecturer. The students can to a greater extent hide behind the screen. Such an abrupt transition for lectures can lead to stress and uncertainty, in line with previous research (Klapproth et al, 2020). Moreover, the transition from location-based teaching to online teaching can cause issues related to pedagogical challenges (Hjelsvold et al, 2020). Both in terms of how to utilize the opportunities that exist, but also in relation to the knowledge of use, as well as to be integrated as part of the teaching context.

5.4 Bridging the results

While students are mostly happy with digital teaching, it leads to significantly less interaction between lecturer and students, as well as among students. Although the teaching offered due to Covid-19 was originally intended for traditional classroom lectures, students feel that the lecturer is prepared and have a plan for the lecture hours. The students may also experience better flexibility because the lecture is recorded and available on the learning platform at any time.

Despite this, there is a lack of physical presence and interaction, which are important features in a learning process. This is about, among other things, the learning the students receive beyond lectures, such as through informal conversations, discussions and group work including personal chats with fellow students. Classroom teaching is also, to a greater extent, designed for personal guidance and interaction in a learning process.

Our quantitative study does not directly ask the reasons to why students dislike breakout rooms, however, we may assume that the same reasons for them not to turn on their cameras in a lecture apply in the breakout rooms. Overall, we see that digital teaching works well for both teachers and students, but that there is a lack of completeness in terms of important elements beyond the lecturer talking to students and presenting subject matter.

6. Conclusion

As an alternative to traditional teaching, at a time when this was not possible, technology enabled teaching in higher education to continue, but under other conditions. We conclude that the consequences of Covid-19 and the abrupt transition to digital teaching have worked reasonably well from a student perspective. However, active learning is significantly more difficult compared to a traditional classroom-setting and students are more passive. Students become significantly less active and they are primarily listeners, although they are encouraged by the lecture to take an active role. Educational institutions understand the challenges Covid-19 has posed and facilitate learning in a different context. Recordings of lectures are greatly appreciated by students, but they do not favour exposing them self by using the camera or participate in group discussions in digital rooms. Digital teaching leads to some challenges in relation to how students experience that they are exposed in a new learning context and social presence has many advantages that is absent in digital environments. Perhaps counter-intuitively, it is clear that digital teaching, while often considered *the future*, when applied in practice leads both students and lecturers to revert to more traditional forms of teaching and learning. To dig deeper into this subject of interest in a forthcoming paper, we have planned thorough qualitative analysis of the open-ended comments from the respondents in this study.

References

Biggs, J. (1999) "What the Student Does: teaching for enhanced learning", *Higher Education Research & Development*, Vol. 18, No. 1 pp. 57–75.

Castelli, F. and Sarvary, M. (2021), "Why students do not turn on their video cameras during online classes and anequitable and inclusive plan to encourage them to do so", *Ecology and Evolution.* DOI: 10.1002/ece3.7123.

Gudmundsdottir, G. B. and Hathaway, D. M. (2020) "We always make it work": Teachers' agency in the time of crisis"", *Journal of Technology and Teacher Education,* Vol. 28, No. 2 pp. 239–250.

Heiberger, R. M. and Robbins, N. B. (2014) "Design of diverging stacked bar charts for Likert scales and other applications", *Journal of Statistical Software,* Vol. 57, No. 5 pp. 1–32.

Heldt, J., Agrawal, A., Loeb, R., Richards, M., Castillo, E. and Debonis, K. (2021), "We're Not Sure We Like It but We Still Want More: Trainee and Faculty Perceptions of Remote Learning During the COVID-19 Pandemic", *AcademicPsychiatry*.

Henderson, M., Selwyn, N. and Aston, R. (2017) "What works and why? student perceptions of 'useful' digital technology in university teaching and learning", *Studies in Higher Education,* Vol. 42, No. 8 pp. 1567–1579.

Hjelsvold, R., Nykvist, S., Lorås, M., Bahmani, A., and Krokan, A. (2020) "Educators' Experiences Online: How COVID-19 Encouraged Pedagogical Change in CS Education", *Norwegian Conference on Didactics in IT education (NOKOBIT),* Norway.

Klapproth, F., Federkeil, L., Heinschke, F. and Jungmann, T. (2020) "Teachers' experiences of stress and their coping strategies during COVID-19 induced distance teaching", *Journal of Pedagogical Research*, pp. 444–452.

König, J., Jäger-Biela, D. J., and Glutsch, N. (2020) "Adapting to online teaching during COVID-19 school closure: teacher education and teacher competence effects among early career teachers in Germany", *European Journal of Teacher Education*, Vol. 43, No. 4 pp. 608–622.

Neuwirth, L. S., Jovi, S., and Mukherji, B. R. (2020) "Reimagining higher education during and post-COVID-19: Challenges and opportunities", *Journal of Adult and Continuing Education*, pp. 1–16.

Pedersen, L. (2021) *Kjære medstudent, skru på kameraet!* Available at: https://www.vg.no/nyheter/meninger/i/X8W77W/25-under-25-kjaere-medstudent-skru-paa-kameraet (Accessed: 07 May 2021).

Raaen, K., Sørum, H., and Gonzalez, R. (2020) "IT bachelor capstone project during lockdown: Student experiences", *Norwegian Conference on Didactics in IT education (NOKOBIT*), Norway.

Scherer, R., Howard, S. K., Tondeur, J., and Siddiq, F. (2021) "Profiling teachers' readiness for online teaching and learning in higher education: Who's ready?", *Computers in Human Behavior,* 118, 106675.

Serhan, D. (2020) "Transitioning from Face-to-Face to Remote Learning: Students' Attitudes and Perceptions of using Zoom during COVID-19 Pandemic", *International Journal of Technology in Education and Science*, pp. 335–342.

Svendsen, N. V. (2021) *Har ikke fikset håret: Studenter gjemmer seg under digital undervisning*. Available at: https://khrono.no/har-ikke-fikset-haret-studenter-gjemmer-seg-under-digital-undervisning/545602 (Accessed: 07 May 2021).

Zhou, X. and Milecka-Forrest, M. (2021), "Two groups separated by a shared goal: how academic managers and lecturers have embraced the introduction of digital technologies in UK Higher Education", *Research in Learning Technology*, 29.

OPSCL: A Comprehensive System of Reviews for Chinese Learning Materials

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Abstract: The Online Platform for Successful Chinese Learning (OPSCL) is an online platform providing reviews of Chinese learning materials, with a focus on those available online and for free. The platform is fully bilingual in English and Chinese and comprehensive in coverage. All learning resources are described using a detailed ontology of categories and labels. The categories are organised in a tree-like structure, with 5 categories (Chinese characters, Mandarin, Cantonese, Chinese culture, and Hong Kong culture) at the top and specific subcategories (such as 'Mandarin » Reading comprehension » News') at the bottom. Each review consists of an 'objective' and a 'subjective' part: The objective part lists information such as the name, link, category, price, romanisation, and a textual description of the resource, accompanied by screenshots. The subjective part includes our estimate in terms of language level (on an 8-level scale based on Europe's CEFR) and a textual assessment of the quality of the resource. The reviews are original and in-depth, not only describing each learning resource but also situating it (where applicable) in the context of related learning materials and Chinese language learning in general. For example, our reviews comment on whether standard conventions for romanisation are followed and whether the use of visuals in YouTube videos is effective for the given target audience ('foreigners' vs heritage learners vs speakers of other Chinese topolects), compared to similar resources. Our platform contains a search interface that lets users search for resources by any combination of criteria derived from our ontology (such as the type of romanisation used and the language level targeted by the resource). Students have the option of rating the resources and writing their own comments, thereby supplementing our official evaluation. We also provide a 'self-assessment system' for 3 of our 5 top-level categories (Chinese characters, Mandarin, and Cantonese), which consist of extended questionnaires with the option to upload writing samples, recordings, and videos. Their purpose is to let students voluntarily provide information to our teachers to facilitate the selection of suitable learning materials for further study. Overall, the platform was designed with the goal of promoting independent language learning in mind.

Keywords: language learning, Chinese language, Chinese culture, independent learning, classification of learning materials, user reviews

1. Background and introduction

Given the rise of China on the global scene, Chinese has become more and more popular as a foreign language. (Gao, 2011) This market demand is mirrored by the well-known efforts of the Chinese government to open Confucius Institutes all over the world. Before proceeding, it should be noted that from a linguistic point of view, 'Chinese' refers to a group of mutually unintelligible languages (or dialect groups), the most widely spoken of which are Mandarin and Cantonese. Our project deals with both varieties. Learning Chinese poses unique challenges (Kane, 2006): First and foremost, Chinese characters pose great difficulty for learners, due to their demands on a learner's visual memory. Furthermore, Chinese dictionaries are difficult to use. In fact, Daniel Kane and Jane Orton have estimated that 'there [are] only 130 Australians of non-Chinese heritage who can speak Mandarin proficiently' (Das, 2019); note that the present population of Australia is about 25.8 million.

This shockingly low number deserves some explanation. Students of popular foreign languages such as French or Spanish will, after taking perhaps a year's worth of classes, be able to travel to a country where the target language is spoken and make swift progress by themselves. This has largely to do with the fact that new words which are first encountered auditorily will be reinforced when they are seen in written form, and vice-versa. The reason for this in turn is that these languages (and in fact most written languages) have more or less transparent writing systems. That is, the spoken and written forms correspond closely to each other and can to some extent be predicted from each other. In linguistic terms, one would say that the grapheme-to-phoneme mappings are transparent. The situation is radically different for Chinese (both Mandarin and Cantonese), where the writing system offers few phonetic cues for the learner. (However, things are not as dire for Chinese as they are for Japanese, whose writing system is the most pictographic one among those in present use.) Put simply, while parts of Chinese characters often give an indication about their semantic field and pronunciation, these are hopelessly vague. Also, people process writing systems phonetically instead of semantically, even the (somewhat picto-semantic) writing systems of Chinese and Japanese. (DeFrancis, 1984) A learner hearing a new vocabulary item in Chinese won't easily recognise it in its written form without explicit and dedicated study. Similarly, a new item first encountered visually won't easily be recognised in a conversation unless the learner made the laborious effort to look it up in a dictionary. A large number of Chinese textbooks is on the market. The reader can easily convince him- or herself of the great variety of English-language textbooks for Mandarin by doing a search in a search engine or online bookstore. Similarly, any visit to a Chinese brick-and-mortar bookstore will convince any sceptic of the large number of Chinese-language textbooks for Mandarin. (Given the limited fluency of Chinese learners estimated by Kane and Orton mentioned above, many of these are sadly inaccessible to the vast majority of learners.) In the experience of the authors of this publication as language educators, the quality of Chinese learning materials is all over the place. Of course there exist excellent materials, such as Zhu & Gao's (2013) grammar and Zhu's (2019) monographic treatment of the Mandarin aspect particle le [了]. What distinguishes the former is that it makes an explicit effort to relate the grammar of Mandarin to that of English, matching up corresponding grammatical constructions wherever possible and contrasting them elsewhere. What distinguishes the latter is the (remarkably successful) attempt at providing an exhaustive treatment of the trickiest and most confusing aspect of Mandarin grammar. Sadly, such truly excellent learning materials are few and far between; mediocrity is the norm. Our *Online Platform for Successful Chinese Learning (OPSCL)* is meant to address this issue by serving as a guide to Chinese (*ie* Mandarin and Cantonese) learning materials. It is an attempt to categorise and evaluate Chinese learning materials, so that any learner can find those that are most suited to them. We are targeting learners of all imaginable backgrounds ('foreigners', international school kids, heritage learners, speakers of other Chinese topolects, etc), since all of them can be found in Hong Kong. We focus on learning resources available online and free of cost simply because of the ever-increasing importance of online learning (García-Morales, et al., 2021; Hockly, 2015). Our online platform is designed for autodidactic learners as the target audience (Morrison, 2011) due to the growing availability of decent-quality learning materials suitable for independent language learners.

2. Design of the online platform

Here are two screenshots of our platform:

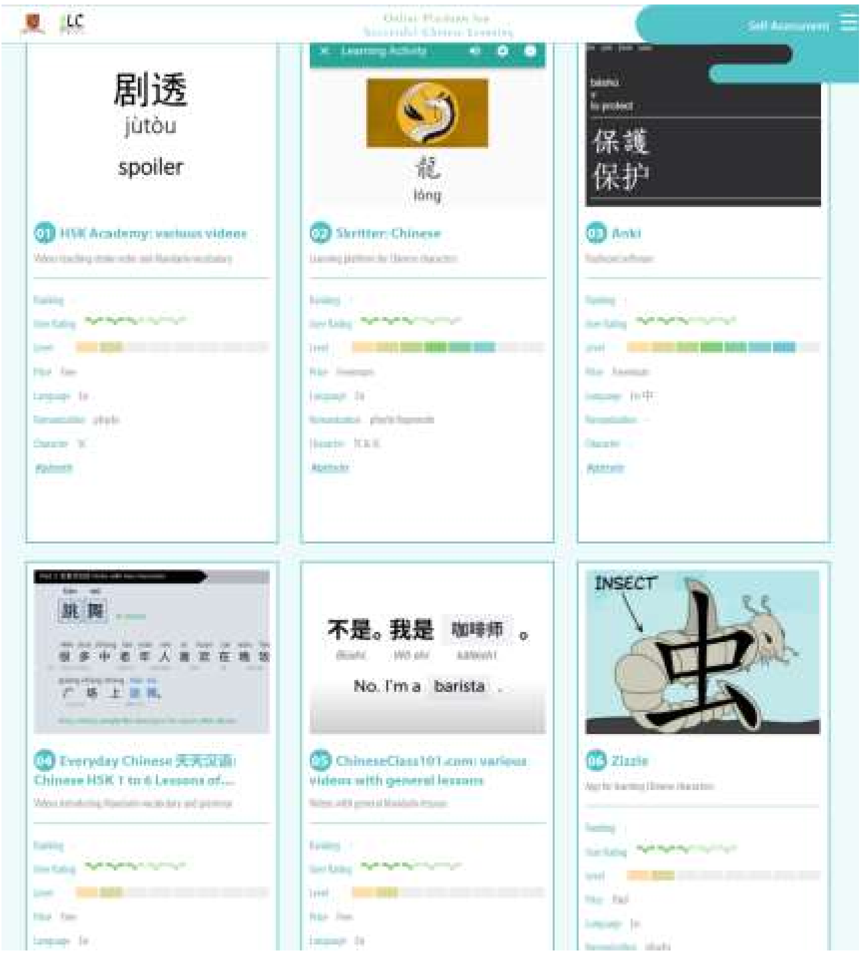

Figure 1: Listing of Chinese learning resources

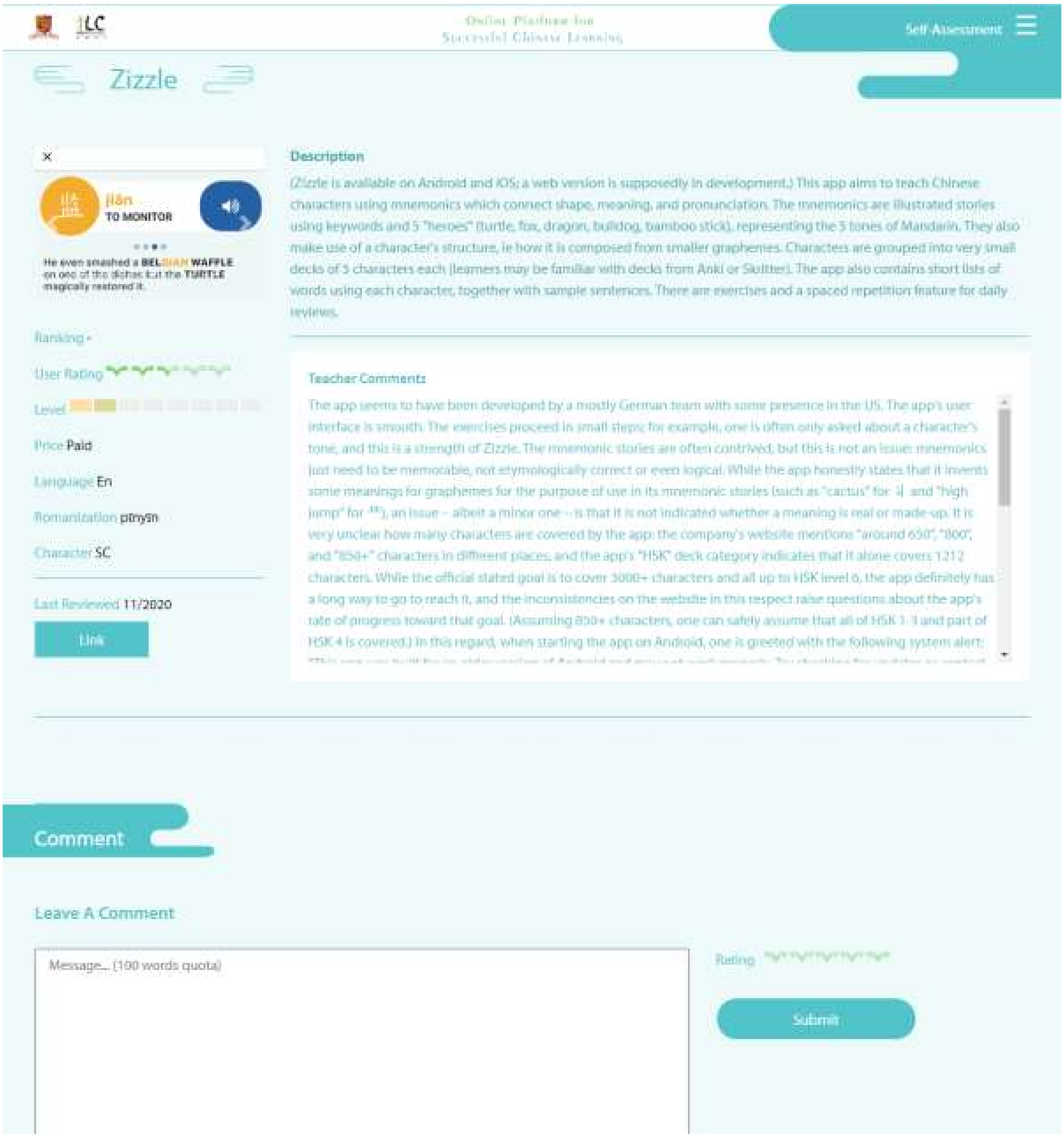

Figure 2: Review of an individual Chinese learning resource

(Our platform is fully bilingual in English and Chinese, but the Chinese version is not shown in the Figures in this paper.)

Figure 1 shows an overview of the learning resources we compiled in the category MANDARIN » VOCABULARY AND PHRASES, and Figure 2 shows a review of a Chinese learning resource, in this case the Chinese character learning app Zizzle.

Our online learning platform's central component is its accumulation of Chinese learning resources. Ancillary components are its comment functionality and our so-called self-assessment system, both of which will be explained later.

Learning materials were gathered through internet searches and by referring to existing online compilations, such as the excellent website Ling-Ling Chinese (Shih, 2020), which offers a large and partially annotated list of Chinese learning materials grouped into categories.

2.1 Categories of Chinese learning materials

Our platform groups Chinese learning materials into the following categories, sub-categories, and sub-sub-categories, arranged in a tree-like structure:

OPSCL
- Chinese characters
  - Introductory resources
  - Dictionaries and dictionary-like resources
  - Handwriting
  - Calligraphy
  - Exercise books and online exercises
- Mandarin / Cantonese
  - Textbooks and online courses/lessons
    - General
    - Business Chinese
  - Pronunciation
  - Vocabulary and phrases
    - Vocabulary
    - Phrases
  - Grammar
    - General
    - Differentiation of synonyms
  - Listening comprehension
  - Speaking
  - Reading comprehension
    - General
    - News
    - Bilingual reading
  - Writing
  - Dictionaries
  - Test prep [only for Mandarin]
    - HSK (汉语水平考试)
    - HSKK (汉语水平口语考试)
    - BCT (Business Chinese Test) / 商务汉语考试
    - TOCFL (Test of Chinese as a Foreign Language) / 華語文能力測驗
    - *etc*
- Chinese culture
- Hong Kong culture

Figure 3: Taxonomy of categories for learning materials about the Chinese language and culture

Chinese characters are used in Mandarin, Cantonese, and many other Chinese languages. Hence, the top-level category CHINESE CHARACTERS exists specifically for materials which focus on character knowledge and are not or only little about other aspects of Mandarin or Cantonese. The existence of CHINESE CHARACTERS » DICTIONARIES AND DICTIONARY-LIKE RESOURCES alongside MANDARIN » DICTIONARIES and CANTONESE » DICTIONARIES is justified by the distinction between character dictionaries (*zìdiǎn*/字典) and (ordinary word-based) dictionaries (*cídiǎn*/词典) for Chinese. This distinction derives from the fact that Literary Sinitic (commonly referred to as Classical Chinese) is a largely character-based and hence mostly monosyllabic language, which gave rise to character-based dictionaries. The resulting character- (instead of word-)oriented way of doing lexicography is linguistically unfortunate but persists until the present day. In any case, our taxonomy of learning materials needs to reflect the reality of the persistence of character-based dictionaries, irrespective of whether we like it.

The distinction between HANDWRITING and CALLIGRAPHY may seem natural from a Western perspective, but in Chinese, both can be referred to using the same word *shūfǎ* [书法]. We would hence like to draw attention to this distinction, since our platform is bilingual. In Hong Kong usage, the word 'Mandarin' is often used to refer to only spoken Mandarin (corresponding to the Chinese word *pǔtōnghuà*/普通话), while written Mandarin is called 'Chinese' (corresponding to the Chinese word *zhōngwén*/中文). Of course, our top-level category MANDARIN comprises both spoken and written *guānhuà*/官话 (this is the Chinese linguistic term for the Mandarin dialect group of Chinese), but Hong Kong users may want to take note. Incidentally, this confusion is rooted in the misconception that there exists only one written Chinese language, while the spoken varieties are mere 'dialects' of each other – though this paper is not the right place to delve into this issue. Under VOCABULARY there are two types of resources: those which present vocabulary thematically (organised by topic) and those which present it in a graded way (by difficulty, exam level, or frequency). The category PHRASES typically includes phrasebooks and similar materials targeted at travellers. LISTENING COMPREHENSION includes materials that come with audio recordings or videos. Online videos are counted if they showcase at least intermediate-level authentic conversations. SPEAKING includes collections of dialogues on a specific topic. Online videos are counted if they go beyond the phrase level and contain at least intermediate-level topical dialogue or reporting. BILINGUAL READING is for bilingual books, pairs of books with identical content in different languages, and bilingual websites. This category excludes news. As for WRITING, there are mainly 2 types of resources: those that focus on grammar and those that focus on style. The sub-sub-categories under TEST PREP refer to Chinese language proficiency exams. Resources about Cantonese culture (*ie* the culture of Guangdong Province) are categorised only under HONG KONG CULTURE, not under CHINESE CULTURE, for the sake of simplicity. (However, in general resources can and do appear simultaneously under multiple categories in our taxonomy depicted in Figure 3.)

2.2 Format of each entry

Each entry for a Chinese learning resource consists of two parts: objective information and subjective information. The objective part includes: a short description, the name (or bibliographic information in the case of books), a link (for online resources), the price, the written language, the spoken language, the choice of romanisation, the character set (traditional vs simplified), a descriptive paragraph, and screenshots. The subjective part includes an indicator of the language level/difficulty, a review paragraph, a star rating, and a 'last reviewed' date. Here is an example of an underlying database entry, specifically the one for the app *Zizzle*:

to be filed under:	CHINESE CHARACTERS » EXERCISE BOOKS AND ONLINE EXERCISES
to be filed under:	MANDARIN » VOCABULARY AND PHRASES » VOCABULARY
short description:	app for learning Chinese characters
name:	Zizzle
link:	https://www.zizzle.io/
cost:	HK$78/mo, HK$198/3mo, HK$468/yr
lang-wr:	En
lang-spk:	<none>
rom:	pīnyīn
charset:	简
descr:	(Zizzle is available on Android and iOS; a web version is supposedly in development.) This app aims to [...]
screenshots:	`<Zizzle-01.tif>`, `<Zizzle-02.tif>`, [...]
level:	L1-L2
review:	The app seems to have been developed by a mostly German team with [...]
star rating:	<initially unassigned>
last reviewed:	2020-Nov

Figure 4: Database entry for a Chinese learning resource (*Zizzle*)

The app *Zizzle* thus appears in our system in three different ways: in a summary view (Figure 1), in a detailed view (Figure 2), and in the database underlying our platform (Figure 4).

As for the COST, it should be noted that a lot of online resources nowadays follow a 'freemium' model: a basic version is free of cost, while a feature-rich version is offered for pay.

As for the WRITTEN LANGUAGE, this item indicates the user interface (UI) language in the case of websites whose main function is to provide content such as news articles. For example, irrespective of whether a website provides English or Chinese essays, its user interface (the buttons, section headings, etc) can be English or Chinese or bilingual. For online videos, the En [English as a WRITTEN LANGUAGE] label signifies at least the presence of an English translation, whereas the 中文 [Chinese as a WRITTEN LANGUAGE] label is used only if explanations (*eg* definitions of vocabulary items) are given in Chinese. WRITTEN LANGUAGES other than English and written Chinese won't have labels (but might be mentioned in the description or review text). In this regard, written Cantonese (粵語白話文 (粵文)) is a very attractive candidate for an additional WRITTEN LANGUAGE resource label, but there is a severe shortage of instructional online materials in this language. (For those interested in an example, one notable such resource goes by the name *Cantonese Museum* (廣東話資料館).) There are however many non-instructional materials written in it, such as blogs. For information on how written Cantonese is distinct from Mandarin or standard Chinese, see the book *Cantonese as Written Language* (Snow, 2004).

For online videos, SPOKEN LANGUAGE labels are used only if spoken explanations (*eg* about grammar) are given in the respective language or the main content of the video is spoken content (normally: dialogue, a speech, or narrative content (such as reporting)) in the target language. That is, mere reading aloud of on-screen definitions (*eg* of vocabulary items) in a language doesn't count. SPOKEN LANGUAGES other than English, Mandarin, and Cantonese won't have labels (but might be mentioned in the description or review text).

We chose to have labels for the nowadays most commonly encountered systems of romanisation. For Mandarin, these are: pinyin (Hanyu Pinyin), bopomofo, Wade-Giles, and Gwoyeu Romatzyh (GR). For Cantonese, these are: Jyutping, Yale, and the Guangdong Romanization. As for the CHARACTER SET, quite a few resources don't only use traditional or simplified characters (or both), some use mainly one of the two character sets but supplement it with the other whenever there are differences. For example, a dictionary might be in simplified Chinese characters and indicate traditional Chinese characters in brackets only whenever they are different.

We decided on the following 8-LEVEL system of proficiency descriptors, derived from the CEFR (Council of Europe, 2001; 2020), which has 6 levels.

L1	CEFR A1	HSK levels 1-3
L2	CEFR A2	HSK levels 3-4
L3	CEFR B1	HSK level 5
L4	CEFR B2	HSK levels 5-6
L5	CEFR C1	TOCFL level 5
L6	CEFR C2	TOCFL level 6
L7	very advanced	refining idiomatic accuracy
L8	highly advanced	perfecting one's knowledge

Figure 5: Proficiency level indicators

We picked this enhanced system described in Figure 5 not because Chinese is fundamentally different from European languages, but to reflect the fact that there are 'expert' levels of knowledge that go beyond ordinary 'high' proficiency.

As for how to rate resources, we initially rated some on a scale from 0 to 5 stars but in the end decided to not give out initial RATINGS. They will be assigned (and later adjusted) by us based on student feedback. Also, our own resources (*ie* those by CUHK's Independent Learning Centre) won't be rated, for the obvious reason that we wouldn't be impartial judges of the products of our own mental efforts.

Finally, we should note that many of our linguistic labels don't apply to resources that are purely about culture (under the CHINESE CULTURE and HONG KONG CULTURE top-level categories).

2.3 Other functionality of our online platform

The user can search for resources in various ways, for example by specifying labels and by indicating a range of proficiency levels. Students can also rate our resources and write comments and reply to other students' comments.

We provide a 'self-assessment system' for the following 3 of our 5 top-level categories: Chinese characters, Mandarin, and Cantonese. These consist of extended questionnaires with the option to upload writing samples, recordings, and videos. Their purpose is to let students voluntarily provide information to our teachers to facilitate the selection of suitable learning materials for further study.

The actual questions are inspired by the CEFR's level descriptors (Council of Europe, 2001; 2020). They are very detailed and are intended to determine a student's level in the four language skills and other areas with respect to our own 8-level system. For example, we ask about a student's languages spoken at home, languages formally studied, languages used in their schooling, character knowledge, knowledge of Chinese character input methods, self-rated level of proficiency in the four language skills, language learning activities, and more.

The intended use of the self-assessment system is that a student's self-evaluation combined with the optional teacher-based evaluation of the student's uploaded content lets us recommend resources for further study that are intended to fit the specific learner as best as possible. This process might even be partly automated; this part of our project is open-ended.

3. Characteristics of existing Chinese learning resources

This section summarises observations about things commonly done wrong and about good practices we would like to see more of. It is based on our investigation of around 200 resources for learning Chinese.

3.1 Common flaws

There are some common themes with respect to what needs to be done better. We wish content creators were more aware of these points.

Romanisation mistakes are very common. Also, words in pinyin should have their syllables aggregated ('*pǔtōnghuà*' instead of '*pǔ tōng huà*'). Resources for Cantonese tend to have more romanisation mistakes than those for Mandarin.

Many Mainland-Chinese instructional websites rely on older internet technology, such as Java applets and Adobe Flash. If such technologies later become outdated (as has happened in these two cases), these resources can no longer be fully used. This is a pity, as the underlying content is still there and often is of a textual nature. Part of the appeal of online learning is to make education more accessible to the masses, but unfortunately, much instructional online content doesn't persist.

A similar issue is that, if development of the online content is discontinued, which happens often, the content becomes inaccessible due to maintenance issues or software security updates. In fact, many language learning apps are not well thought-out and are prematurely discontinued, making them useless for anyone but true beginners. Apps which are not maintained will become unusable on older phones due to updates to their operating systems.

Instructional YouTube channels tend to have characteristic problems. Many of them have videos which don't exceed a low-intermediate language level. This may have to do with an audio-visual teaching modality being more suitable for beginners, but we believe that such videos don't lead the learner far enough in the journey to master the Chinese language. Some YouTube videos teaching vocabulary use speech synthesis and automatically generated pronunciations, which are full of mistakes. For example, many Chinese characters have multiple pronunciations (*duōyīnzì*/多音字), and an automated system might pick the Mandarin pronunciation *liǎo* for the character 了 instead of the much more common *le*. Some YouTube channels with instructional videos have videos which are irrelevant to language learning. For example, some channels with Chinese language lessons have videos where the host talks in English about traveling through China. Learners need to be aware of this.

3.2 Best practices

Despite the flaws enumerated above, some learning resources do a very good job. We believe that keeping these things in mind can significantly improve the Chinese learning experience.

The best resources make use of frequency information: they teach the most common words, phrases, and idioms, and they might even teach them in the order of frequency in the language.

There seems to be a surge in YouTube-based course offerings, some of which exhibit great creativity. YouTube videos can be surprisingly effective at simulating real classroom teaching, except for the interactional element. It helps immensely when videos have all of the following in their subtitles: a phonetic transcription, Chinese characters, and an English translation. All learners except for very advanced ones benefit from thorough phonetic annotations of texts and from translations. For non-advanced learners, it can be beneficial to not teach Chinese monolingually in Chinese.

Bilingual news are an excellent but underused learning resource. There are enough bilingual Chinese-English news articles on the internet to keep even the most voracious learner busy for a long time. By the way, making such textual content pastable makes it easy for the learner to look up expressions in a dictionary.

4. Limitations

Regarding the user interface of our platform, we are still experimenting with proper search functionality and the best way to display the many screenshots of the learning resources which we are reviewing. Even though we presently cover around 200 Chinese learning resources, there are many more out there. We haven’t yet completed our research into Cantonese learning resources, and we are still in the process of compiling resources about Chinese and Hong Kong culture. The former process is very manageable in scope, but the latter is uncharted territory, given the fact that ‘culture’ is an ill-defined and hence open-ended term. We are also still looking into the proper design of our self-assessment system: if we ask the students too many questions, we will create a cumbersome experience for them; if we ask too few questions, we might not be able to fully utilise the intricate system we built. Finally, we don’t yet know how easy it will be to moderate the comment functionality of our platform.

5. Conclusions and future development

Our system is a large repository of original reviews for Chinese learning materials. Our coverage is comprehensive (with 191 reviews to date), our infrastructure of categories and labels is novel, and our reviews are detailed, thus providing an ideal resource for independent language learners in the age of online learning.

Many online reviews of language learning resources seem to have been written impressionistically, *ie* without the writer really trying out the resource in depth. In this regard, we hope that our platform will fill an important gap.

There are many ways we can go from here in terms of future development of the platform. Our platform’s reviews can be further annotated with resource-specific usage instructions, where applicable. We can look into ways of adjusting our resource ratings based on actual stories of user success or failure. It would be interesting to not only give suggestions for resources to use, but also suggest entire learning paths through which we can guide the learner. Last but not least, we can use the knowledge we gain from using our platform to develop insights into how to design brand-new learning resources for Chinese.

Acknowledgements

This project was supported by the Teaching Development and Language Enhancement Grant (TDLEG) for the 2019-2022 triennium by Hong Kong’s University Grants Committee (UGC).

References

Council of Europe. (2001) Common European Framework of Reference for Languages: Learning, teaching, assessment. Cambridge University Press.

Council of Europe. (2020) Common European Framework of Reference for Languages: Learning, teaching, assessment – Companion volume. Strasbourg: Council of Europe Publishing.

Das, S. (2019) Are there only 130 Australians of non-Chinese heritage who can speak Mandarin proficiently?, RMIT ABC Fact Check. [Online] Available at: https://www.abc.net.au/news/2019-06-24/fact-checka-are-there-only-130-people-who-can-speak-mandarin/11235484 [Accessed 27 May 2021].

DeFrancis, J. (1984) The Chinese Language: Fact and Fantasy. University of Hawaii Press.

Gao, H. (2011) An Analysis of the Phenomenon of Global "Mandarin Fever". Asian Social Science, 1 December, 7(12), pp. 253-257.

García-Morales, V. J., Garrido-Moreno, A. & Martín-Rojas, R. (2021) The Transformation of Higher Education After the COVID Disruption: Emerging Challenges in an Online Learning Scenario. Frontiers in Psychology, 11 February, Volume 12, Article 616059.

Hockly, N. (2015) Developments in online language learning. ELT Journal, July, 69(3), pp. 308-313.

Kane, D. (2006) The Chinese Language: Its History and Current Usage. Tuttle.

Morrison, B., ed. (2011) Independent Language Learning: Building on Experience, Seeking New Perspectives. Hong Kong University Press.

Shih, L.-L. (2020) Ling-Ling Chinese. [Online] Available at: https://ling-lingchinese.com/ [Accessed 27 May 2021].

Snow, D. (2004) Cantonese as Written Language: The Growth of a Written Chinese Vernacular. Hong Kong University Press.

Zhu, C. (2019) Chinese Aspectual Particle le: A Comprehensive Guide. Hong Kong University Press.

Zhu, C. & Gao, Y. (2013) A Chinese Grammar for English Speakers. Peking University Press [北京大学出版社].

Studying Algorithmic Fairness in Moodle Learning Analytics Using Code Analysis

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DOI: 10.34190/EEL.21.136

Abstract: Online learning platforms gained popularity in recent years. These platforms often provide learning analytics, which offer educators prediction on students' progress. For this purpose, machine learning algorithms are employed. As machine learning reproduces bias from the training data, such systems can potentially deliver unfair or discriminatory results. If the system outcomes are used to provide assistance or guidance to learners or if they influence educators' grading decisions, biased predictions affect students notably. It is therefore necessary to assess the fairness of learning analytics systems, especially when they use machine learning. There are different ways to assess fairness of systems. In this paper, we discuss fairness assessment using code analysis. While it has been shown multiple times using real world training data that machine learning systems are biased and potentially unfair the objective of code analysis without the use of training data is to show the fairness of a system and its limitations. Code analysis thus complements the existing data driven fairness metrics. We propose a code analysis procedure to study the algorithmic fairness that consists of acquiring code and documentation, identifying and description of relevant system components, and fairness risk assessment. We conclude that the use of code analysis for the purpose of fairness auditing requires specialized knowledge about the application domain, programming, and machine learning. It is very time consuming and dependent on quality of code documentation. We apply this approach on Moodle, a widely used open-source platform, and propose a code analysis procedure to study the algorithmic fairness of Moodle learning analytics. We identify relevant components (learning analytics is only a tiny fraction of the Moodle system), exam their role, and discuss the effect of data and user on fairness. Our analysis shows that Moodle learning analytics does not use protected attributes such as age, gender, or ethnicity. However, users must be aware of other potential fairness aspects. Furthermore, user's knowledge about machine learning, and evaluation metrics effects the fairness.

Keywords: Moodle, learning analytics, algorithmic fairness, code analysis, machine learning

1. Introduction

Learning analytics assists educators to evaluate and support students. To protect students from discriminatory, unfair treatment, it is crucial that these systems act fairly. Assessing data driven systems for fairness has become a widely discussed challenge. The European Union has recently proposed a framework for the regulation of artificial intelligence (AI) (European commission, 2021), stressing the importance of fairness especially for high-impact sector applications. In public discussions on the fairness of AI systems a call for code audits is often heard, reflecting the wide-spread opinion, that if only adequately trained experts had access to the source code, system fairness could be evaluated, even certified (Datenethikkommission der Bundesregierung, 2019; Stenkamp and Skierka, 2019). The outcome of such code audit is expected to be a recommendation on whether the system is fair, or under which circumstances it is not. In this paper we aim to discuss how code analysis can contribute to assessing algorithmic fairness. We will explore the process, benefits, and limitations of code analysis by applying it to the learning analytics functionality of Moodle.

2. Theoretical background

2.1 Learning analytics and algorithmic fairness

Siemens and Long (Siemens and Long, 2011) define learning analytics (LA) as "the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs". LA-applications and their importance have risen quickly in recent years (Dawson et al., 2019), many studies aim to predict student success (Cambruzzi, Rigo and Barbosa, 2015; Lu et al., 2018; Xing et al., 2015).

Fairness of AI systems can be measured on an individual, a group, or a subgroup level (Mehrabi et al., 2019). Several toolkits have been proposed to measure fairness, e.g., (Bellamy et al., 2018; Madnani et al., 2017; Saleiro et al., 2018). Fairness in learning analytics has been studied for graduation prediction (Anderson, Boodhwani and Baker, 2019), or with regards to predictive quality between learner sub-groups (Riazy and Simbeck, 2019).

2.2 Code analysis and algorithmic fairness

Code analysis is one of multiple possibilities to assess the fairness of systems. Sandvig et al. propose four more possible audit designs: noninvasive user audit (studying user interactions with a platform), scraping audit (using repeated queries to a platform), sock puppet audit (researcher as users), and collaborative or crowdsourced audit (Sandvig et al., 2014). The latter four designs analyze system behavior using in and output, whereas code audit relies on source code understanding.

Binkley defines code analysis as “the process of extracting information about a program from its source code” (Binkley, 2007). Source code analysis can focus solely on technical issues, for example with regards to the use of variables and pointers, in those cases it can be supported using toolkits (Novak and Krajnc, 2010). With regards to AI accountability Raji et. al. introduce a framework for an internal fairness auditing process (Raji et al., 2020). This framework includes scoping, mapping, artifact collection, testing and reflection stages. Wilson et al. use code, documentation and representative datasets to audit an HR-candidate-search platform for fairness (Wilson et al., 2021).

2.3 Learning analytics in Moodle

Moodle is an open-source learning management system that provides learning environments for educators. Moodle includes a learning analytics functionality to analyze learning process and progress of students. Organizations can use Moodle without it.

The Moodle learning analytics functionality has been the subject of research, e.g., (Fenu, Marras and Meles, 2017; Verdu et al., 2021; Zhang, Ghandour and Shestak, 2020) but not with regards to fairness. Bognar and Fauszt have analyzed the impact of dataset size on predictors and time splitting method in Moodle (Bognar and Fauszt, 2020), their focus was mainly on performance and accuracy, not fairness. Thus, we believe, a comprehensive analysis of the Moodle learning analytics system, its abilities limitations, and fairness constitutes a research gap. This is becoming more essential, since educators tend to rely on outcomes of LA systems in their perception and evaluation of students (Mai, Köchling and Wehner, 2021).

3. Fairness of Moodle Learning analytics

In this paper, we are aiming to identify potential fairness risks arising from using Moodle learning analytics. Therefore, we will identify relevant components of Moodle software for learning analytics and examine them. Machine learning (ML) has been associated with fairness issues in learning analytics and other applications. Thus, we will investigate the employment of machine learning in Moodle LA and its impact. It is crucial to ensure, student success does not depend on protected attributes, e.g., gender, ethnicity, or age. Consequently, we will check whether such attributes are implicitly or explicitly used in Moodle LA.

We are proposing a structured approach to assess fairness of learning analytic systems using code analysis on the example of Moodle. For this purpose, we will first confine relevant resources (source code and documentation). We will then conduct a descriptive analysis of code and documentation to enhance understanding of the dimensions of the project and accessible information. Next, we identify important classes and study their functions and relationships. We look at major components individually and analyzed their influence on fairness of the system. Finally, we examine their combined implication and the dependencies on data, user, and proper employment.

3.1 Confining the LA system

In scope for this analysis is only the learning analytics functionality of Moodle. The analysis has been conducted on Moodle 3.10.4 as of May 2021. Both the source code and the documentation are used for analysis. As a first step, the code of the learning analytics functionality needs to be identified in the source code. We excluded 37% of code files that only implements web functionality and design of Moodle, such as HTML, CSS and JavaScript. In Moodle there are over 2.6 Mio. PHP lines of code (LOC), of which 1.5 Mio. are non-comment lines of code (NCLOC) in 11,175 files. With over 16 thousand NCLOC learning analytics represents only about 1% of Moodle (Table 1). Similar ratios also apply across classes and packages. The Python repository contains additional 1,140 LOC. For calculating properties of code, we reimplemented and compared three approaches: LOC and NCLOC (AlDaniel, 2021), classes (Bergmann, 2021) and packages using our own-developed method.

Table 1: Number of files, packages, classes, and lines of code in Moodle and Moodle learning analytics (only PHP)

	Files	LOC	NCLOC	Packages	classes
Moodle	11,175	2,642,663	1,539,664	565	12,201
Moodle LA	254	34,389	16,766	4	214
LA share in Moodle (%)	2.27	1.30	1.08	0.71	1.75

Moodle provides a multilingual documentation for users in ten different languages, and an English documentation for developers. To estimate the dimension of the documentation, we collected all corresponding pages and counted words. The length of the documentation varies between different languages. For example, English documentation has about 5% more words than German documentation. The user documentation offers information and instructions for optimal usage of the platform, whereas the developer documentation dives deeper in the structure of the project and functionality of modules. The developer documentation is much shorter than the user documentation and does not contain a comprehensive module-structure, class, or code explanation. Table 2 shows an overview of the number of words in the different language documentations in English and German documentations.

Table 2: English and German Moodle documentation in numbers

	User doc	Dev. doc	LA user doc	LA dev doc
English	414,993	198,098	14,337	7,605
German	392,194	n/a	12,574	n/a

3.2 Descriptive analysis

Moodle learning analytics offers descriptive analysis of student learning, and predictions about success of students (Moodle, 2021e). There are two kinds of models in Moodle LA: static and machine learning based. Static models use simple rules to detect specific situations whereas machine learning models employ machine learning algorithms and previous data to predict a situation, e.g., "Students at risk of dropping out". The ML-based LA provide two machine learning backends (PHP and Python). Users (administrators, educators) can choose a backend. Although various classification and regression algorithms are implemented, the PHP backend (default) currently only uses logistic regression. The Python backend applies a single hidden layer neural network using TensorFlow (Moodle, 2021d). PHP code is part of Moodle main project whereas Python is available via an extra repository.

To apply ML-based learning analytics and predict an event, the user must first create or choose a model. There are some predefined models already included in Moodle. For example, “Students at risk of dropping out”. Users can also create their own models, which contains multiple features and predict specific events. Figure 1 shows the major components of ML-based LA in Moodle.

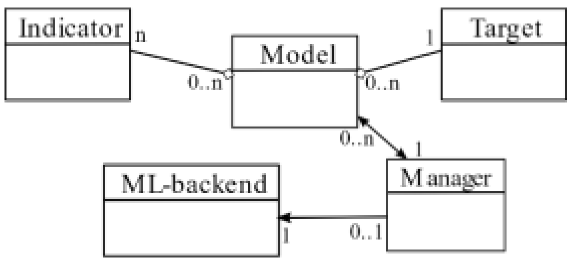

Figure 1: Simplified class diagram of ML-based LA in Moodle, based on (Moodle, 2021a)

3.3 Major components and their implication for fairness

In Moodle, indicators are features that measure a specific property or activity. There are some general features, e.g., “any write action”, “read actions amount”, “User is tracking forums”, as well as a set of indicators based on the “Community of Inquiry model of student engagement”. These exist in two types: cognitive depth and social breadth (Moodle, 2021b). Users can also import and use further indicators. To train and use ML-based LA, users need to provide training data. This fact has two-sided implications. On the one hand, it assures the used data is known by the users. On the other hand, it is more probable that the ML-Method is trained with a smaller, less diverse dataset, which could lead to unfavorable results. To ensure fair LA, indicators must be defined carefully. It is important that features do not draw a conclusion from activity, nor rely on actions that are not decisive for the purpose. Furthermore, relying heavily on on-site activities neglect offline work of students. In Moodle, protected attributes like gender, ethnicity etc. cannot be used for indicators. Yet, it must be examined whether a feature could leak protected information.

Targets are events, that LA tries to predict. Moodle provides a growing list of targets, e.g., “Students at risk of dropping out”, “Students at risk of not achieving the minimum grade to pass the course”, “Students at risk of not meeting the course completion conditions” (Moodle, 2021c). Meanwhile, the value of target in previous data represent the label for ML-algorithm. Regarding fairness, it is important to ensure whether the target is predictable given the available indicators. For example, is the available data conclusive enough to surely infer, if a student will pass or fail a class. Additionally, since the outcome of previous courses act as labels for machine learning algorithm, it is vital that the outcome was a result of the available interaction in Moodle. For example, in case there were on-site and offline activities, the resulting grade or outcome (pass or fail) might not be correlating solely to data and create inaccurate implications.

A model is a set of features (indicators) that should predict an outcome (target). Moodle provides some predefined models with predefined features and targets (Moodle, 2021a). For example, “Students at risk of dropping out” uses 49 indicators to predict students at risk. Users can also create their own models with an individual set of indicators. Regarding fairness the composition of the model is crucial. Choosing a proper set of indicators for the predicted event can improve fairness of the LA-system. It is also vital to examine, if the event is predictable using available features, as well as prediction fairness regarding offline activities.

The ML-backend implements the functions as the engine of ML-based LA. It uses previous data and associated labels to train and later predict the selected event. The two different ML-backends in Moodle use logistic regression (PHP backend) and neural networks (Python backend) (Moodle, 2021d). Different stages of the ML-backend play a role in ensuring fairness. Firstly, choosing the proper algorithm could improve prediction accuracy, and thus fairness. This decision is best made regarding data, outcome, and resources. It is debatable if a single pre-selected algorithm will suit different models. Secondly, training is the most important part of ML-prediction. To reach suitable results, the dataset must satisfy basic criteria, e.g., size of the dataset, balance among different labels, proper randomization of data splitting for training and testing (for example through multiple execution and comparison). Thirdly, the evaluation of results is a vital part of ensuring fairness. ML-algorithms are not perfect. This should be clear for all stakeholders, especially users. Each algorithm or application will have their strength and weaknesses. The evaluation can be represented with different metrics. For proper and fair application of ML-processes it is important that users have clear understanding of these metrics and their implications.

Table 3: Major components of ML-based LA and their relevance for fairness

Component	Relevant for fairness in implementation	Relevant factors for fairness in application
Indicator	properly measurable indicators explicit, unambiguous features	indicator selection
Target	predictable target using available data	measurable target
Model	model definition model composition	model composition consideration offline-activity
ML-Backend	suitable algorithm proper configuration rigorous evaluation	understanding of ML-process familiarity with evaluation metrics

Fourthly, in all stages of the ML-process, choosing the proper parameters leads to significant changes in results. Thus, it is important to continuously examine their effect on the result and its fairness. Moodle LA enables users to quickly employ a model and create predictions regardless of their ML-knowledge. This can lead to severe fairness problems since these users will not be able to assess the validity of the predictions, and in worst case trust unreliable results. The fairness risks of the Moodle LA components are summarized in table 3.

4. Discussion

It is often thought that access to source code of an intelligent system can significantly contribute to assessing fairness. Although, this can improve possibilities for the assessment, especially regarding possible problems in design or implementation, it has its own difficulties.

Firstly, source code review is a very time and resource consuming process. On developing projects like Moodle, this might need to be a recurring process. A comprehensive documentation is also greatly beneficial. In case of

Moodle, documentation is not sufficient for this purpose. Furthermore, reviewers need to have a solid understanding of the project and related areas, e.g., programming, machine learning. Consequently, this process cannot be administered at end-user level, like schools or universities.

Secondly, data influences the outcome of ML-based systems notably. In an untrained delivered system like Moodle, the same model could result in quite different predictions for different users. Therefore, assessing fairness of a system cannot be achieved independently of the data.

Thirdly, proper usage of a predictive system determines the fairness of the outcome. The user should be able to assess the results and their validity. This is especially crucial for systems, like Moodle, where users must configure, train, and apply the model. In order to ensure fairness in a LA-system, users must be properly informed about these challenges and be provided with necessary information about abilities, and limitations of the system, as well as data science know-how for interpretation of results.

Despite these factors, code analysis offers valuable insights about abilities and limitations of learning analytics systems like Moodle LA. It can expose vulnerabilities and potential fairness risks caused by assumptions and parametrization in source code. Our approach attempts to address this research gap, as majority of other studies focus on performance optimization (Bognar and Fauszt, 2020) or primarily use data-based analysis to assess algorithmic fairness (Anderson, Boodhwani and Baker, 2019).

We believe, code analysis and data-based analysis can complement each other and thus, ensure more comprehensive fairness examination. We aim to conduct such extensive study in future works.

5. Conclusion

In this paper we make two major contributions. Firstly, we discuss an approach to assessing AI fairness using code analysis. Secondly, we apply this approach to the Moodle learning analytics and thus give insights about its inherent fairness. In order to assess AI systems for fairness, the following steps are necessary:

- Acquire system code and documentation,
- Identify relevant system components for fairness analysis,
- Descriptive analysis of relevant parts of codes (size, class diagram),
- Description of relevant classes as well as input and output data,
- Fairness risk assessment considering application, dataset, and user interaction.

Even though it is widely discussed that AI systems' code should be analyzed for fairness, code analysis can only provide limited insights into the fairness of an AI system. Our analysis shows that Moodle LA doesn't use protected attributes such as age, gender or ethnicity. Nevertheless, users must be aware of other potential individual fairness perspectives. Moodle offers two types of LA, one of them uses machine learning algorithm. Different components carry fairness risk potentials. A cautious use of ML-based LA, especially regarding to data, model and evaluation is crucial for a fair LA-usage. User's knowledge about machine learning, evaluation metrics etc. can have big impact on fair, proper application.

In future works, we will continue fairness-assessment of Moodle by a more detailed modular examination of LA-components and their dependencies to data and users. We will use synaptic data and a study group to assess measures for ensuring fairness in learning analytics predictive systems.

Acknowledgements

This research has been funded by the Federal Ministry of Education and Research of Germany in the project "Fair Enough?" (Project ID: 16DHB4002).

References

AlDaniel (2021) AlDanial/cloc, 11 June 2021. Available at: https://github.com/AlDanial/cloc (Accessed: 11 June 2021).

Anderson, H., Boodhwani, A. and Baker, R.S. (2019) 'Assessing the Fairness of Graduation Predictions', EDM.

Bellamy, R.K.E. et al. (2018) 'AI Fairness 360: An Extensible Toolkit for Detecting, Understanding, and Mitigating Unwanted Algorithmic Bias', arXiv preprint arXiv:1810.01943.

Bergmann, S. (2021) sebastianbergmann/phploc, 11 June 2021. Available at: https://github.com/sebastianbergmann/phploc (Accessed: 11 June 2021.132Z).
Binkley, D. (2007) 'Source Code Analysis: A Road Map', Future of Software Engineering (FOSE'07), pp. 104–119.
Bognar, L. and Fauszt, T. (2020) 'Different learning predictors and their effects for Moodle Machine Learning models', 2020 11th IEEE International Conference on Cognitive Infocommunications (CogInfoCom), pp. 405–410.
Cambruzzi, W.L., Rigo, S.L. and Barbosa, J.L. (2015) 'Dropout prediction and reduction in distance education courses with the learning analytics multitrail approach', J. UCS, 21(1), pp. 23–47.
Datenethikkommission der Bundesregierung (2019) 'Gutachten der Datenethikkommission der Bundesregierung'.
Dawson, S. et al. (2019) 'Increasing the Impact of Learning Analytics', Proceedings of the 9th International Conference on Learning Analytics & Knowledge, pp. 446–455.
European commission (2021) 'Regulation of the european parliament and of the council, Laying down harmonised rules on artificial intelligence (artificial intelligence act) and amending certain union legislative acts, COM(2021) 206 final'.
Fenu, G., Marras, M. and Meles, M. (2017) 'A Learning Analytics Tool for Usability Assessment in Moodle Environments'. Journal of e-Learning and Knowledge Society, 13(3), pp. 331–342.
Lu, O.H.T. et al. (2018) 'Applying learning analytics for the early prediction of Students' academic performance in blended learning', Journal of Educational Technology & Society, 21(2), pp. 220–232.
Madnani, N. et al. (2017) 'Building Better Open-Source Tools to Support Fairness in Automated Scoring', Proceedings of the First ACL Workshop on Ethics in Natural Language Processing, pp. 41–52.
Mai, L., Köchling, A. and Wehner, M. (2021) ''This Student Needs to Stay Back': To What Degree Would Instructors Rely on the Recommendation of Learning Analytics?' CSEDU (1), pp. 189–197.
Mehrabi, N. et al. (2019) 'A Survey on Bias and Fairness in Machine Learning', arXiv preprint arXiv:1908.09635.
Moodle (2021a) Analytics API - MoodleDocs, 18 May.2021. Available at: https://docs.moodle.org/dev/Analytics_API (Accessed: 4 June 2021).
Moodle (2021b) Learning analytics indicators - MoodleDocs, 18 May.2021. Available at: https://docs.moodle.org/310/en/Learning_analytics_indicators (Accessed: 4 June 2021).
Moodle (2021c) Learning analytics targets - MoodleDocs, 18 May.2021. Available at: https://docs.moodle.org/310/en/Learning_analytics_targets (Accessed: 4 June 2021).
Moodle (2021d) Machine learning backends - MoodleDocs, 18 May.2021. Available at: https://docs.moodle.org/dev/Machine_learning_backends (Accessed: 5 June 2021).
Moodle (2021e) Analytics - MoodleDocs, 7 June.2021. Available at: https://docs.moodle.org/311/en/Analytics (Accessed: 16 June 2021).
Novak, J. and Krajnc, A. (2010) 'Taxonomy of static code analysis tools', The 33rd International Convention MIPRO, The 33rd International Convention MIPRO, pp. 418–422.
Raji, I.D. et al. (2020) 'Closing the AI accountability gap', Proceedings of the 2020 Conference on Fairness, Accountability, and Transparency, pp. 33–44.
Riazy, S. and Simbeck, K. (2019) 'Predictive Algorithms in Learning Analytics and their Fairness', DELFI 2019, pp. 223–228.
Saleiro, P. et al. (2018) 'Aequitas: A Bias and Fairness Audit Toolkit', arXiv preprint arXiv:1811.05577.
Sandvig, C. et al. (2014) 'Auditing algorithms: Research methods for detecting discrimination on internet platforms', Data and discrimination: converting critical concerns into productive inquiry (22), pp. 4349–4357.
Siemens, George and Long, Phil (2011) 'Penetrating the Fog: Analytics in Learning and Education', EDUCAUSE Review, 46(5), p. 30.
Stenkamp, D. and Skierka, S. (2019) 'Ein TÜV für Algorithmen', Handelsblatt, 27 November, p. 48.
Verdu, M.J. et al. (2021) 'MSocial: Practical Integration of Social Learning Analytics Into Moodle', IEEE Access, 9, pp. 23705–23716.
Wilson, C. et al. (2021) 'Building and Auditing Fair Algorithms: A Case Study in Candidate Screening', Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency, FAccT '21: 2021 ACM Conference on Fairness, Accountability, and Transparency, Virtual Event Canada, pp. 666–677.
Xing, W. et al. (2015) 'Participation-based student final performance prediction model through interpretable Genetic Programming: Integrating learning analytics, educational data mining and theory', Computers in Human Behavior, 47, pp. 168–181.
Zhang, Y., Ghandour, A. and Shestak, V. (2020) 'Using Learning Analytics to Predict Students Performance in Moodle LMS', International Journal of Emerging Technologies in Learning (iJET), 15(20), p. 102.

Learning Analytics in Support of Video Corpus Construction and Exploration

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DOI: 10.34190/EEL.21.034

Abstract: The OpenMWS project applies learning analytics to university students' engagements with the videos hosted on social media platforms. Part of the online MWSWeb platform for Higher Education, OpenMWS is a specialised interface for video corpus construction and analysis that functions as an overall pedagogical support for video-based investigations into multiliteracies. At a basic level, it currently provides sequence-based viewings for YouTube videos. It splits these videos into sequences by interpreting the instructions contained in two uploaded Excel files, the first an Overview file containing a list of YouTube videos, the second, a Transcript file, containing students' division of each video into time-based sequences that also include multimodal transcriptions and analyses of the characteristics of each sequence. A further level of engagement with videos is provided by tools for the online annotation of the each of the video sequences made available. The application of student-defined descriptors to these sequences creates a searchable corpus. Search tools then use these descriptors to identify sets of video sequences with similar characteristics. In this way, patterns are detected that highlight the presence (or absence) of specific sociocultural, methodological and genre features. Learning analytics help guide students through the various stages of corpus building. They also provide teachers and researchers with data about students' performance in the various tasks to be accomplished as well as indications of what additions and improvements are to be made to the individual corpora, and, more generally to the functionalities of the MWSWeb platform and its OpenMWS interface.

Keywords: OpenMWS; MWSWeb platformning analytics

1. Introduction

The advent of video-sharing websites such as YouTube and Vimeo, alongside other video platforms with primarily educational orientations such as Ted (https://www.ted.com) and Khan Academy (https:// www.khanacademy.org), has led today to virtually unlimited access to online videos. This, in turn, has paved the way for the construction of video corpora, to an extent unthinkable fifteen or so years ago when video hosting sites first started to become of interest in education (for TedTalks, see Anderson 2016; Taibi et al, 2015; Kenworthy, 2010; Goldin, 2009; for YouTube, see Burke & Snyder, 2008; Buzzetto-More, 2014; Brame, 2015). However, although tools to construct and explore video corpora exist in the literature, they do not as yet explicitly seek to provide the resources that Higher Education students need to construct video corpora by themselves and on themes of their own choice. This instead is the major focus of group project work based on OpenMWS, a specialised interface for the MWSWeb platform (http://mws.pa.itd.cnr.it) designed to provide distance-learning resources that permit students to adapt their interaction with video-sharing sites in educationally viable ways. The paper provide as case study illustrating one of many such projects currently being undertaken in Italian universities (Taibi et al, 2014; Baldry et al, 2020). It does so bearing in mind, the recent EU-financed report "The Common Framework of Reference for Intercultural Digital Literacies" (Sindoni et al, 2019, henceforth CiFRIDIL) which, by evoking the Council of Europe's "Common European Framework of Reference for Languages", underscores how different today's society is from the one which put together the A1/A2/B1/B2/C1/C2 system as a way of standardising the levels of language throughout Europe some thirty years ago (https://www.coe.int/en/web/common-european-framework-reference-languages/history). Despite the success that this system continues to have in many educational and employment contexts, CiFRIDIL points to the constant need for revision of our basic cultural and societal assumptions. Indeed, despite its social impact with 500 hours of video uploaded every minute and one billion hours of YouTube viewings each day − more than Netflix and Facebook video combined (source: www.brandwatch.com/blog/youtube-stats/) − from an educational and training standpoint, YouTube is, at one and the same time, both an under-used resource and a poorly-managed one as well. Given that the essence of video-hosting sites is the ease with which sharing can take place, how ironic it is that, in so many educational contexts, students are the passive recipients of a chain of command in which individual teachers engage in the lengthy procedure of searching for videos, downloading them and then re-uploading them to other platforms and applications:

> *"One of the main advantages of YouTube is that it is a free web based service [….]. Educators can easily search and review videos related to a specific concept or knowledge, and then provide the students with the link. In our case the videos were downloaded using RealPlayer plugin, which*

allowed us to download any video streaming content on the web. Then we have uploaded the videos in our LMS (learning management system.

https://ieeexplore.ieee.org/document/6246045?reload=true

The pedagogical methodology used in the OpenMWS platform is, instead, student-centric, concerned with students' direct management of video-sharing sites using techniques that avoid repetitive, inauthentic labour and which heighten students' feeling that *they* and *not* others are in the driving seat, instructing YouTube to do what they, and *not* others, want. As previously reported (Taibi 2020), this methodology is the result of teamwork involving joint CNR and University observation of students' interactions with online videos (Vasta & Baldry 2020). Hence the development of the quick-and-easy "Overview" template − an Excel file into which a group of students type a list of the YouTube video titles and addresses that *they* chose on a selected topic and which *they* then upload to the OpenMWS file platform, once and once only, allowing other students (besides themselves) to view the selected videos in any desired order. In other words, this the first step in creating an end user-defined subcorpus in which paradigmatic, choice-based selections override and replace the sequentially-defined, and essentially lock-step, procedure of YouTube playlists whose contents are based on associations and choices often remote from, and irrelevant to, those that motivate specific groups of students in a specific educational context.

As further illustrated below in the case study, the pedagogic focus is necessarily on the multiliteracies entailed by digital genres and on choice-based flexibility. This dictates the need for data management techniques that allow online solutions to shape and promote data collection whence the use of 'live' video sequences, rather than stills, as this ensures investigative studies of videos can be performed more easily. The case study reported below illustrates these pedagogical principles at work. They relate to the Simulations Video Corpus (hereafter SVC) which details how, under the guidance of a remote teacher, a group of twenty undergraduates − all from the same degree course and university but working individually from home during the Covid-19 lockdown − successfully constructed a video corpus of one hundred videos on the theme of simulation techniques and technologies used in healthcare. Within studies of multimodal genres (Coccetta, in press; O'Halloran et al, 2011; Bateman, 2008; Vasta & Baldry 2020), video corpora, as a method through which to undertake genre analysis with a strong educational impact, are rapidly becoming a growing reality (Baldry & Kantz in press; Baldry & Thibault, 2001, 2008; Taibi 2020) as they provide visual/verbal insights that take into account communities' social and cultural values and ideologies as well as their discourse practices.

In this respect, it should be recalled that OpenMWS in its role of mediating between end user and YouTube is also a data-acquisition system that records users' interactions. In others words, it is a learner analytics system that enables the typical patterns of use to be monitored. As the case study shows, since their inception, simulations have been used in many contexts where safety is a major consideration − learning to fly, carry out a surgical operation, working in dangerous environments. The feedback on interaction tells us what aspects in an OpenMWS corpus are most sought after. Indeed publications to date have shown that since OpenMWS simply correlates an Overview file, essentially a playlist, with a Transcript file, containing students' multimodal transcriptions and divisions of videos into sequences, it is relatively easy to measure the speed with which students master teachers' guidance about how to model their analyses (Baldry et al. 2020) and ability to respond quickly and creatively (Vasta & Baldry 2020). The division of videos into sequences makes it possible to identify meaning-making subunits entextualising specific themes which can be annotated and retrieved on the basis of a search command. This also dictates the need in online teacher-student interactions, for data management tracking and tracing of the pathways and trajectories of the meaning-making processes involved which in many ways are akin to "think-aloud protocols" found in traditional pedagogical practice (Cowen 2019), including potential error identification, feedback and checklists. The potential for investigation into genres becomes greater with the ability to identify patterns and carry out crosschecks in both specialised and cross-genre corpora. In this respect, the design of OpenMWS is such to allow comparisons of different student groups in the performance of the analytical and annotation tasks set in relation to specific corpora. In this way, it is possible to provide teachers and researchers with valuable information about students' learning styles and strategies, both individual and collective, in group projects as well as regards the time and place where this is undertaken and through what devices. In particular, OpenMWS provides charts (currently pie charts) and tables that summarize the activities performed by students. Thanks to visualizations, the latter can compare their activities to those performed by their peers thus becoming more aware about the results they have achieved, as well as obtaining suggestions about how to undertake a task appropriately.

As argued in the concluding section, the role of analytics in this project is ultimately to provide all concerned, students, teachers and researchers, with information about students' learning styles and strategies in group projects, both of an individual and collective nature that might otherwise be difficult to collect and analyse. In this respect, the research is motivated and underpinned by interest in student-led investigations into multiliteracies and multimodality in Higher Education as expressed, for example in the CFRIDiL framework for online training in digital intercultural and text analysis skills for which the OpenMWS platform provides a significant reference point for both infrastructure and implementation. Indeed, the current experimentation is a first step towards providing a pedagogically-inspired model for analytics in this sector. The concluding section, however, also remarks on the possibilities for extending the reach of the MWSWeb platform to encompass learning scenarios, such as those entailed by mobile devices (Seta et al, 2008; Fulantelli, Taibi & Arrigo, 2013), which go beyond the project's initial concern with individual students' participation in group projects from their home base. As such learning analytics are a significant formative tool whose nature and impact needs to be further assessed and researched, at the very least, as is the case here, in relation to semester-long video corpus projects.

2. Materials and methods

As part of their credit-awarding final year apprenticeships, twenty first-degree students at the University of Salento, volunteered, in the December 2020-May 2021 period, to participate in the construction of the SVC searchable online corpus of videos on the theme of simulations in healthcare education, a theme chosen by their online tutor. The methodology used by OpenMWS dispenses with any need to upload or download videos or with any form of complex training, with students required to spend only a couple of hours reading the project manuals. The first preliminary stage required students to use Excel files to draw up an Overview file, essentially a playlist of YouTube videos that the students themselves selected on the SVC theme, and a Transcription file breaking up the selected videos into sets of sequences each marked up in terms of: a) duration; b) use of oral and written discourse and c) tags indicating recurrent features.

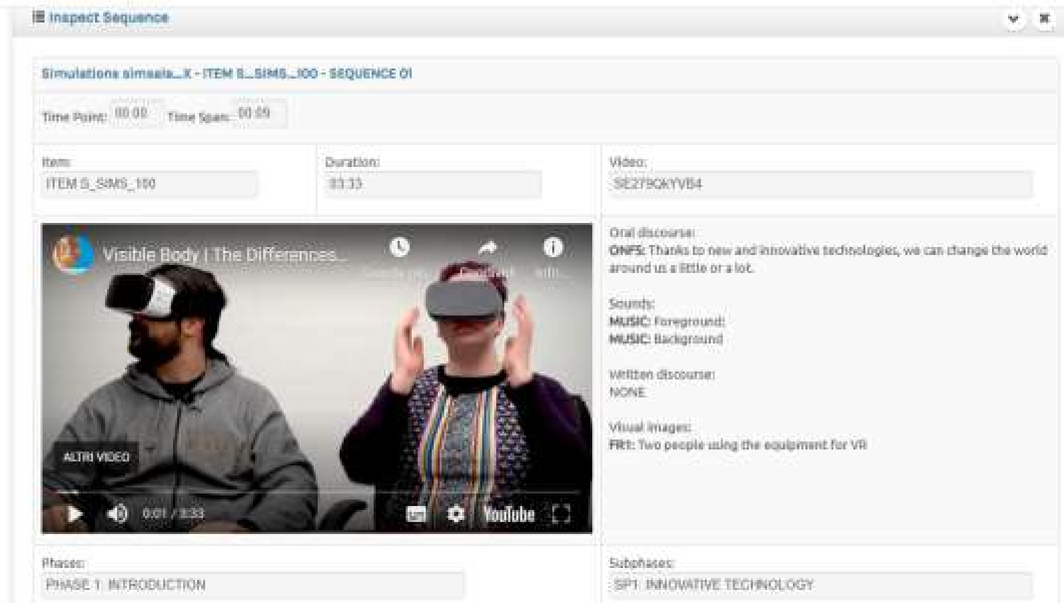

Figure 1: A screenshot from the first sequence in the last video/item in the corpus

As Figure 1 shows, the OpenMWS interface uses these files to split YouTube videos into shorter video sequences viewed side by side with written transcriptions of what is said and seen. As indicated in the top bar of the screenshot in Figure 1, the results of this process are presented in the Inspect Sequence window, where students check the accuracy of their sequencing and undertake remedial action, correcting and re-uploading the Transcription file, when necessary. Typical mistakes become apparent when the students play the video sequence e.g. when what is said in the playable video sequence is truncated with respect to the oral discourse transcription (Figure 1, top right). Others, signalled automatically by the fact that a particular sequence fails to play, are the result of mistakes in timespan mark-up or incorrect YouTube identifiers. Naturally, the transcriptions themselves call on students to exercise and perfect their understanding of multiliteracies (Sindoni et al, 2019) requiring them to dissect each sequence in terms of how visual and verbal resources interact to make meaning. It also requires a basic understanding of how, in the later stages of this corpus-building and searching project, tag-based indications of speaker identity (e.g. ONFS for on-screen female speaker shown in Figure 1, top right) and others such as those describing different types of sounds and images contribute to the identification of recurrent characteristics.

In the second stage of their online work, students access the Sequence Annotation menu, where they are provided with a set of annotation tools, four of which, Overview, Soundtrack, Videotrack and Composition, are currently active. The remaining two, Interaction and Phase and other features are in the design phase as they entail greater familiarity on the part of students with more abstract text analysis concepts and semiotic principles that require further investigation in the light of data emerging from the current round of experimentation. As Figure 2 shows, this second stage allows corpus annotation and searching to be carried out in relation to user-defined features that further investigate (and justify) the initial selection of videos. Overview menus support annotation of general characteristics i.e. with reference to the entire video (the WHOLE VIDEO indicated in Figure 2), whereas the remaining tools, further described below, are related to the annotation of the characteristics of individual sequences. Annotation is based on a select-and-save principle, although a SUGGEST button (Figure 2, right) prompts students to use tags incorporated in the previous transcription stage, a way of reminding them that previous decisions, whether accepted or rejected, need to be taken into account.

Figure 2: Sequence annotation and the overview menu

The third and final stage in the corpus construction process relates to the production of search results. The menu used to this end is a mirror image of those used in the Sequence Annotation phase shown in Figure 2 plus tools that define which corpora, video items and sequences are to be searched for. The manuals and video clips used in the project constantly encourage students to check their annotation performance using these search results tools. This encouragement is further backed up by a dashboard style of data presentation featuring combinations of bar-and-pie charts that are simple to read and understand. The charts are dynamic, currently providing two states of presentation, one shown in Figure 3, oriented towards classification, the other shown in subsequent figures (e.g. Figure 4, top) towards distribution. Students switch between the two states using the Alphabetical Order/Numerical Order menu shown in the top part of the Search Result dashboard. Annotation of the almost two thousand video sequences that make up the current SVC naturally leads students to encounter difficult and unexpected cases. Figure 3 entitled *D2: Salient Messaging Device* reproduces the results for a similarly named search option relating to the messaging technologies used in the selected videos. This is in fact an example of an early stage in the annotation, when only a third of the sequences had been annotated. It contains unclassified elements identified through the use of a hyphen and upper-case lettering which are separated from those which have been fully determined, thus indicating how the OpenMWS interface signals requests for other team members to step in and help sort matters out. Typically, such cases *are* resolved by peer discussion. As the annotation proceeds unclassified elements are redetermined to the point where they disappear altogether. In fact, as the OpenMWS server's database records, the annotations for this SVC feature had already undergone re-examination that whittled down the original number of UNDECIDED cases.

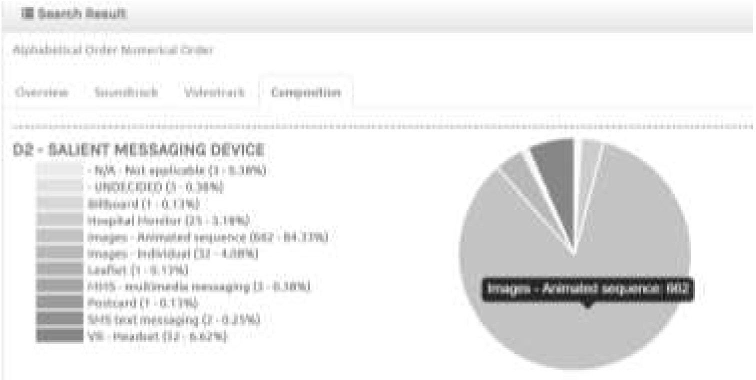

Figure 3: An example of chart-based corpus search results

The procedure adopted so far in the project is to provide a bare minimum of menus and descriptors so that the students have to make a specific request for new menus and new descriptors to be added. Put another way, students have to negotiate their proposals for new labels with their peers and their teacher, a process, which regardless of the outcome, underscores the need for peer consultation and teamwork in the resolution of difficult cases and the need for analytics to support negotiation in which feedback flows in many directions between teachers and students. Indeed, while emails and other forms of messaging are currently used to this end, the next phase of development will incorporate such messaging within the OpenMWS platform in keeping with the commitment to further develop analytics. We may note in passing that Figure 3 shows that even in the age of Bluetooth and headsets, though heavily outnumbered, postcards and leaflets are still part of current communication. Such data help sharpen students' understanding of the "continued practices of borrowing and refashioning among multiple media forms" (Bolter, 2016), which is, naturally, one of the awareness-raising goals that the SVC corpus seeks to fulfil.

3. Results

One reason why the Overview function is the first on the Annotation Menu list is that it helps provide a sense of completion and achievement early on in the development of a specific corpus. As Figure 4 shows one of the first annotation tasks to be completed in the SVC project related to the identification and incidence of the various SVC themes. Figure 4 demonstrates that the students were able to construct the corpus around a variety of themes.

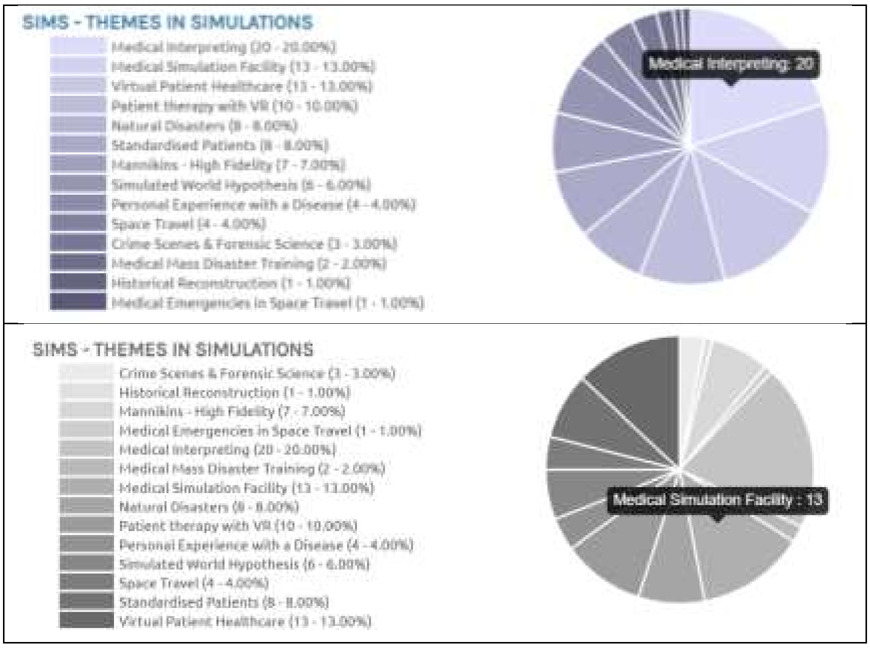

Figure 4: Data presentation: (top) foregrounding of incidence; (bottom) foregrounding of type

What is striking is that, despite the priority given to frequency or type of theme chosen that the highlighted segments in the charts foreground, a more basic underlying contrast exists between, on the one hand, a focus on patients and their experience of diseases, and a focus, on the other hand, on doctors, the facilities they have but also their need to cope with non-hospital emergencies. Thus, while the data in Figure 4 suggest that the corpus construction tasks were properly completed in relation to fourteen thematic fields chosen, little is explicitly forthcoming about the reasons for these choices as compared to others that might have been made. Some explanation begins to emerge, as discussed in the next Section, when we look at the data in relation to some of the many other annotation menus used to analyse the SVC corpus.

4. Discussion

As explained in the Introduction and as briefly illustrated above, the entire MWSWeb project is part of a pedagogical strategy dedicated to extending the role students play in the construction of video corpora as a way of securing the development of students' digital literacy awareness and associated skills. This principle applies both to the current OpenMWS interface and its predecessor, the House Corpus. As shown in Figure 5, the House Corpus, also accessed through the MWSWeb platform, used a multimedia interface consisting of a side-by-side combination of video clip and written transcript to highlight the results of key word searches for each of the 6300 plus scenes making up this TV series (Taibi et al, 2019).

Figure 5: Example of a keyword search using the House Corpus multimedia interface

In a break with the traditional function of online corpora as sites to be consulted in a manner akin to online dictionaries with a view to obtaining information, the House Corpus took the innovative step of casting students in the role of corpus builders adding the rider that the corpora they were to build were for use by *other* students in unrelated degree courses. In one such corpus-building task, language students from the University of Salento compiled a list of all the medical acronyms used in this TV series which allowed first-year medical students in other universities, as end users (Loiacono & Tursi, 2019), to focus on memorising these acronyms and understanding how they are used. By activating the Highlight Acronym function in the top left-hand corner of Figure 5, the medical students were encouraged to read and view scenes in which these acronyms appear. Equally, the corpus-building task allowed the language students to reflect on the nature, frequency and role that acronyms and initialisms play in medical discourse in English as, unlike many other languages, they can function as verbs (e.g. MRI'd) as well as nouns and adjectives and can refer to medical staff (e.g. MRI sent him over) as well as facilities and associated equipment (Loiacono & Tursi, 2019).

However, despite the significance of corpus-building and the content so produced, it was the capacity to turn project work into interaction between groups that mattered most from a pedagogical standpoint. This was a first step in encouraging interaction between different groups of students in different degree courses. In this first experiment, no direct interaction was envisaged between the language students and the medical students. Stimulating such interaction remains one of the goals of the OpenMWS project, one that potentially changes the way corpora are used in Higher Education.

However, with the construction of many corpora by different teams of students, some degree of interaction between groups has begun to emerge thanks to the possibilities for data comparison and aggregation that OpenMWS provides. In this respect, Figure 6 lists three different perspectives on the SVC corpus. The top two charts relate to the original corpus built, undertaken by the first fourteen students to join the project, while the second relates to a separate corpus which raised the overall number of videos to one hundred and which was built by the six team members who joined the project later. The bottom chart aggregates the data for both these groups. In other words, the affordances of the OpenMWS interface are such to allow teachers to adopt a modular approach to corpus building as the data visualisation tools used in OpenMWS allow seamless integration between corpora created by different groups.

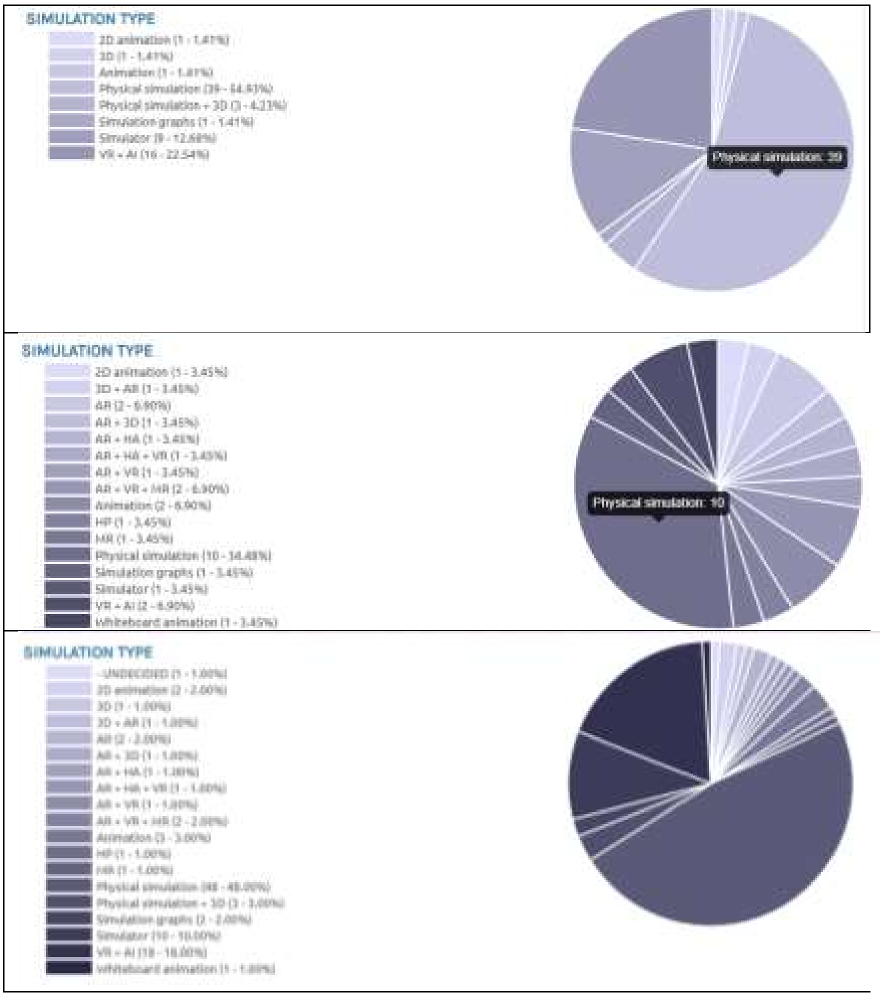

Figure 6: Comparing and combining corpora built by two different student groups

In theory, this allows every student in a team to create their own individual corpus in the knowledge that provided the same menus and descriptors are used, their work can be compared and combined with that of all the other team members. However, it is equally true that the data can still be compared and combined in the manner illustrated in Figure 6 even in the case where some, but not all, of the menus and descriptors are shared. This opens up various opportunities for collaboration between students in different universities and different degree courses that have already been illustrated in publications relating to video corpus construction with OpenMWS (Baldry & Kantz, in press). In the case of the SVC project, it is expected that, as with the House Corpus, SVC will be used by medical students given that a sizeable subcorpus (see Figure 4) relates to medical interpreting services that simulate the mistakes made by doctors when attempting to interact with patients who do not speak their language or who attempt to speak to lip-reading deaf patients while wearing a mask.

Unlike the House Corpus, there are no limits on the number of videos which can be incorporated in the SVC corpus, so that inter-University collaborations on the same project are realistically achievable. Already the micro-scale comparison afforded by the charts in Figure 6 shows an increase in the overall inventory of types of simulation. While the first corpus is only concerned with VR (Virtual Reality), AI (Artificial Intelligence) and, above all, physical simulation (i.e. manikins or real people acting as if they were patients), the second corpus includes AR (Augmented Reality), MR (Mixed Reality), HA (Haptics) and HP (High Performance/high-end virtual reality) demonstrating that the second group of students built on the selections made by the first group and thus enriched the range and representativeness of the corpus. This suggests that the many types of simulations that now exist are as yet unmapped in the minds of many users but become so when a first round of engagement with videos on this theme encourages a second look. All this strongly suggests that video corpora have a future as an educational reality, especially when their value in illustrating the impact of technological innovations and the methods used to describe them are foregrounded (Baldry & Kantz in press; Baldry & Thibault, 2006; Taibi et al, 2015; Taibi, 2020).

5. Conclusion

The project's starting point is that the use of the online OpenMWS interface allows YouTube's thousands of poorly-indexed videos to be re-indexed and efficiently accessed on the basis of the most significant sequences they contain. With SVC, this has been undertaken in relation to the various blends of virtual and augmented reality and to training contexts where feasibility, cost and safety are major factors. The results of this preliminary case study, suggest that students willingly participate in project work that exercises a variety of skills including, most prominently, reflection on how to organise video corpora and how to improve their range and impact. As described in various publications, this type of research involves a challenging change in perspective shifting video corpus studies away from traditional word-based conceptions typical of corpus linguistics, and embracing instead descriptor-based searches that support the quest to identify recurrent visual/verbal patterns (Baldry, 2020; Baldry & Thibault 2001, 2008; Coccetta, in press).

Pilot video corpus studies show that the MWSWeb platform has successfully demonstrated students' willing and profitable distance-learning participation in video corpus construction (Loiacono/Tursi 2019; Baldry et al. 2020; Baldry in press). However, pilot studies have limits. Advancing the state of the art involves addressing media issues as well as pedagogical ones in which analytics plays major role. It also requires a deeper understanding of student-led project work in distance-learning environments and domain-specific discourses. Only then will the viability of the corpora and methodologies suggested above be demonstrated through detailed evidence-based illustrations of changes in the way todays' students learn. Indeed, as mentioned in the Introduction, a significant aspect of the thinking that has guided the design of the OpenMWS interface is its mediation role between end user and YouTube, a philosophy in keeping with the processes of remediation that all media technologies have undergone since the dawn of civilisation (Hurlburt & Voas, 2011). Indeed, overall, the OpenMWS project makes students aware that all media technologies, video-sharing platforms such as YouTube included, constantly and remorselessly remediate each other (Bolter 2016; Bolter & Grusin, 1996, 1999; Silverstone, 2005) and that the entire corpus-building conception that underlies OpenMWS is a pedagogical exercise in grasping the extent to which the existence of societies, from cave dwellers to online interactants, is dependent on the co-evolution, co-deployment and co-contextualisation of media technologies.

Although just one of the many video corpus projects currently being undertaken in six Italian universities (Baldry, Bianchi & Vasta forthcoming), the SVC is special in this respect because of its heightened focus on the processes of mediation and remediation as underscored by the fact that the group of students who mastered the various stages in the construction and analysis of a corpus of videos, were all budding translators and interpreters enrolled in a first degree course in mediation. This helps explain why the first group of students focused on videos simulating hospital interactions between doctors and patients and also why the second group of students made substantial changes and additions, a learning outcome that we know about thanks the presence of analytics tools measuring the change in direction.

The case study thus includes indications about the role that learning analytics has so far played in formative contexts, in which individual students are faced with the need to complete teamwork tasks in the knowledge that they are making judgements about other students' work and that their own performance will be judged by their peers as well as their teachers. In this respect, the paper illustrates the potential role of analytics in recording and informing actions, as well as regards efforts to optimise the platform's role in the mediation between YouTube and end-users. Indeed, while complying with the need for Higher Education in the digital era to provide online tools that encourage a high degree of learner autonomy and while fostering creativity and a sense of successful task completion, the functionalities provided by the current OpenMWS interface are by no means definitive. Nevertheless, the current design of OpenMWS is such to allow the relatively unexplored territory of cross-group comparisons to be investigated in relation to the corpora that each of the different student groups produce in the fulfilment of the analytical and annotation tasks set.

By focusing on this aspect, the paper has suggested the implications and adjustments for learning analytics entailed by the ongoing research pathway with its emphasis on monitoring procedures designed to improve video corpus construction methodology. These include extending the reach of the OpenMWS platform so as to encompass educational contexts that embrace learning scenarios, such as those entailed by mobile devices, which transcend the project's initial concern with individual students' participation in group projects from their home base. As such, there is a need to reflect carefully on the definition of learning analytics, presented in 2011 at the first Learning Analytics and Knowledge Conference, as "*the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs*". The suggestion that emerges from the experiences described above is that in many Higher Education contexts construing learning analytics in terms of reports on "*data about learners …*" is too restrictive and needs at the very least to be accompanied by rider that suggests that learning analytics is also well and truly "*for learners".*

References

Anderson, C. (2016) TED talks: The official TED guide to public speaking. Houghton Mifflin Harcourt.

Baldry, A., Bianchi, F. and Vasta, N. (eds). (forthcoming) Online Video Genres and Specialised Discourse: Engagements, empowerments and extensions in corpus-based approaches. ESE: Salento University Publishing.

Baldry, A. (In press) Multimodality and Genre Evolution: A decade-by-decade approach to online video genre analysis. In I. Moschini & M.G. Sindoni (Eds.), Mediation and multimodal meaning making in digital environments. Routledge.

Baldry, A. and Kantz, D. (In press) "Corpus-Assisted Approaches to Multimodal Discourse Analysis for English for Medical Purposes". In: Bonsignori, Veronica, Crawford Camiciottoli, Belinda and Filmer, Denise (eds.). Analysing Multimodality in Specialized Discourse: Innovative Research Methods and Applications. Wilmington (DE): Vernon Press.

Baldry, A., Kantz, D., Loiacono, A., Marenzi, I., Taibi, D. and Tursi F. (2020) "The MWSWeb Project: Accessing medical discourse in video-hosting websites". In Bianchi, Francesca and Manca, Elena (eds.). Specialised Discourse and Multimedia. Linguistic features and translation issues. ESE: Salento University Publishing, pp. 433-472 DOI 10.1285/i22390359v40p433.

Baldry, A. and Thibault, P. J., (2001) "Towards multimodal corpora." Towards multimodal corpora. 1000-1016.

Baldry, A. and Thibault, P. J. (2006) Multimodal corpus linguistics. In G. Thompson & S. Hunston (Eds.), System and corpus. Exploring connections, 164-183. Equinox.

Baldry, A. P. and Thibault, P.J. (2008) Applications of multimodal concordances. HERMES, 41, 11-41.

Bateman, J., (2008) Multimodality and Genre. New York: Palgrave.

Bolter, J. D. (2016) "Remediation". In: Jensen, Klaus B. and Craig, Robert T. (eds.). The International Encyclopedia Of Communication Theory And Philosophy, Bridgewater, NJ : JohnWiley: pp. 1-11. doi: 10.1002/9781118766804.wbiect207.

Bolter, J. D. and Grusin, R. A. (1996) "Remediation". Configurations 4(3), 311-358.

Bolter, J. D. and Grusin, R. A. (1999) Remediation: Understanding new media, Cambridge, Massachusetts: MIT Press, 20-50.

Brame, C.J. (2015) Effective educational videos. [online retrieved 26.05.2021] http://cft.vanderbilt.edu/guides-sub-pages/effective-educational-videos/

Burke, S. C., and Shonna L. S. (2008) "YouTube: An Innovative Learning Resource for College Health Education Courses." International Electronic Journal of Health Education 11 (2008): 39-46.

Buzzetto-More, N. A. (2014) An examination of undergraduate student's perceptions and predilections of the use of YouTube in the teaching and learning process. Interdisciplinary Journal of E-Learning and Learning Objects, 10(1), 17-32.

Coccetta, F. (in press). "Multimodal concordancing in DDL". In: Jablonkai, Reka R. and Csomay, Eniko (eds.), The *Routledge* Handbook of Corpora in English Language Teaching and Learning. London: Routledge.

Cowan, J. (2019) "The potential of cognitive think-aloud protocols for educational action-research." Active Learning in Higher Education, 20(3), 219-232.

Fulantelli, G., Davide T., and Marco A. (2013) "A semantic approach to mobile learning analytics." In Proceedings of the first international conference on technological ecosystem for enhancing multiculturality, 287-292.

Goldin, I. (2009) "Navigating our global future." TED Global.

Hurlburt, G. F., and Voas J. (2011) "Storytelling: From cave art to digital media." IT Professional 13, 5: 4-7.

Kenworthy, A. L. (2010) TEDTalks an online video resource presented by TED (Technology, Entertainment, Design) at (www.ted.com). AMLE, 9, 727–729. https://doi.org/10.5465/amle.9.4.zqr727

Koester, A. (2010). "Building small specialised corpora". In: O`Keeffe, Anne and McCarthy, Michael (eds.). The Routledge Handbook of Corpus Linguistics. London and New York: Routledge, pp. 66-79.

Loiacono, A., & Tursi, F. (2019). Mapping medical acronyms. In A. Baldry, F. Bianchi, & A. Loiacono (Eds.), Representing and redefining specialised knowledge: Medical discourse (pp. 93-126). ESE University of Salento Publishing. https://doi.org/10.1285/i9788883051531

O'Halloran, K. L., Tan, S., Smith, B. A. & Podlasov, A. (2011). "Multimodal analysis within an interactive software environment: critical discourse perspectives". Critical Discourse Studies 8(2), pp. 109-125.

Silverstone, R. (2005) The sociology of mediation and communication. in C. Calhoun, C. Rojek and B. Turner (eds) The International Handbook of Sociology. London: Sage, 188–207

Sindoni M. G. et al. (2019). “The Common Framework of Reference for Intercultural Digital Literacies”. www.eumade4ll.eu/wp-content/uploads/2020/02/cfridil-framework-linked-fin1.pdf.

Seta, L., Gentile G., Taibi D., Arrigo M., Fulantelli G., Novara G., and Di Giuseppe O. (2008) "Multimodality in a Mobile Learning Environment." In 2008 19th International Workshop on Database and Expert Systems Applications, 160-165. IEEE, 2008.

Taibi, D., & Dietze, S. (2012) Fostering analytics on learning analytics research: The LAK dataset. LAK ‘15: Proceedings of the Fifth International Conference on Learning Analytics and Knowledge, 15(3), 1-163.

Taibi, D., Kantz D., and Fulantelli G. (2014). "Supporting formative assessment in content and language integrated learning: the MWS-Web platform." International Journal of Technology Enhanced Learning 6, 4: 361-379.

Taibi, D., Chawla S., Dietze D., Marenzi I., and Fetahu B. (2015) "Exploring TED talks as linked data for education." British journal of educational technology 46, 5: 1092-1096.

Taibi, D., Marenzi, I., & Ahmad, Q.A.I. (2019) Ain’t that sweet: Reflections on scene level indexing and annotation in the House Corpus Project. In A. Baldry, F. Bianchi, & A. Loiacono (Eds.), Representing and redefining specialised knowledge: Medical discourse (pp. 151-181). ESE University of Salento Publishing. https://doi.org/10.1285/i9788883051531

Taibi, D. (2020). “Analysis D: Shaping digital identities through group study: A simulated case study using online tools and videos to explore animal-human interaction”. In Vasta, N. and Baldry, A., pp. 190-195.

Vasta, N. and Baldry, A. (2020). Multiliteracy Advances and Multimodal Challenges in ELT Environments. Udine: Forum.

An Innovative Platform to Promote Social Media Literacy in School Contexts

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Abstract: In spite of the impressive number of adolescents using social media, only a minority is aware of the risks associated with the use of the Internet. Hate speech, violation of personal rights, psychological attacks, deceiving people with fake accounts, as well as cyberbullying, harassment and insults are some examples of toxic content that can jeopardize adolescent well-being on the Web. Social Media literacy paths in school contexts provide students with the proper defence instruments to face these problems. Furthermore, it is important to underline the role of social media on both the intrinsic and extrinsic motivation of adolescents which has short- and long-term influences when using these virtual environments. However, traditional teaching approaches are not enough to engage students, and the need for innovative learning activities and tools emerges. In this paper we present an online platform specifically designed to support the development of competences related to Information and Data Literacy, Communication and Collaboration and Digital Content Creation. These competences are connected to the most recent versions of the Digital Competence Framework for Citizens, and the Global framework of reference on digital literacy skills promoted by UNESCO. The platform is based on PixelFed, an open-source alternative to Instagram, so that adolescents can practice with an environment they are familiar with. Our platform extends the PixelFed environment with functionalities designed to implement use cases that make students aware of the mechanisms behind social media, such as the use of artificial intelligence algorithms to filter the content they have access to. This platform has been experimented during a pilot run with secondary school students, by proposing them educational activities based on our platform, aimed at educating and supporting students to increase their awareness and counteract the problems that arise within social media.

Keywords: social media literacy, social media risks, social learning environments

1. Introduction

According to the Digital 2020 July Global Statshot report, July 2020 can be considered a milestone in the history of the internet, since for the first time more than half of the world's total population was using social media, with a total number of 3.96 billion active social media users (Hootsuite & We Are Social, 2020). Due to the coronavirus pandemic lockdowns, this number increased up to 4.33 billion active social media users in April 2021 (55.1% of world population, with an annual increase close to 14%) (Hootsuite & We Are Social, 2021). The share of adolescents contributing to these numbers is impressive: US statistics in 2018 showed that nearly all teens aged 13-17 (95%) have access to a smartphone and 45% of them reported that they were online "almost constantly" (Anderson & Jiang, 2018).

The rapid spread of social media, since its appearance in the Internet universe, has attracted the attention of scholars, who have explored the communicative, psychological and social potentials of social media in everyday life (Kaplan & Haenlein, 2010; Chen & Li, 2017; Kane, 2017). Moreover, the enormous attention aroused by social media has fuelled a debate among the promoters of the use of social media, who tend to highlight their benefits, and those who tend to underline the risks (medical, psychological, cognitive, sociological) deriving from the use of social media (Bouvier & Machin, 2018; Kaplan & Haenlein, 2010; O'Keeffe & Clarke-Pearson, 2011).

Research in Education is one of the areas that has paid great attention to social media since their emergence. Research on learning supported by social media is extremely rich, and few technologies have impacted education as the Internet and social media have done. In particular, studies on social media in formal and informal education have proliferated over the last decade (Chen & Bryer, 2012; Mbati, 2013; Mao, 2014; Greenhow & Lewin, 2016; Selwyn & Stirling, 2016). In fact, social media offer important affordances for students' learning that Greenhow, Galvin and Staudt Willet (2019) summarize in: "fostering active learning, enhancing students' collaboration, and increasing their community connections" (Greenhow, Galvin and Staudt Willet

2019:179). Furthermore, it is important to underline the role of social media on both the intrinsic and extrinsic motivation of adolescents which has short- and long-term influences when using these virtual environments (Agrifoglio et al., 2015; Allam et al., 2019).

Several studies have provided empirical evidence of the social media and Social Networking Sites (SNSs) opportunities for supporting learning activities, improving academic achievements, and assisting the advancement of their social interactions and motivations (e.g. by meeting new friends with shared interests or finding community and support for specific activities) (Foulger et al., 2009; Junco, 2012; Wang, 2012).

The literature in the educational domain shows various attempts to exploit social functionalities of SNSs in the educational contexts to investigate their potentialities to develop innovative educational plans, to fill the gap between educators and millennials, and to provide heterogeneous, appealing, and engaging learning environments (Escamilla-Fajardo et al., 2021).

Some of the most popular social media such as Facebook (FB) and Instagram have been piloted to study their effects in the learning process with particular respect to their social network functionalities and their intuitive interface, both for students and teachers.

Facebook, one of the first mainstream social media, has been positively tested as a valid supporting tool to increase teacher-student and student-student interactions (Balcikanli, 2015). Its use in the classroom allows more attractive lessons thus enhancing students' engagement and performances. Chugh & Ruhi (2018) have proved that the usage of FB helps to promote awareness in the language teaching domain. Moreover, using FB in the learning context has positively affected groupworking dynamics, by improving the involvement of shy students in the online discussion (Harran & Olamijulo, 2014).

Instagram offers interesting features for education, related to the visual-content sharing, private messaging, and hashtag usages. In (Carpenter et al, 2020) a study on the usage of Instagram as an educational tool has involved 841 educators. More than 80% of the interviewed have strongly agreed that Instagram helps to increase the educator's self-efficacy and to enhance their pedagogical knowledge.

Despite the great advantages brought by social media in education, the potential offered by social media technologies could be compromised by the threads associated with their use.

Hate speech, violation of personal rights, psychological attacks, deceiving people with fake accounts, as well as cyberbullying, harassment and insults are some examples of toxic content that can jeopardize adolescent well-being on the Web (Anderson & Jiang, 2018; Maghsoudi et al. 2020).

Based on the analysis of the literature, Willoughby (2019) has identified four areas of risk: cyberbullying and online abuse, exposure to negative forms of user-generated content (such as self-harm, hate, pro-anorexia or sexually explicit content, also known as toxic content), the converging of offline and online networks, and developing interpretations of privacy. The urgency of the risks deriving from the use of social media is so evident that it has become not only the subject of study by researchers, but also of investigations and journalistic insights that have allowed to open a debate at the society level.

Social media are alleged to manipulate their users thus inducing different forms of addiction and affecting the mental health of adolescents. The American docudrama film "The Social Dilemma", released in 2020, clearly unveils how social media leverages big data produced by their users, on top of which executing sophisticated machine learning algorithms in the background that impact decisions of billions of people. Recommendation algorithms are more and more implemented by search engines and social media to filter the content and draw the attention of users only to a selected portion of Web content. The consequences of this scenario are polarization, radicalization, and the creation of filter bubbles and echo chambers (Pariser, 2011; Sunstein, 2018).

Internet and social media users are unwary of these mechanisms, or at best they underestimate the effects that these virtual environments have in real life. Furthermore, these effects are more exacerbated when it comes to adolescents. Actually, children and adolescents are more exposed to the social media threats, since they are unable to perceive the profoundly different dynamics that govern offline and online networks. In particular, the scientific evidence arising from most of the reviewed literature suggests that in general, children, adolescents and those with offline vulnerabilities are most at risk of being harmed by their online activity and that as offline and online social networks converge, so do offline and online problems (Willoughby, 2019). Children with low self-esteem or unsatisfying friendships or parental relations are considered higher risk from social networking sites (Ballantyne et al., 2010; Kwan and Skoric, 2013; O'Neill, Livingstone, & McLaughlin, 2011). Livingstone and colleagues indicated that 1 in 12 children have met an online contact in presence, with a further 30% suggesting they have communicated with someone they have not met face-to-face (Livingstone et al., 2011:8). The meaning and nature of friendships is altered by social media insofar as the interactions and connections children and young people make are not contained to the physical boundaries of being present with one another (Willoughby, 2019).

The importance of the problem also arises from studies that show how the age of subjects at risk is getting lower and lower. In their study with 593 middle school students, Martin and colleagues (2018) have found out that 17% of them started using social media at age nine or younger, 40% accepted friend requests from people they do not know, and 40% reported that their parents did not monitor their social media use.

As underlined at the beginning of this section, the coronavirus pandemic lockdowns have dramatically increased the number of social media users. Furthermore, the lockdowns have forced millions of students at home, and mobile phones and social media have become essential communication tools even for primary school pupils, thus contributing to lower the age of those who use social media (Benigno et al., 2020; Gentile et al., 2021).

Although there are a plethora of studies concerning the task of informing about benefits and risks that come from social media in various contexts for different types of users, there is a lack of educational tools that address how to make users aware of social media risks. In this perspective, Social Media Literacy (SML) can help users and students to become aware of the dark sides of SNSs. It concerns decoding, evaluating and creating communication exploiting social media content representation (e.g text, image) and social interaction (e.g relationships and networks) (Livingstone, 2014). Although there exist tools capable of supporting education processes related to cyberbullying (Calvo-Morata et al., 2019), disinformation (Nygren et al., 2021), to the best of our knowledge, there is scarce evidence of similar tools to increase SML and supporting teaching of Social Media risks in a sense of explaining the underlying algorithms that manage the content filtering, especially if tackled through Artificial Intelligence approaches.

Traditional teaching approaches are not enough to engage students and support them in a conscious and correct use of the internet environment, and the need for innovative learning activities and tools emerges.

In this paper we present an online platform specifically designed to support the development of competences connected to the most recent versions of the Digital Competence Framework for Citizens (Carretero Gomez et al., 2017), and the Global framework of reference on digital literacy skills promoted by UNESCO (Law et al. 2018).

The platform is based on PixelFed, an open-source alternative to Instagram, so that adolescents can practice with an environment they are familiar with. The platform simulates different algorithms adopted by social media to engage their users and maximise the time they spend on them. For instance, the recommendation algorithms that propose to the users, similar content to the one they are interested in. Through our platform teachers can select the algorithms to be analysed together with the students and show to them the effects that different parameters can have in the behaviour of this algorithm itself. Our platform extends the PixelFed environment with functionalities designed according to a neuroscience theoretical approach (Puvia et al., 2020) which makes students aware of the mechanisms behind social media (e.g. the use of artificial intelligence algorithms to filter the content they have access to).

2. Social media literacy in school contexts

Media Literacy Education (MLE) aims at developing information and critical understanding in young people about the nature and categories of media. It concerns the set of knowledge and skills that allow everyone to use the media and their contents in a conscious, effective and safe way. It is a fundamental element of individual training, which schools should also promote. MLE is an education that is an integral part of the cultural background of an active and responsible digital citizen (Bergsma and Carney, 2008).

Furthermore, MLE is important to understand the techniques used by the media to construct, interpret, and disseminate specific messages and languages. The MLE indicates education with the media considered as tools to be used in general educational processes. The purpose of media education is to offer new generations of young adolescents the keys to understanding the media, but also to promote better media quality and a constructive contribution to the relationships that adolescents build on the media. This aspect is particularly relevant especially in recent years with the advent of smartphones, and the wide diffusion of social media. As stated in the introduction, interaction with social media represents the activity that covers most of the hours of a teenager's day. As a consequence, teenagers are continually influenced, both in their intellectual life and in their emotional and social life. From social media teenagers draw important elements to build their own identity, their own models of health and well-being, and of social behavior. It is clear, therefore, that from an educational point of view, it is necessary to promote actions aimed at increasing teenagers' ability in using the social media and the information conveyed by them in a critical and creative way in order to promote their individual and social development.

The online platform presented in this paper aims at supporting the development of competences related to social media literacy. These competences are borrowed from the most recent versions of the Digital Competence Framework for Citizens - DigComp (Carretero Gomez et al., 2017), and the Digital Literacy Global Framework (DLGF) of reference on digital literacy skills promoted by UNESCO (Law et al. 2018).

In particular, the DigiComp framework includes the following five areas of competences related to: 1. Information and data literacy, 2. Communication and collaboration, 3. Digital content creation, 4. Safety, 5. Problem solving. Each of them is organized in subareas covering different aspects of the digital competences at different proficiency levels. The UNESCO DLGF framework features 26 competences organized in seven competence areas. Specifically, it extends the DigComp framework with two additional areas related to: Devices and software operations and Career–related competences. The first concerns basic use of digital devices and basic concepts of hardware and software. The latter includes competences for a particular field focused on the use of specialized digital technologies, and data interpretation and manipulation.

From these frameworks, that are very wide and covering a large number of competences in the digital domain, we have selected a subset of competences that are strongly connected with the development of Social Media Literacy.

The competences included in the subset are reported in Table 1 (the corresponding DigComp competence is reported in brackets).

Table 1: Digital competence and social media

Competence	Description
Browsing, searching and filtering data, information and digital content (DigComp 1.1)	It regards the ability to search for data, information and content as well as to access and navigate them in different digital environments.
Evaluating data, information and digital content (DigComp 1.2)	This competence concerns the ability of analysing, interpreting and critically evaluating the credibility and reliability of data, information and content.
Sharing through digital technologies (DigComp 2.2) and Netiquette (DigComp 2.5)	This competence is focused on data, information and content sharing with others through the appropriate digital technologies, by taking into account the behavioural norms at the basis of the interactions, and by adapting communication strategies to the specific audience.
Managing digital identity (DigComp 2.6)	In this competence the attention is drawn to the management of the digital identities, with particular respect to the protection of one's own reputation, by taking into account the data produced in different digital environments.

Competence	Description
Protecting health and well-being (DigComp 4.3)	This competence addresses the ability of avoiding health-risks and threats to physical and psychological well-being while using digital technologies. It is necessary to be able to protect oneself and others from possible dangers in digital environments (e.g. cyberbullying), being aware of digital technologies for social well-being and social inclusion.

The platform presented in this paper has the aim of supporting learning scenarios in which these competences are stimulated to increase students' awareness in the use of social media.

3. A customized social network environment for social media literacy

In this section we introduce a social network environment specifically designed to support scientific investigations on the use of social media by young adolescents. This environment, which extends an open-source platform alternative to Instagram (named PixelFed), has been developed in the framework of the project "COURAGE - A social media companion safeguarding and educating students, funded by the Volkswagen Foundation in the topic Artificial Intelligence and the Society of the Future.

The COURAGE social network environment allows young adolescents to perceive and elaborate online information in a more critical way than in commercial social network, and to face the challenges posed by the modern digital environments of social networks in which they are imbued.

In particular, this environment provides students with specific use case scenarios in which the effects of different algorithms used by social networks to present content to their users can be studied.

The availability of such an environment, with similar functionalities to the ones that students are familiar with, allows teachers and researchers to investigate students' interactions in social network sites, and allows students to better understand how the content publishing changes according to the tuning of parameters of the algorithms used.

In the next sections we present three use case scenarios implemented in the COURAGE social network environment to support students towards a critical use of social networks, specifically aimed at supporting social media literacy actions in the context of secondary schools.

3.1 Like-Dislike scenario

This first use case scenario, which we call Like-Dislike, has been designed with the aim of providing young adolescents with posts containing specific images or texts and collect their reactions in real-time by adopting different types of interactions such as like/dislike buttons.

The scenario starts by showing a time-line similar to the one available in Facebook (Figure 1). The young adolescent can choose to appreciate or not the content of the post by means of the two buttons. The posts proposed belong to two different categories: one carrying positive messages (including posts with pictures that represent positive emotions) and one carrying negative emotions (including pictures that represent negative emotions).

Each time the young adolescent makes a choice, a new post is generated in the timeline. The generation of the content of the new post can take place on the basis of three different strategies:

- 1. Random generation (50% of the two categories)
- 2. Positive reinforcement generation (70% of the category chosen, 30% of the other).
- 3. Negative reinforcement generation (30% of the category chosen, 70% of the other).

In the first strategy the generation of a new post, whether it is positive or negative, has the same probability.

The Positive reinforcement generation strategy, as well as the Negative reinforcement generation is based on choice that the adolescent did on the previous post. For example, if the young adolescent has appreciated a positive image through the like button, then there will be 70% probability of generating a new post of the same (positive in this case) class and 30% of generating a negative one.

In the Negative reinforcement generation strategy, instead, if the young adolescent has appreciated a positive image through the like button, then there will be 70% probability of generating a new post of the opposite (negative in this case) class and 30% of generating a positive one.

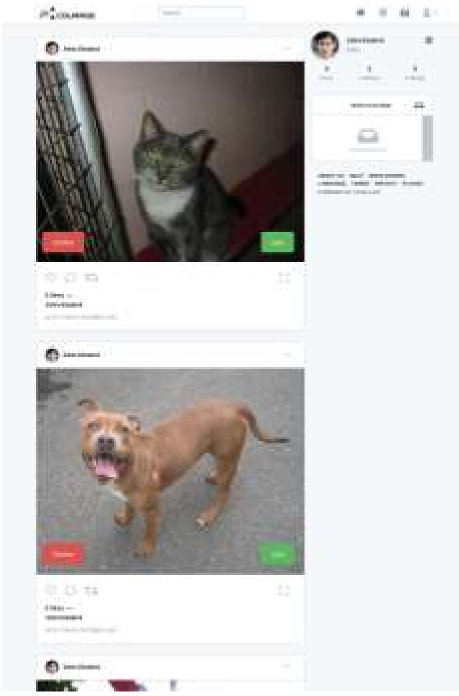

Figure 1: PixelFed timeline with users' post

3.2 Like-Dislike scenario with dynamic probability

The second use case scenario is similar to the one presented in the previous section. Young adolescents can show their preference toward contents by using 'Like' or 'Dislike' buttons but in this scenario a dynamic probability is used to generate new content in the timeline. When the adolescents express a preference for a category, the probability that the next generated post belongs to that class is increased according to following formula:

$$P_i = \frac{m_i + \beta}{m_i + \beta c}$$

where P_i indicates the probability that the next generated post belongs to the i-th class, m_i is the number of times an i-th class post has been chosen by the young adolescent, m is the total number of preferences that the teenager has fulfilled, β is merely an adjustment parameter (used to balance the effects of the number of categories) and c indicates the number of the classes (equal to two in our experiments: positive and negative).

In the setting presented in the Like-Dislike scenarios (with and without dynamic probability) we are able on the one hand, to show to young adolescents how the response of a social network environment changes by varying the parameters provided by the designer and, on the other hand, what are the implications in a social network architecture of pursuing certain actions instead of others. In other words, the goal of this task is to analyse how the social networks work in order to make students aware of the hidden mechanisms that are implemented in them.

3.3 Scenario "Would you share it?"

The third use case scenario presented in this paper is called "Would you share it?". During this task, young adolescents have to fill in a questionnaire regarding morality aspects as shown in Figure 2. Subsequently, a grid of posts showing images will be shown to the user, who can select the posts of her/his own interest (Figure 3).

Once a post has been selected, the young adolescent will be asked whom s/he would like to share this post with (nobody, acquaintances, classmate, friends, family members, everyone) (Figure 4).

Through this task, teachers and researchers can assess young adolescents' willingness to share posts with a specific group of people.

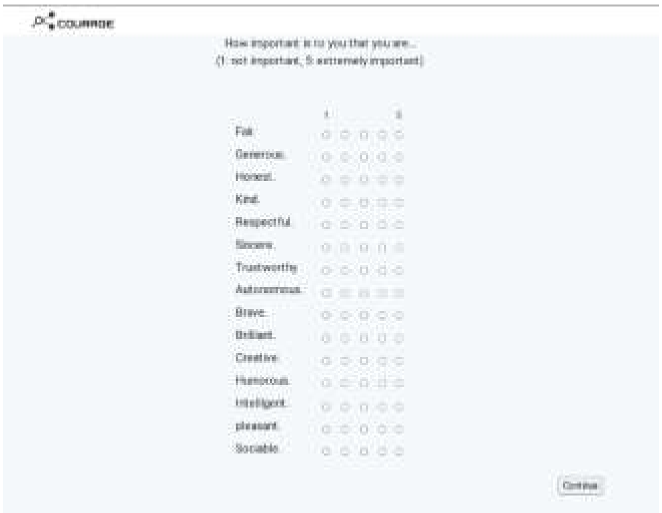

Figure 2: Questionnaire in the customized PixelFed environment

Figure 3: Discovery panel for post selection

Figure 4: Integrating posts and questionnaire in the user interface

4. Pilot

The COURAGE social network environment has been piloted in a preliminary study with students from a secondary school in Palermo (Italy) involving n = 17 adolescents (8 male, 9 female, average age = 16.23 years). The pilot was divided into two phases. The first phase consisted of a training school activity promoting and supporting constructive use of social media through social media literacy learning paths. In particular, the training activity has aimed at mitigating social media risks, such as disinformation and misinformation, echo chamber and filter bubble, improper use of Artificial Intelligence algorithms. Because of the COVID-19 lockdown, the pilot was directed and coordinated online. The second phase consisted of a learning activity in which the COURAGE social network environment has been assessed with the 17 young adolescents participating in the pilot. In particular, the "Would you share it?" use case scenario has been selected for the pilot. In this case 12 images, 6 representing positive emotions, and 6 representing negative emotions have been shown to the participants. These images have been selected from the EMOTIC (EMOTions In Context) dataset, a database of images available for non-commercial research and educational purposes, with people in real environments, annotated with their apparent emotions (Kosti et al. 2019).

Participants have to select alternatively a positive and a negative image and respond to questionnaire in which they express, by assigning a score from 0 to 10, the willingness to share the image with group of persons that are strongly or weakly connected to them. Strong tied connections are represented by groups of persons socially closer to the participants: family members, classmates, or friends, while weak tied connections are acquaintances, or anyone not known. At present, the analysis of the pilot results has highlighted, in general, a greater willingness to share positive images rather than negative ones. In particular, students have expressed the willingness to share positive images more with strong ties than with weak ties. Instead, concerning negative images, participants declared their willingness to share more this type of images with weak ties. These results are highlighted by the comparison of figure 5 and figure 6, in which the average of the scores given by each student respectively for the 6 negative images (figure 5) and 6 positive images (figure 6) are shown.

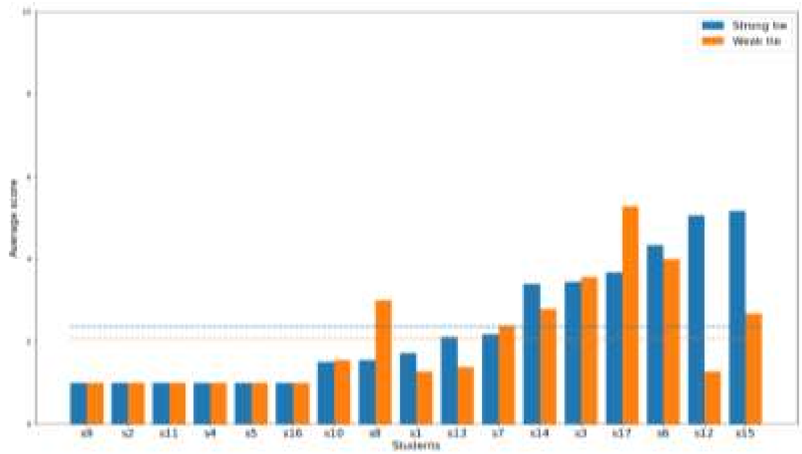

Figure 5: Average score for the willingness to share negative images

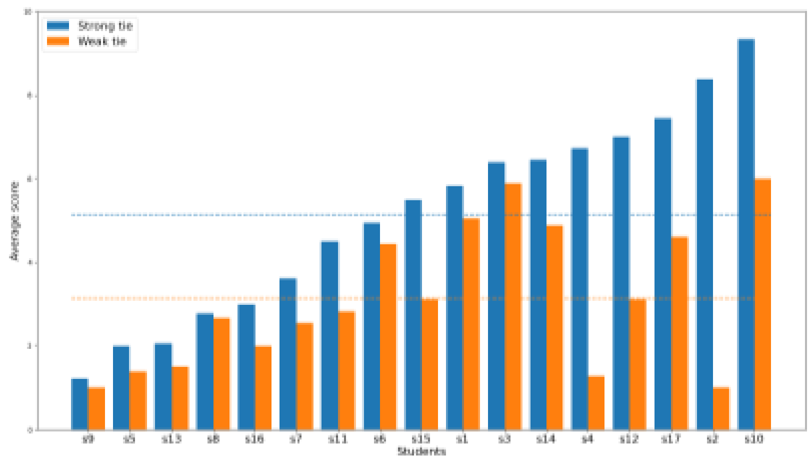

Figure 6: Average score for the willingness to share positive images

5. Conclusions and ongoing work

In this paper we have presented the COURAGE social network environment, an experimental online platform specifically designed with a twofold objective: to assess how young adolescents use social media and support the development of competences related to social media literacy. This platform extends the PixelFed environment, an open-source alternative to Instagram, with functionalities designed to implement learning scenarios that make students aware of the mechanisms behind social media and social networks (such as the use of artificial intelligence algorithms to filter the content they have access to) and provide them with the necessary cultural tools to counteract the problems that arise within social media.

This platform has been piloted with students from a secondary school in Italy. The results of the pilot highlight the willingness of the students to share content with strong ties. This fits with Greenhow and colleagues' findings about the affordances offered by the social media for increasing students' community connections and collaboration (Greenhow, Galvin and Staudt Willet 2019:179).

Moreover, a qualitative analysis conducted during the pilot through structured interviews has shown that specific training activities performed during the pilot have increased students' awareness on the strategies for leveraging the collaborative power of social media and avoiding an unconscious and uncontrolled use of them. These preliminary findings confirm the relevant role of Social Media literacy. In a world where the internet and social media are no longer intended as a tool but as a "place" to live in, it is extremely important to educate children and adolescents to live in these social environments, by offering them support to develop the skills and competences to manage their social world. In particular, Social Media literacy paths in school contexts can provide students with the proper defence instruments to face problems typically met in social media.

This can contribute to increase the awareness of the impressive number of adolescents using social media that is not aware of the risks associated with their use.

In future work we would like to introduce assessment procedures aimed at analysing psychological characteristics of adolescents in correlation with social media use, in particular, mental well-being, life satisfaction and resilience. Furthermore, we would like to use the COURAGE social network environment to further study the effect of social media literacy actions in supporting adolescents to cope with social media risks.

Acknowledgements

This work has been developed in the framework of the COURAGE - A social media companion safeguarding and educating students (no. 95567), funded by the Volkswagen Foundation in the topic Artificial Intelligence and the Society of the Future.

References

Agrifoglio R., Black S., Metallo C. & Ferrara M., (2015). Extrinsic versus Intrinsic Motivation in Continued Twitter Usage. Journal of Computer Information Systems. https://dx.doi.org/10.1080/08874417.2012.11645594

Allam H., Bliemel M., Spiteri L., Blusteind J., Hassan H. (2019) Applying a multi-dimensional hedonic concept of intrinsic motivation on social tagging tools: A theoretical model and empirical validation. International Journal of Information Management. https://doi.org/10.1016/j.ijinfomgt.2018.11.005

Anderson, M., & Jiang, J. (2018). Teens, social media & technology 2018. Pew Research Center. Retrieved from http://www.pewinternet.org/2018/05/31/ teens-social-media-technology-2018

Balcikanli, C. (2015). Prospective English language teachers' experiences in Facebook: Adoption, use and educational use in Turkish context. International Journal of Education and Development Using ICT, 11(3), 82–99.

Ballantyne, N., Duncalf, Z., & Daly, E. (2010). Corporate parenting in the network society. Journal of Technology in Human Services, 28 (1–2).

Benigno, V., Caruso, G., Chifari, A., Ferlino L., Fulantelli G., Gentile M., Allegra M. (2020). Le famiglie italiane e la didattica a distanza durante l'emergenza una prima riflessione, in Roncaglia G. (a cura di), L'educazione e la distanza: le risposte della scuola e il ruolo delle biblioteche scolastiche. Biblioteche oggi Trends, 6(2), 110-134.

Bergsma, L.J., & Carney, M.E. (2008). Effectiveness of health-promoting media literacy education: a systematic review. Health Education Research, 23, pp. 522-542. https://doi.org/10.1093/her/cym084

Bouvier, G., & Machin, D. (2018). Critical discourse analysis and the challenges and opportunities of social media. *Review of Communication*, *18*(3), 178-192.

Calvo-Morata, A., Freire-Morán, M., Martínez-Ortiz, I., & Fernández-Manjón, B. (2019). Applicability of a cyberbullying videogame as a teacher tool: Comparing teachers and educational sciences students. IEEE Access, 7, 55841-55850.

Carpenter, J. P., Morrison, S. A., Craft, M., & Lee, M. (2020). How and why are educators using Instagram? Teaching and Teacher Education, 96, 103149. https://doi.org/10.1016/j.tate.2020.103149

Carretero Gomez S., Vuorikari R., Punie Y. (2017). DigComp 2.1 - The Digital Competence Framework for Citizens. Publications Office of the European Union. ISBN: 978-92-79-68006-9. DOI: 10.2760/38842.

Chen, B., & Bryer, T. (2012). Investigating instructional strategies for using social media in formal and informal learning. International Review of Research in Open and Distributed Learning, 13(1), 87-104.

Chen, H. T., & Li, X. (2017). The contribution of mobile social media to social capital and psychological well-being: Examining the role of communicative use, friending and self-disclosure. *Computers in Human Behavior*, *75*, 958-965.

Chugh, R., & Ruhi, U. (2018). Social media in higher education: A literature review of Facebook. Education and Information Technologies, 23(2), 605-616. doi:10.1080/09523987.2012.662625

Escamilla-Fajardo, P., Alguacil, M., & López-Carril, S. (2021). Incorporating TikTok in higher education: Pedagogical perspectives from a corporal expression sport sciences course. Journal of Hospitality, Leisure, Sport and Tourism Education, 28(August 2020). https://doi.org/10.1016/j.jhlste.2021.100302

Foulger, T., Ewbank, A., Kay, A. Popp, S. & Carter, H. (2009). Moral spaces in MySpace: Preservice teachers' perspectives about ethical issues in social networking. Journal of Research on Technology in Education, 42(1), 1–28. doi:10.1080/15391523.2009.10782539

Fulantelli G., Scifo L., Taibi D. (2021). Training school activities to promote a conscious use of social media and human development according to the ecological systems theory. In Proceedings of International Conference on Computer Supported Education, 23-25 April 2021, online.

Gentile M., Benigno V., Caruso G., Chifari A., Ferlino L., Fulantelli G., Allegra M. (in print). Italian parents' perception about learning practices and educational effectiveness of remote schooling during the first lockdown. Qwerty - Open and Interdisciplinary Journal of Technology, Culture and Education (in print)

Greenhow, C., & Lewin, C. (2016). Social media and education: Reconceptualizing the boundaries of formal and informal learning. Learning, media and technology, 41(1), 6-30.

Greenhow, C., Galvin, S. M., & Staudt Willet, K. B. (2019). What should be the role of social media in education? Policy Insights from the Behavioral and Brain Sciences, 6(2), 178-185.

Harran, M., & Olamijulo, C. (2014). Social media communication spaces to develop literacies in a higher education language classroom context. South African Journal of Higher Education, 28(2), 410-435.

Hootsuite & We Are Social (2020), "Digital 2020 July Global Statshot report", retrieved from https://wearesocial.com/blog/2020/07/digital-use-around-the-world-in-july-2020

Hootsuite & We Are Social (2021), "Digital 2021 April Global Statshot report", retrieved from https://datareportal.com/reports/digital-2021-april-global-statshot https://doi.org/10.1007/s10639-017-9621-2

Junco, R. (2012). The relationship between frequency of Facebook use, participation in Facebook activities, and student engagement. Computers & Education, 58(1), 162–171.

Kane, G. C. (2017). The evolutionary implications of social media for organizational knowledge management. *Information and organization*, *27*(1), 37-46.

Kaplan, A. M., & Haenlein, M. (2010). Users of the world, unite! The challenges and opportunities of Social Media. *Business horizons*, *53*(1), 59-68.

Kwan, G. C. E., & Skoric, M. M. (2013). Facebook bullying: An extension of battles in school. Computers in human behavior, 29(1), 16-25.

Kosti R., Álvarez J.M., Recasens A. and Lapedriza A. (2019). Context based emotion recognition using emotic dataset. IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI), 2019.

Law, N., Woo, D., Torre, T. and Wong, G. (2018). A global framework of reference on digital literacy skills for indicator 4.4.2. UNESCO Institute for Statistics information paper, no. 51. Montreal: UNESCO Institute for Statistics.

Livingstone, S. (2014). Developing social media literacy: How children learn to interpret risky opportunities on social network sites. Communications, 39(3), 283-303. https://doi.org/10.1515/commun-2014-0113

Livingstone, S., Haddon, L., Görzig, A., & Ólafsson, K. (2011). Risks and safety on the internet: The perspective of European children. Full Findings. London: EU Kids Online, LSE.

Maghsoudi, R., Shapka, J., & Wisniewski, P. (2020). Examining how online risk exposure and online social capital influence adolescent psychological stress. Computers in Human Behavior, 113

Mao, J. (2014). Social media for learning: A mixed methods study on high school students' technology affordances and perspectives. Computers in Human Behavior, 33, 213-223.

Martin, F., Wang, C., Petty, T., Wang, W., & Wilkins, P. (2018). Middle school students' social media use. J. of Educational Technology & Society, 21(1), 213-224.

Mbati, L. (2013). Online social media applications for constructivism and observational learning. International Review of Research in Open and Distributed Learning, 14(5), 166-185.

Nygren, T., Guath, M., Axelsson, C. A. W., & Frau-Meigs, D. (2021). Combatting Visual Fake News with a Professional Fact-Checking Tool in Education in France, Romania, Spain and Sweden. Information, 12(5), 201.

O'Keeffe, G. S., & Clarke-Pearson, K. (2011). The impact of social media on children, adolescents, and families. *Pediatrics*, *127*(4), 800-804.

O'Neill, B., Livingstone, S., & McLaughlin, S. (2011). Final recommendations for policy, methodology and research. London: EU Kids Online, LSE

Pariser, E. (2011). The filter bubble: What the Internet is hiding from you. Penguin UK.

Puvia, E., Monteleone, V., Fulantelli, G., & Taibi, D. (2020). Facing the Appeal of Social Networks: Methodologies and Tools to Support Students towards a Critical Use of the Web. CSEDU, 1, 567-573.
Selwyn, N., & Stirling, E. (2016). Social media and education… now the dust has settled. Learning, media and technology, 41(1), 1-5.
Sunstein, C. R. (2018). # Republic: Divided democracy in the age of social media. Princeton University Press.
Wang, C. M. (2012). Using Facebook for cross-cultural collaboration: The experience of students from Taiwan. Educational Media International, 49(1), 63-76.
Willoughby, M. (2019). A review of the risks associated with children and young people's social media use and the implications for social work practice. Journal of Social Work Practice,33(2), 127-140.

Media and Public Opinion About Online Learning During the Covid Pandemic: A Content Analysis of Newspaper Articles

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DOI: 10.34190/EEL.21.016

Abstract: Amid the Covid breakout in 2020, the Malaysian government was forced to temporarily close education institutions in the country to prevent the spread of the virus among students. All of a sudden, students found themselves struggling to accommodate to an online learning environment in which they no longer met their classmates and lecturers in person in a physical classroom. Instead, they needed to sit in front of a computer screen watching live-streamed or pre-recorded lessons, participating in online discussion forums, or submitting their homework to a virtual dropbox. Although some students might have had some experience with a blended learning environment, a complete online learning environment was entirely new to many. Apart from students, lecturers and education institutions from the primary and secondary to the tertiary levels also had to cope with the changing circumstances and technical challenges of online learning. This study attempted to better understand people's discussions about teaching and learning in an online environment during the pandemic period, particularly the issues faced by students, lecturers, and education institutions. Using a text analytics software, this study performed a content analysis on a total of 322 newspaper articles that were published between January to September 2020 in the top three English newspapers in Malaysia. These articles covered issues pertaining to private and public education institutions from the primary to the tertiary levels. The findings show that the discussions can be categorised into twelve underlying themes, i.e. internet accessibility, learning continuity, learning environment, learning design, learning activities, learning resources, learning technology, learning performance, online learning benefits, online learning challenges, self-directed learning, and skill sets. The findings from this study can be useful to stakeholders in the education and training sector, e.g. students, parents, lecturers, governments, education institutions, etc., in different ways to further improve the overall teaching and learning experience in an online environment.

Keywords: content analysis, learning environment, teaching and learning, online learning, pandemic

1. Introduction

A new type of virus that can cause human respiratory infections has been in the news since January 2020. As the virus outbreak spread quickly across the globe, it resulted in a high number of deaths. The World Health Organization (WHO) officially named the virus "Covid-19" on 11 February 2020 and publicly declared the virus outbreak a pandemic on 11 March 2020 (WHO, 2020).

To contain the spread of the virus, many countries have been forced to implement drastic measures, such as restricting international travel, closing schools and non-essential businesses, and enforcing mask-wearing, etc. The Malaysian government adopted the same approach by enforcing a nationwide Movement Control Order (MCO) on 18 March 2020 (The Star, 2020). As a result of the closure order, education institutions, lecturers, and parents faced pressure to minimise learning disruption as students stayed at home. Online learning was therefore regarded the most viable alternative to face-to-face classroom learning.

However, full online learning is relatively new to many Malaysian students. Prior to the pandemic, although most universities had a learning management system for their students to access online learning materials, students still physically attended classes on campus. In blended learning environments, although students were able to access certain learning activities online, they would still interact with their classmates and lecturers in physical classes. In comparison to university students, primary and secondary school students would have substantially less experience with online learning.

Full online learning is challenging to not only students but also to other relevant stakeholders. For example, lecturers need to adapt to a new teaching environment, e.g. adopting a different teaching pedagogy, preparing suitable learning materials, and learning to use various technology tools. Education institutions and the government need to have the technological infrastructure ready to support a full online learning environment, e.g. hardware and software, broadband connectivity, and technical support. Parents are worried whether their children are able to learn effectively at home.

To better understand the issues faced by students, lecturers, and education institutions with regard to online learning during this pandemic period, this study performed a content analysis of newspaper articles, published from January to September 2020, in the top three English newspapers in Malaysia. The analysis focused on newspaper articles related to teaching and learning in Malaysia, and excluded articles that reported about other countries as well as those that were not relevant to teaching and learning.

The remainder of this paper provides a background to the research, explains the data collection method, presents the text analysis results, and concludes with a discussion of the key themes identified from the text analysis.

2. Research background

To continue teaching and learning activities during the pandemic period, education institutions in Malaysia quickly shifted from conventional face-to-face learning to full online learning. This allowed students to continue attending classes as scheduled, albeit in an online learning environment. In such an environment, students and lecturers rely heavily on various key digital technology for online lessons, sharing of learning resources, student-student or student-lecturer interactions, and so on. Common digital technology resources used are learning management systems (e.g. Moodle, Blackboard, CourseNetworking, Google Classrooms), social media apps (e.g. WhatsApp, Facebook Livestream), or video conferencing tools (e.g. Zoom, Microsoft Teams, Google Meet).

However, students, lecturers, and education institutions still face various issues during this transition period. For example, some students and lecturers may have had prior online learning or teaching experience as a result of having studied or worked in a blended learning environment before the Covid breakout. However, the learning and teaching experience is entirely different in a full online learning environment. There are also many students or lecturers who do not have any online learning or teaching experience as they had only been in a face-to-face learning environment. Therefore, it takes time for students and lecturers to adjust to learning and teaching in a full online learning environment. In addition, assessment tasks may need to be revised or redesigned so that they are suitable for an online learning environment without compromising the intended learning outcomes (New Straits Times, 2020). Other frequently reported issues include poor internet access, communication difficulties with lecturers, slow access to learning materials, etc. (Malay Mail, 2020).

3. Data collection

Although the MCO began on 18 March 2020, as early as January 2020, Malaysian newspapers had already been reporting on the increasing infection cases in other countries and the viability of online learning as an alternative learning delivery mode. To capture newspaper discussions about challenges faced by students, lecturers, and education institutions with regard to online learning during the Covid pandemic, this study searched for newspaper articles, ranging from nation news, education news, opinion columns to letters from readers, that were published between 1 January 2020 and 30 September 2020 in three major English newspapers in Malaysia, i.e. New Straits Times (NST), The Sun, and The Star. The breadth of discussions in these articles covered education institutions from the primary to the tertiary levels.

Using the search terms “online learning” and “e-learning”, a search for newspaper articles on Google found a total of 786 articles. Table 1 shows the search results. To download the contents of the articles from the respective newspaper websites, a cloud-based web scraping software, Octoparse 8, was used. The article contents were saved in Excel spreadsheets for further text analysis.

Table 1: Google search results

Search terms	NST	The Sun	The Star	Total
e-learning	118	19	207	344
Online learning	170	38	234	442

4. Text analysis and results

Before the text analysis process could begin, the articles were read to filter out irrelevant articles. Articles that were not written in the Malaysian context (e.g. those about other countries) or those that were not specific to teaching and learning (e.g. commercial advertisements about learning institutions) were first removed. Any duplicate articles were also removed. In total, 464 articles were removed. The remaining 322 articles from NST (115), The Sun (22), and The Star (185) were further analysed. Table 2 shows the distribution of those articles by month.

Table 2: Number of articles by month (2020)

Month	Number of articles
January	0
February	1
March	30
April	73
May	77
June	67
July	41
August	16
September	17
Total	322

This text analysis process follows the qualitative content analysis steps proposed by Bengtsson (2016), i.e. decontextualisation, recontextualisation, and categorisation. A text analytics software, RapidMiner Studio, was used to perform the decontextualisation step. This step began with extracting the text of the articles, followed by tokenising the text, transforming the cases, filtering the stopwords, and generating the n-Grams (3-gram). The final output of this step was a list of slightly more than 19,000 entries. The list was further analysed to remove any trivial entries to obtain a preliminary list for the recontextualisation step. The objective of the recontextualisation step was to ensure that the entries on the preliminary list matched the context of the original articles. Non-matching entries were removed to create a final list. Lastly, the categorisation step sorted the entries on the final list to reveal twelve themes. These twelve themes are: internet accessibility, learning continuity, learning environment, learning design, learning activities, learning resources, learning technology, learning performance, online learning benefits, online learning challenges, self-directed learning, and skill sets.

To further examine the trend of such terms as "online learning", "e-learning", and other related terms occurring in the texts, a separate analysis was performed on the texts from each month. Table 3 shows the frequency of occurrence of each term by month.

Table 3: Frequency of occurrence of terms by month (2020)

Terms	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Total (by term)
Online learning	1	49	119	123	113	55	17	18	495
e-learning	0	70	105	88	50	23	9	13	358
Online teaching	1	13	38	33	22	11	3	6	127
Digital learning	0	3	6	10	15	0	0	10	44
Face-to-face teaching	3	6	7	11	13	0	0	0	40
Distance learning	0	7	3	14	7	2	0	3	36
Remote learning	0	0	11	6	9	8	0	0	34
Face-to-face learning	1	0	2	10	10	6	4	0	33
Blended learning	1	5	0	4	2	7	4	0	23
Classroom learning	0	0	5	4	3	0	0	0	12
Total (by month)	7	153	296	303	244	112	37	50	

5. Discussion and conclusion

It is interesting to note that the amount of discussion in the newspapers regarding online learning in the first two months of 2020 (zero in January and one in February) was negligible. However, as Malaysia first closed education institutions in March (The Star, 2020), the number of articles relating to online learning began to increase and peaked from April to June 2020, and slowed down from July onwards. In these articles, besides online learning and e-learning being the top two most frequently mentioned terms, other terms like online teaching, digital learning, face-to-face teaching, and classroom learning were also used. Some terms were used interchangeably, e.g. online learning or teaching, e-learning, and digital learning.

The topics of the discussions in the newspapers are consistent with areas of concern that past literature has reported about the use of online learning for teaching and learning in education institutions. These topics are categorised into twelve themes: internet accessibility, learning continuity, learning environment, learning design, learning activities, learning resources, learning technology, learning performance, online learning benefits, online learning challenges, self-directed learning, and skill sets.

5.1 Internet accessibility

Good-quality internet service is a key enabler for students to attain a satisfying learning experience in an online learning environment. Without access to fast and affordable internet service, it is challenging for students to attend online classes, download learning materials, watch lecture recordings, and so on. However, not all students can enjoy good internet access because of poor network infrastructure in rural areas (Dube, 2020) or unaffordable data rates (Bacher-Hicks, Goodman and Mulhern, 2021). Thus, the need to address the digital divide has become increasingly apparent during the pandemic period. Unstable internet connection is also a cause of anxiety for students (Bennett, Uink and Cross, 2020). In addition, another critical issue is the lack of digital devices at home, such as computers or smartphones, with which to access the internet (Kalman, Macias Esparza and Weston, 2020).

5.2 Learning continuity

The increasing number of Covid infection cases has forced many education institutions to stop face-to-face classes. To enable students to continue their learning, online learning seems to be the only alternative. Moving learning to an online environment allows students to safely stay at home and yet be able to attend classes as usual on the web (Dinh and Nguyen, 2020; Mitchell, 2020; Reyna, 2020). In this sudden shift to online learning, synchronous online lectures or asynchronous pre-recorded lectures replace face-to-face lectures (Carolan et al., 2020). However, prolonged school closure may cause stress or anxiety for some students (Debbarma and Durai, 2021) or inconvenience for students with special needs (Yarimkaya and Esenturk, 2020). In addition, certain learning activities are difficult to be effectively accomplished online, e.g. field practice in social work studies (Azman et al., 2020) or practical or clinical training in medical education (Olum et al., 2020).

5.3 Learning environment

Several basic characteristics differentiate online learning from face-to-face learning, e.g. lecture delivery (face-to-face vs. online), group discussion (classroom-based vs. web-based), and learning feedback (immediate vs. delayed) (Thai, de Wever and Valcke, 2017). Online learning can be delivered in synchronous and asynchronous modes. In synchronous mode, the delivery is real-time online interaction between students and lecturers; whereas in asynchronous mode, the delivery is on an online learning platform which allows many students to access learning materials at a place and time convenient to them (Bryson and Andres, 2020). However, not every student or lecturer has the same level of experience or expectations (Simon et al., 2020), readiness (Küsel, Martin and Markic, 2020), or academic skills (Mirķe, Cakula and Tzivian, 2019) to implement and engage in online learning effectively. Thus, some students may struggle with and be disadvantaged by full online learning.

5.4 Learning design

Effective learning delivery in an online learning environment requires the alignment of such learning design elements as teaching pedagogy and strategies, learning objectives and outcomes, and assessment tasks (Reyna, 2020). To deliver the intended learning outcomes, a good learning design should also consider the learning platform, learning tools and technologies, subject content, lecturers, and students (Jan and Vlachopoulos, 2018). Learning design should also consider student characteristics, learning needs, learning styles, and prior online learning experience in determining an appropriate teaching strategy (Li et al., 2017; Tratnik, Urh and Jereb, 2019). The overall quality of learning design affects the learning experience of online students (Bearman, Lambert and O'Donnell, 2020) and their learning satisfaction (Li, Marsh and Rienties, 2016). Therefore, the design of online learning activities require careful consideration to ensure that intended learning outcomes are achieved.

5.5 Learning activities

Learning activities that are commonly utilised in a face-to-face learning environment are not necessarily suitable for online learning and may need to be redesigned. Instead of merely replicating face-to-face learning activities (Watermeyer et al., 2021), lecturers need to rethink their pedagogic approach to design learning activities that are effective for online learning (Bryson and Andres, 2020). To design creative learning activities that better engage online students (Chen et al., 2018) and facilitate student interactions (Coman et al., 2020), lecturers would need to effectively incorporate such learning activities as online discussions, presentations, self-reflection (Azman et al., 2020), interactive gamified learning activities (Chen et al., 2018), or asynchronous online discussions (Thomas and Thorpe, 2019). Jamison and Bolliger (2020) highlight that despite the usefulness of interactive and collaborative group activities, it is also necessary to design individual activities to accommodate different learning needs.

5.6 Learning resources

The availability of learning resources is valuable to students in an online learning environment, especially during the pandemic period when school campuses are closed. While learning from home, students require access to learning resources on learning management systems or the web (Bacher-Hicks, Goodman and Mulhern, 2021). Well-designed learning resources complement learning delivery and provide a good learning experience (McDougall, 2019). Jeong and Hmelo-Silver (2010) explain that learning resources are information or tools that students can leverage to aid in their learning and can exist internally (e.g. prior knowledge) or externally (lecturers or books). Learning resources also differ in functions such as information repositories (e.g. books, videos) or information processing tools (e.g. calculators, visualisation tools), or in paper or digital form (e.g. text, pictures, multimedia, video). To effectively use and learn from online learning resources, it is essential to educate students about the types of resources that are available and the ways to access them before the students embark on an online learning programme.

5.7 Learning technology

Technology plays a key enabling role in online learning. Apart from internet access, learning technologies such as computers, tablets, smartphones, learning management systems (e.g. Moodle and Blackboard), learning platforms (e.g. Google Classroom), video conferencing platforms (e.g. Zoom, Microsoft Teams), social media platforms (e.g. Facebook, Twitter, WhatsApp), learning tools (e.g. Google Apps, Office 365), etc. are also parts of the whole ecosystem (Heggart and Yoo, 2018; Robinson, 2019; Turhangil Erenler, 2020). For online learning to be effective, it is essential to examine the readiness and attitudes of students in using technologies for learning purposes, e.g. technology literacy and competency (Küsel, Martin and Markic, 2020; Robinson, 2019). Lecturers and education institutions need to know how to better leverage technologies and engage students for effective learning (Bouilheres et al., 2020). In addition, easily accessible and responsive technology support is also a key aspect, e.g. helpdesk, to assist users with any technical issues (Davis et al., 2019).

5.8 Learning performance

Learning performance is not merely about learning new knowledge and skills, but also about applying them (Yin and Yuan, 2021). There have been interest in the factors that contribute to better learning performance among online students, e.g. physical activity and sedentary behaviours (Gijselaers et al., 2016), student engagement (Tao, Zhang and Lai, 2018), cognitive and metacognitive strategies (Ramirez-Arellano, Bory-Reyes and Hernandez-Simon, 2019), and features of online learning design (McNaught, Lam and Cheng, 2012). To help students in the learning process towards achieving better performance, Coman et al. (2020) and Reyna (2020) suggest strategies such as timely feedback to students, learning support, task diversity, different teaching tools, different ways to present information in different formats, and student motivation and engagement. Therefore, efforts to make online learning engaging should not happen at the expense of instructional practices that are fundamental to improving learning performance.

5.9 Online learning benefits

Without the physical constraints of face-to-face learning environments, such as space, location, and class size, online learning offers essential benefits to the education sector. A unique characteristic of online learning is that students can still attend classes any time and any place using a digital device connected to the internet. Besides learning flexibility and convenience, other key benefits of online learning include easy accessibility of online learning resources and better learning experience with interactive online activities (Bolliger and Martin, 2018; Regmi and Jones, 2020). In addition, online learning enables self-paced individualised learning which gives students greater autonomy to progress based on their learning pace and abilities (Gonçalves, Sousa and Pereira, 2020; Warren et al., 2020). For example, students can watch lecture recordings to review a topic whenever necessary (Kalman, Macias Esparza and Weston, 2020). Online learning not only benefits students but also helps lecturers and education institutions to overcome the limitations of face-to-face learning. Despite the challenges created by the sudden shift to online learning, people have also begun to realise the benefits of online learning.

5.10 Online learning challenges

The shift to online learning presents challenges to students, lecturers, and education institutions, especially those who have no prior experience with this mode of learning (Debbarma and Durai, 2021). Not only do students and lecturers need to adapt to a new learning environment, they also face technology issues (e.g. internet connection, digital skills, digital devices), teaching and learning issues (e.g. group interaction and communication, development of learning activities and resources), personal issues (e.g. suitable space at home, time management), and emotional or social issues (e.g. anxiety, isolation) (Azman et al., 2020; Youmans, 2020; Zhang et al., 2020). Education institutions also encounter challenges related to technology infrastructure and support, digital literacy of lecturers, and staff attitudes towards online learning (Carolan et al., 2020; O'Doherty et al., 2018). Lecturers' challenges relate to experience in teaching online, change in teaching styles, and digital skills (Coman et al., 2020). In addition, students with special needs may have additional difficulties in using technologies or in concentrating on their studies (Murphy, Malenczak and Ghajar, 2019).

5.11 Self-directed learning

As online learning requires a higher degree of self-directed learning or self-regulated learning, students need to have higher self-discipline, passion, and self-responsibility to learn. Students who lack the motivation will find it challenging to learn effectively in such an environment (Kalman, Macias Esparza and Weston, 2020; Tratnik, Urh and Jereb, 2019). Students' levels of motivation differ based on such factors as students' characteristics and passion for a subject (Kalman, Macias Esparza and Weston, 2020). Motivation is a prerequisite for engagement. Therefore, students who are motivated to learn tend to have a higher level of cognitive, behavioral and emotional engagement (Dutton, 2019). Students who are more involved in active learning practices tend to be more engaged in their learning (Cole, Lennon and Weber, 2019). Higher student engagement may eventually lead to better student performance (Soffer and Cohen, 2019). For effective online learning to take place, there is a need for lecturers to precede online learning instruction with some instruction on how to practice self-directed learning in an online environment.

5.12 Skill sets

Students require certain important skill sets to successfully engage in effective online learning. For example, as students take more personal responsibility in their learning, such skills as time management, planning, comprehension, and critical thinking are necessary (Coman et al., 2020; Simon et al., 2020). Other skills like self-regulation, goal setting, self-efficacy, and social skills are also important (Tseng, Yi and Yeh, 2019). Students should also know how to interact well with others to participate meaningfully in online discussions (Wise et al., 2013). To be able to navigate through the online learning resources or to search, review, and use information that is abundantly available online, information literacy skills are essential (Jeong and Hmelo-Silver, 2010; Zakharov and Maybee, 2019). Similarly, lecturers need certain skills as well for effective online teaching, e.g. digital competencies (Blayone et al., 2018). Education institutions cannot assume that students and lecturers would be able to embark on online learning effectively. Instead, education institutions need to provide training in these skill sets to ensure successful online learning and teaching.

In conclusion, this study has identified twelve themes from people's discussions in the Malaysian national newspapers about teaching and learning in an online environment during the Covid pandemic. These themes reflect issues of concern to the Malaysian media and public, and therefore provide useful insights for relevant stakeholders, e.g. students, lecturers, parents, course designers, education institutions, and governments. For example, governments could expand broadband infrastructure to make internet access more widespread and affordable (Mitchell, 2020). Education institutions could invest in high-quality learning platforms and technologies that are easy for students and lecturers to use (Robinson, 2019) and provide sufficient training for lecturers to increase their readiness for online learning delivery (Cutri, Mena and Whiting, 2020). Besides providing students with the learning materials, it is also essential for lecterers to leverage active and interactive learning activities to help facilitate learning (Lamon et al., 2020). Students who do not adjust well to an online learning environment may feel overwhelmed and pressured; they might therefore require additional support from their lecturers and parents (Coman et al., 2020). Effective online teaching and learning can only be achieved if lecturers and students are provided with sufficient support for them to be successful.

References

Azman, A., Singh, P.S.J., Parker, J. and Crabtree, S.A. (2020) "Addressing Competency Requirements of Social Work Students during the COVID-19 Pandemic in Malaysia", *Social Work Education*, Vol. 39, pp 1058-1065.

Bacher-Hicks, A., Goodman, J. and Mulhern, C. (2021) "Inequality in Household Adaptation to Schooling Shocks: Covid-Induced Online Learning Engagement in Real Time", *Journal of Public Economics*, Vol. 193, pp 104345.

Bearman, M., Lambert, S. and O'Donnell, M. (2021) "How a Centralised Approach to Learning Design Influences Students: A Mixed Methods Study", *Higher Education Research and Development*, Vol. 40 No. 4, pp 692-705.

Bengtsson, M. (2016) "How to Plan and Perform a Qualitative Study Using Content Analysis", *NursingPlus Open*, Vol. 2, pp 8-14.

Bennett, R., Uink, B. and Cross, S. (2020) "Beyond the Social: Cumulative Implications of COVID-19 for First Nations University Students in Australia", *Social Sciences & Humanities Open*, Vol. 2, No. 1, pp 100083.

Blayone, T.J.B., Mykhailenko, O., van Oostveen, R., Grebeshkov, O., Hrebeshkova, O. and Vostryakov, O. (2018) "Surveying Digital Competencies of University Students and Professors in Ukraine for Fully Online Collaborative Learning", *Technology, Pedagogy and Education*, Vol. 27, No. 3, pp 279-296.

Bolliger, D.U. and Martin, F. (2018) "Instructor and Student Perceptions of Online Student Engagement Strategies", *Distance Education*, Vol. 39, No. 4, pp 568-583.

Bouilheres, F., Le, L.T.V.H., McDonald, S., Nkhoma, C. and Jandug-Montera, L. (2020) "Defining Student Learning Experience through Blended Learning", *Education and Information Technologies*, Vol. 25, No. 4, pp 3049-3069.

Bryson, J. R. and Andres, L. (2020) "Covid-19 and Rapid Adoption and Improvisation of Online Teaching: Curating Resources for Extensive Versus Intensive Online Learning Experiences", *Journal of Geography in Higher Education*, Vol. 44, No. 4, pp 608-623.

Carolan, C., Davies, C.L., Crookes, P., McGhee, S. and Roxburgh, M. (2020) "COVID 19: Disruptive Impacts and Transformative Opportunities in Undergraduate Nurse Education", *Nurse Education in Practice*, Vol. 46, pp 102807-102807.

Chen, C.C., Huang, C.C., Gribbins, M. and Swan K. (2018) "Gamify Online Courses with Tools Built into Your Learning Management System (LMS) to Enhance Self-Determined and Active Learning", *Online Learning Journal*, Vol. 22, No. 3, pp 41-54.

Cole, A.W., Lennon, L. and Weber, N.L. (2019) "Student Perceptions of Online Active Learning Practices and Online Learning Climate Predict Online Course Engagement", *Interactive Learning Environments*, pp 1-15.

Coman, C., Tiru, L.G., Mesesan-Schmitz, L., Stanciu, C. and Bularca, M.C. (2020) "Online Teaching and Learning in Higher Education during the Coronavirus Pandemic: Students' Perspective", *Sustainability*, Vol. 12, No. 24, pp 10367.

Cutri, R.M., Mena, J. and Whiting, E.F. (2020) "Faculty Readiness for Online Crisis Teaching: Transitioning to Online Teaching during the COVID-19 Pandemic", *European Journal of Teacher Education*, Vol. 43, pp 523-541.

Davis, C., Greenaway, R., Moore, M. and Cooper, L. (2019) "Online Teaching in Social Work Education: Understanding the Challenges", *Australian Social Work*, Vol. 72, No. 1, pp 34-46.

Debbarma, I. and Durai, T. (2021) "Educational Disruption: Impact of COVID-19 on Students from the Northeast States of India", *Children and Youth Services Review*, Vol. 120, pp 105769-105769.

Dinh, L.P. and Nguyen, T.T. (2020) "Pandemic, Social Distancing, and Social Work Education: Students' Satisfaction with Online Education in Vietnam", *Social Work Education*, Vol. 39, No. 8, pp 1074-1083.

Dube, B. (2020) "Rural Online Learning in the Context of COVID 19 in South Africa: Evoking an Inclusive Education Approach", *Multidisciplinary Journal of Educational Research*, Vol. 10, No. 2, pp 135-157.

Dutton, K. (2019). "Learner Engagement: The Relationship between Learners, Instructors, and Content in Online Education", *Development and Learning in Organizations*, Vol. 33, No. 1, pp 31-33.

Gijselaers, H.J., Kirschner, P.A., Verboon, P. and de Groot, R.H. (2016) "Sedentary Behavior and not Physical Activity Predicts Study Progress in Distance Education", *Learning and Individual Differences*, Vol. 49, pp 224-229.

Gonçalves, S.P., Sousa, M.J. and Pereira, F.S. (2020) "Distance Learning Perceptions from Higher Education Students - The Case of Portugal", *Education Sciences*, Vol. 10, No. 12, pp 374.

Heggart, K. and Yoo, J. (2018) "Getting the Most from Google Classroom: A Pedagogical Framework for Tertiary Educators", *The Australian Journal of Teacher Education*, Vol. 43, No 3, pp 140-153.

Jamison, T.E. and Bolliger, D.U. (2020) "Student Perceptions of Connectedness in Online Graduate Business Programs", *Journal of Education for Business*, Vol. 95, No. 5, pp 275-287.

Jan, S. K. and Vlachopoulos, P. (2018) "Influence of Learning Design of the Formation of Online Communities of Learning", *International Review of Research in Open and Distance Learning*, Vol. 19, No. 4, pp 1-16.

Jeong, H. and Hmelo-Silver, C.E. (2010) "Productive Use of Learning Resources in an Online Problem-Based Learning Environment", *Computers in Human Behavior*, Vol. 26, No. 1, pp 84-99.

Kalman, R., Macias Esparza, M. and Weston, C. (2020) "Student Views of the Online Learning Process during the COVID-19 Pandemic: A Comparison of Upper-Level and Entry-Level Undergraduate Perspectives", *Journal of Chemical Education*, Vol. 97, No. 9, pp 3353-3357.

Küsel, J., Martin, F. and Markic, S. (2020) "University Students' Readiness for Using Digital Media and Online Learning-Comparison between Germany and the USA", *Education Sciences*, Vol. 10, No. 313, pp 313.

Lamon, S., Knowles, O., Hendy, A., Story, I. and Currey, J. (2020) "Active Learning to Improve Student Learning Experiences in an Online Postgraduate Course", *Frontiers in Education*, Vol. 5, pp 227.

Li, N., Marsh, V. and Rienties, B. (2016) "Modelling and Managing Learner Satisfaction: Use of Learner Feedback to Enhance Blended and Online Learning Experience: Modelling and Managing Learner Satisfaction", *Decision Sciences Journal of Innovative Education*, Vol. 14, No. 2, pp 216-242.

Li, N., Marsh, V., Rienties, B. and Whitelock, D. (2017) "Online Learning Experiences of New Versus Continuing Learners: A Large-Scale Replication Study", *Assessment and Evaluation in Higher Education*, Vol. 42, No. 4, pp 657-672.

Malay Mail (2020) "Reality for Malaysia's University Students: Online Learning Challenges, Stress, Workload; Possible Solutions for Fully Digital Future until Dec", [online] Available at: https://www.malaymail.com/news/malaysia/2020/05/30/reality-for-malaysias-university-students-online-learning-challenges-stress/1870717 [Accessed 09 January 2021]

McDougall, J. (2019) "I Never Felt Like I Was Alone": A Holistic Approach to Supporting Students in an Online, Pre-University Programme", *Open Learning*, Vol. 34, No. 3, pp 241-256.

McNaught, C., Lam, P. and Cheng, K.F. (2012) "Investigating Relationships between Features of Learning Designs and Student Learning Outcomes", *Educational Technology Research and Development*, Vol. 60, No. 2, pp 271-286.

Mirķe, E., Cakula, S. and Tzivian, L. (2019) "Measuring Teachers-As-Learners' Digital Skills and Readiness to Study Online for Successful e-Learning Experience", *Journal of Teacher Education for Sustainability*, Vol. 21, No. 2, pp 5-16.

Mitchell, S.I. (2020) "Ethical Concerns of School Closures for Low-Income School Aged Children", *Voices in Bioethics*, Vol. 6, pp 1-6.

Murphy, A.; Malenczak, D. and Ghajar, M. (2019) "Identifying Challenges and Benefits of Online Education for Students with a Psychiatric Disability", *Journal of Postsecondary Education and Disability*, Vol. 32, No. 4, pp 395-409.

New Straits Times (2020) "Covid19, MCO Force Education Sector to Grapple with Technology, Virtual Classrooms", [online] Available at: https://www.nst.com.my/news/nation/2020/04/586033/covid19-mco-force-education-sector-grapple-technology-virtual-classrooms [Accessed 09 January 2021]

O'Doherty, D., Dromey, M., Lougheed, J., Hannigan, A., Last, J. and McGrath, D. (2018) "Barriers and Solutions to Online Learning in Medical Education - An Integrative Review", *BMC Medical Education*, Vol 18, No. 1, pp 130-130.

Olum, R., Atulinda, L., Kigozi, E., Nassozi, D. R., Mulekwa, A., Bongomin, F. and Kiguli, S. (2020) "Medical Education and E-Learning During COVID-19 Pandemic: Awareness, Attitudes, Preferences, and Barriers Among Undergraduate Medicine and Nursing Students at Makerere University, Uganda", *Journal of Medical Education and Curricular Development*, Vol. 7, pp 1-9.

Ramirez-Arellano, A., Bory-Reyes, J. and Hernández-Simón, L.M. (2019) "Emotions, Motivation, Cognitive–Metacognitive Strategies, and Behavior as Predictors of Learning Performance in Blended Learning", *Journal of Educational Computing Research*, Vol. 57, No. 2, pp 491-512.

Regmi, K. and Jones, L. (2020) "A Systematic Review of the Factors - Enablers and Barriers - Affecting E-Learning in Health Sciences Education", *BMC Medical Education*, Vol. 20, No. 1, pp 91.

Reyna, J. (2020) "Twelve Tips for COVID-19 Friendly Learning Design in Medical Education", *MedEdPublish*, Vol. 9, No 1, pp 103.

Robinson, T. (2019) "Using the Technology Acceptance Model to Examine Technology Acceptance of Online Learning Technologies by Non-Traditional Students", *Journal of Educational Technology*, Vol. 16, pp 21-32.

Simon, L.E., Genova, L.E., Kloepper, M.L.O. and Kloepper, K.D. (2020) "Learning Postdisruption: Lessons from Students in a Fully Online Nonmajors Laboratory Course", *Journal of Chemical Education*, Vol. 97, No. 9, pp 2430-2438.

Soffer, T. and Cohen, A. (2019) "Students' Engagement Characteristics Predict Success and Completion of Online Courses", *Journal of Computer Assisted Learning*, Vol. 35, No. 3, pp 378-389.

Tao Z., Zhang B. and Lai, I.K.W. (2018) Perceived Online Learning Environment and Students' Learning Performance in Higher Education: Mediating Role of Student Engagement. In: S. Cheung, J. Lam, K. Li, O. Au, W. Ma and W. Ho (Eds.) *Technology in Education: Innovative Solutions and Practices*, Springer, Singapore.

Thai, N.T.T., de Wever, B. and Valcke, M. (2020) "Face-to-face, Blended, Flipped, or Online Learning Environment? Impact on Learning Performance and Student Cognitions", *Journal of Computer Assisted Learning*, Vol. 36, No. 3, pp 397-411.

The Star (2020) "Malaysia Announces Movement Control Order After Spike in Covid-19 Cases (updated)", [online] Available at: https://www.thestar.com.my/news/nation/2020/03/16/malaysia-announces-restricted-movement-measure-after-spike-in-covid-19-cases [Accessed 09 January 2021]

Thomas, G. and Thorpe, S. (2019) "Enhancing the Facilitation of Online Groups in Higher Education: A Review of the Literature on Face-To-Face and Online Group-Facilitation", *Interactive Learning Environments*, Vol. 27, No. 1, pp 62-71.

Tratnik, A., Urh, M. and Jereb, E. (2019) "Student Satisfaction with an Online and a Face-To-Face Business English Course in a Higher Education Context", *Innovations in Education and Teaching International*, Vol. 56, No. 1, pp 36-45.

Tseng, H., Yi, X. and Yeh, H.T. (2019) "Learning-Related Soft Skills among Online Business Students in Higher Education: Grade Level and Managerial Role Differences in Self-Regulation, Motivation, and Social Skill", *Computers in Human Behavior*, Vol. 95, pp 179-186.

Turhangil Erenler, H.H. (2020) "A Structural Equation Model to Evaluate Students' Learning and Satisfaction", *Computer Applications in Engineering Education*, Vol. 28, No. 2, pp 254-267.

Warren, N., Parker, S., Khoo, T., Cabral, S. and Turner, J. (2020) "Challenges and Solutions when Developing Online Interactive Psychiatric Education", *Australasian Psychiatry: Bulletin of the Royal Australian and New Zealand College of Psychiatrists*, Vol. 28, No. 3, pp 359-362.

Watermeyer, R., Crick, T., Knight, C. and Goodall, J. (2021) "COVID-19 and Digital Disruption in UK Universities: Afflictions and Affordances of Emergency Online Migration", *Higher Education*, Vol. 81, No. 3, pp 623-641.

WHO (2020) "Listings of WHO's response to COVID-19", [online] Available at: https://www.who.int/news/item/29-06-2020-covidtimeline [Accessed 09 January 2021]

Wise, A.F., Speer, J., Marbouti, F. and Hsiao, Y.T. (2013) "Broadening the Notion of Participation in Online Discussions: Examining Patterns in Learners' Online Listening Behaviors", *Instructional Science*, Vol. 41, No.2, pp 323-343.

Yarimkaya, E. and Esenturk, O.K. (2020) "Promoting Physical Activity for Children with Autism Spectrum Disorders during Coronavirus Outbreak: Benefits, Strategies, and Examples", *International Journal of Developmental Disabilities*, pp. 1-6.

Yin, B. and Yuan, C.H. (2021) "Precision Teaching and Learning Performance in a Blended Learning Environment", *Frontiers in Psychology*, Vol. 12, pp 631125-631125.

Youmans, M.K. (2020) "Going Remote: How Teaching During a Crisis is Unique to Other Distance Learning Experiences", *Journal of Chemical Education*, Vol. 97, No. 9, pp 3374-3380.

Zakharov, W. and Maybee, C. (2019) "Bridging the Gap: Information Literacy and Learning in Online Undergraduate Courses", *Journal of Library & Information Services in Distance Learning*, Vol. 13, No. 1-2, pp 215-225.

Zhang, W., Wang, Y., Yang, L. and Wang, C. (2020) "Suspending Classes Without Stopping Learning: China's Education Emergency Management Policy in the COVID-19 Outbreak", *Journal of Risk and Financial Management*, Vol. 13, No. 3, pp 55.

Consistency is the key to Survival: LMS Design Principles in an Online Lower Limb Anatomy Course

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Abstract: In this case study style paper, we discuss an online lesson template created for a Learning Management System (LMS). This emerged from our need to convert a traditional face-to-face lower limb anatomy course to an online format for our Chiropody program. A recent search reveals a shortage of literature on the detailed components of an online lesson plan for an LMS. We present a novel template for an anatomy course that includes didactic asynchronous and synchronous lectures, a dry lab and a weekly live review session. Course content is divided into 13 units. Each unit consists of a repeating content template. This includes eight sections: an overview of the week's learning objectives, a weekly student "to do" checklist, live session details with supporting documents, a self-study asynchronous lecture with supporting class notes, lab videos with worksheets and finally a summary of the week's key concepts and content resources including required readings. To increase learner engagement, knowledge check assessments are embedded into each self-study section using educational technology tools. Periodically we include course activities such as case-based discussion boards and formative knowledge application simulations. The use of a template organizes the population of content and strategically increases teaching effectiveness. The template helps to guide educators on the creation of learning material and activities. This approach maintains a welcoming standard teaching pattern for online courses to alleviate the uncertainty of teaching in an online environment. Based on anecdotal feedback, students were positive about their learning and the clarity offered by the online lesson template for course concepts. We plan to conduct future qualitative analysis to formally assess students' perceptions about the online lesson template.

Keywords: LMS organization, online anatomy course, online lesson template, student engagement, formative assessment

1. Introduction

Within days of the declaration of the world-wide COVID-19 pandemic, educators of the Michener Institute of Education at UHN in Toronto were asked to convert their current face-to-face health science courses to an online format. This transition had to comply with the approved program model route and achieve the course competencies. One author, the subject matter expert, had very little cyberliteracy experience. The other author had recent experience in online course development using a Learning Management System (LMS). They joined forces to transition a lower limb anatomy course for a Chiropody program to an online delivery format.

The authors researched best practices on how to adapt content. Much of the online learning design literature focused on the use of the Community of Inquiry (CoI) framework to increase student engagement, the student community and instructor presence (Garrison et al., 1999). This framework is based on a collaborative constructivist lens that emphasizes the construction of online learning environments modelled on three presences: cognitive, social and teaching (Garrison et al., 1999). Garrison and Arbaugh (2007) suggested teaching presence involves "instructional design and organization" (p. 159) of the course and activities.

The authors were given a LMS platform, had didactic content written for the traditional classroom and realized that given the high volume of anatomy content, an online lesson template was needed. Coppola et al. (2002) found "that they [educators] had to plan and structure a course for online delivery much more tightly than for classroom-based courses" (p. 180). Content was separated into units of learning. This was in alignment with the Universal Design for Learning (UDL) framework and Jumpstart Model of "chunking" content (Centre for Academic and Faculty Enrichment (CAFE), n.d.; CAST, 2021). Course content was transitioned to self-directed asynchronous activities and synchronous lectures in Blackboard Learn®. The authors created an online lesson template to provide consistency and help forecast content development for each unit.

The purpose of this report is to describe how an online lesson template in LMS was used to teach lower extremity anatomy. The case study style, "a contemporary phenomenon within its real-life context" (p. 13) as outlined by Yin (2003), was the preferred method to share best practices and successes. We have found that the reliable arrangement of content using an online lesson template benefited the authors.

2. The online lesson template

The study of human lower limb anatomy is integral to podiatric medicine education. First year Chiropody students find the high volume of detailed content challenging. The UDL framework recommends a modular or unit based format of instructional design (CAST, n.d.). The authors found that the addition of an online lesson template to the units improved and optimized the teaching of anatomy. Using a stable pattern of sections for each unit helped the authors to allocate content and identify gaps to be filled. The online lesson template acted as a blueprint for curriculum development. Within each section, clear instructional language was used to direct students on tasks to watch, download and complete. The online lesson template included the following sections: overview, weekly checklist, live sessions, self-study, lab, summary and content/text resources (Figure 1). Each of these sections will be discussed.

Figure 1: Section headings of the online lesson plan template in Blackboard Learn®

2.1 Overview section

The overview section included a concise high level summary of the unit topic (Figure 2). Learning outcomes tied to the course objectives were listed to prioritize learning.

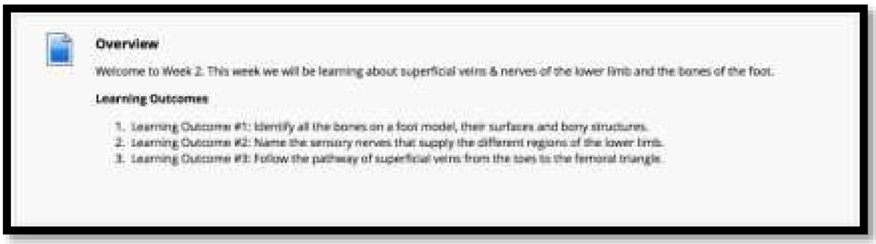

Figure 2: Sample overview section in Blackboard Learn®

2.2 Weekly checklist section

The weekly checklist section was an itemized list of tasks to complete for each unit (Figure 3). This list was designed to help students allot their study time to complete the required tasks for this course. Discussion board podiatric medicine cases were also included in this course outside the learning unit in a separate tab on Blackboard Learn®. The checklist reminded students to access this discussion board to meet deadlines.

Figure 3: Sample weekly checklist section in Blackboard Learn®

2.3 Live sessions section

This section housed the dates and times of synchronous sessions and the accompanying lecture notes and handouts (Figure 4). For the first three units, directions on how to access these sessions were included using screenshots.

Figure 4: Sample live sessions section in Blackboard Learn®

2.4 Self-Study section

The self-study section was the most complex section of the unit because it utilized several educational technology programs (Figure 5). It was important for the authors to display the section content within the same frame to limit the number of open windows. Asynchronous didactic content was narrated on PowerPoint® and uploaded to Vimeo®. Vimeo® content was embedded into Blackboard Learn® with password protected access. To increase student engagement and knowledge retention, formative quizzes were included. Rekhari and Sinnayah (2018) assessed the use of H5P® in an anatomy course and reported "early findings already point to the need for interactive self-directed learning tools that can enhance the quality of asynchronous and synchronous learning" (p. 200). Quizzes were designed using the educational technology H5P® and were embedded into this section. Following the completion of each quiz, celebratory and inspirational videos created with Adobe Spark® played when students were successful and unsuccessful, respectively.

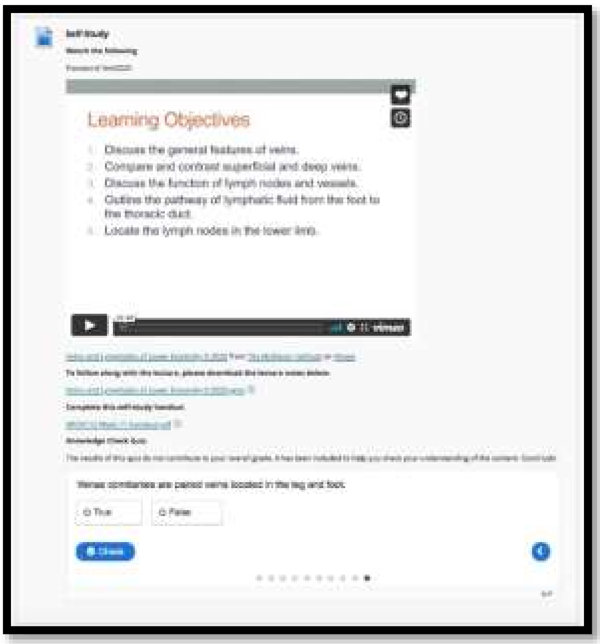

Figure 5: Sample self-study section in Blackboard Learn®

2.5 Lab section

Traditional face-to-face laboratories were transitioned into an online format.

2.5.1 Video demonstrations

Relevant lab skills were demonstrated and filmed (Figure 6). The resulting videos were housed in password protected files on Vimeo® and embedded into the lab section.

Figure 6: Sample lab section in Blackboard Learn®

2.5.2 Worksheet

Worksheets used in each lab were included in this section for students to complete based on the accompanying videos (Figure 7). Periodically for formative feedback, simulation activities were hosted on Padlet® for students to provide opportunities to demonstrate their knowledge.

Figure 7: Sample lab section containing a worksheet in Blackboard Learn®

2.6 Summary section

Key concepts from each unit were outlined in a checklist style format (Figure 8). Course announcements and a description of the topic for the next unit were shared.

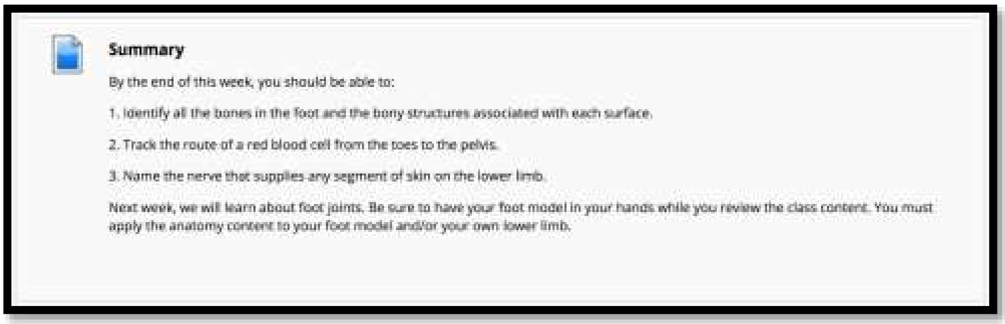

Figure 8: Sample summary section in Blackboard Learn®

2.7 Content/text resources section

Required and supplemental readings were included in this section using hyperlinks to downloadable files (Figure 9).

Figure 9: Sample content/text resources section in Blackboard Learn®

3. Discussion

This case style study shows that using an online lesson template on a LMS contributes to an effective teaching presence. The authors believe the use of the online lesson template provided consistency for both the educator and student. According to Swan (2003), "consistent, transparent, and simple course structures add to such clarity as well as insure that learners only have to adapt to such structures once" (p.7). By guiding this content conversion and creation using the online lesson template, the authors were in agreement with the instructional design elements of teaching presence in the CoI framework.

The Jumpstart Lesson-Planning Model, developed by Durham College (Oshawa, Ontario, Canada), is a tool to help the educator structure online lesson plans (CAFE, n.d.). It aligns with the content arrangement of the authors' online lesson template. The Jumpstart Model includes a connection activity (e.g. ice-breaker), a content activity (e.g. lecture), a practice activity (e.g. worksheet) and a summary activity (e.g. quiz) (CAFE, n.d.). The authors' online lesson template provides a foundation for a unit-based organization of content and activities. The template can be adjusted to appeal to different learning styles and abilities.

The online lesson template complements the UDL approach. The UDL framework advocates for educators to provide multiple means of engagement, representation, action and expression (CAST, 2021). The authors were influenced to include the following aspects of UDL: segmented content, checklists to support engagement, formative quizzes for immediate feedback and direct prompts to help the learner navigate through the learning unit. The addition of UDL elements to the online lesson template improved accessibility and regulated learning.

From an educators' perspective, the online lesson plan template was helpful to direct the population of content in a time efficient way. As illustrated by the Coppola et al. (2002) qualitative study on the changes of the educator's role in the shift to online teaching, "almost all faculty say that teaching online requires substantially more time and effort" (p. 184). Given the uncertainty of the COVID-19 pandemic and the rapid transition to online teaching, it was advantageous for the authors to have a blueprint to follow weekly. This decreased their level of anxiety. In addition, the authors discovered that the online lesson template was transferable as it was successfully adapted for use by two other educators in other Chiropody program courses. The authors produced a visually appealing course with the ability to modify segments of content as required.

4. Practical issues and future research

Our design was limited to the features available on the institutional copy of Blackboard Learn®. The online lesson plan template was displayed in a single navigation window. This resulted in a longer page length that required students to scroll through all sections to locate the desired content. It would be ideal to have each section on a separate hyperlinked page to enable direct access to the content. Future versions of the template can be easily adapted for multi-page connectivity which would allow for less compressed content and improve aesthetics. This could be achieved using the Learning Module option of Blackboard Learn®.

Future research could include a qualitative study of the acceptance and effectiveness of the online lesson template by students. Martin et al. (2009) conducted a survey of an online course hosted on Blackboard Learn®. The survey assessed self-efficacy, or the students' self-rated ability to achieve learning outcomes (Martin et al., 2009). Sections of this survey assessed student access to the course content, completing assessments, viewing grades, asynchronous communication and synchronous communication aspects (Martin et al., 2009). Although no formal survey was undertaken, the authors collected some anecdotal feedback on the online lesson template. The feedback suggested that students were receptive to the organization of the unit that the template provided. In addition, students found the H5P® formative assessment useful. Future work can include a modified version of the Martin et al. (2009) study to formally understand the students' experience and opportunities for improvement.

5. Conclusion

This paper addresses the importance of a standardized unit design for each course content area on a Blackboard Learn® LMS platform. Theorists outline components of online learning environments by offering the who, the why and the what. The authors desire more specific guidance on the how and the whereas related to the organization and display of course material. This online lesson plan template is a dependable tool that can be immediately adapted into practice regardless of the level of cyberliteracy. The quick transition of a lower limb anatomy course to a virtual environment inspired the creation of this template, which was found to be a vital component of the educator's toolkit for survival.

Acknowledgements

We would like to express our gratitude to Dr. Lesley Wilton (University of Toronto) for her valuable and constructive suggestions during the development of this work. We also thank Catharine Gray (Chiropody Program Chair, Michener Institute for Education at UHN) for her encouragement and support of our work. Our grateful thanks to Alex De Oliveira and Graham Lavender (Michener Institute for Education at UHN) for their useful recommendations and insightful comments. Finally, we wish to thank both Marsha Mark and Mary Jean Tyczynski, our family members who generously offered their time as editors.

References

CAST, 2021. *The UDL Guidelines*. [online] Available at: <https://udlguidelines.cast.org/> [Accessed 16 May, 2021].

Centre for Academic and Faculty Enrichment (CAFE), n.d. *The Jumpstart Model.* [online] Available at: <https://durhamcollege.ca/cafe/getting-started/jumpstart-model/> [Accessed 16 May, 2021].

Coppola, N.W., Hiltz, S.R. and Rotter, N.G., 2002. Becoming a Virtual Professor: Pedagogical Roles and Asynchronous Learning Networks. *Journal of Management Information Systems*, *18*(4), pp.169-189.

Garrison, D.R., Anderson, T. and Archer, W., 1999. Critical Inquiry in a Text-Based Environment: Computer Conferencing in Higher Education. *The Internet and Higher Education*, *2*(2-3), pp.87-105.

Garrison, D.R. and Arbaugh, J.B., 2007. Researching the community of inquiry framework: Review, issues, and future directions. *The Internet and Higher Education*, *10*(3), pp.157-172.

Martin, F., Tutty, J.I. and Su, Y., 2010. Influence of Learning Management Systems Self-Efficacy on E-Learning Performance. *i-manager's Journal on School Educational Technology*, *5*(3), pp.26-35.

Rekhari, S. and Sinnayah, P., 2018. H5P and Innovation in Anatomy and Physiology Teaching. In *Research and development in higher education:[re] valuing higher education: volume 41: refereed papers from the 41st HERDSA Annual International Conference. 2-5 July 2018, Convention Centre, Adelaide* (Vol. 41, pp. 191-205). Higher Education Research and Development Society of Australasia.

Swan, K., 2003. Learning effectiveness online: What the research tells us. *Elements of Quality Online Education, Practice and Direction*, *4*(1), pp.13-45.

Yin, R.K., 2003. Case study research: design and methods (ed.). *Applied social research methods series*, *5*.

From Concept to Teaching Unit: Creating ICT-Supported Mathematics Teaching Units Based on Multicultural-Classroom-Aware Concepts

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Abstract: In many European countries, mathematics teachers feel the need for teaching materials being aware of and sensitive to the multicultural background of their classrooms (Favilli, 2015). A number of studies show that such materials should follow certain inclusive criteria (Favilli, 2013; Novotná, Ulovec & Moraová, 2020): Fostering tolerance, inducing interest, value diversity, emphasize cooperative learning, make use of different cultural backgrounds, use a variety of contexts and names from multiple cultures, avoid cultural stereotypes etc. Based on these criteria, the authors, in an international collaboration project, have developed a few exemplary teaching units (Novotná & Ulovec, 2020), as well as a number of teaching unit concepts specifically designed for multicultural classrooms (Novotná, Ulovec & Moraová, 2020). In this paper, we demonstrate how – based on one of these concepts – teachers in the field can create their own fully-developed mathematical teaching units for their multicultural classrooms, making use of ICT tools and thereby following the recommendations of Ebenhofer, M. & Knierzinger, A. (2007). We use the concept of "How (seemingly) simple things can be very different (and difficult) in other places and cultures" to develop two teaching units: First, a teaching unit using Dynamic Geometry Software to analyse parabolas, and second, a teaching unit using CAS to analyse the relation between air pressure and the boiling point of water. These examples can then serve as guidelines for teachers on how to develop teaching units for other mathematical topics and different cultural backgrounds.

Keywords: ICT in mathematics education, multicultural teaching units, students with different linguistic and cultural backgrounds, intercultural classrooms

1. Theoretical background

1.1 Introduction

Multiculturality in classrooms is one of the most profound challenges that teachers are confronted with in the current society. Teachers, particularly those who taught for a long time in culturally homogeneous classes, find it necessary to modify pedagogical documents, materials, and teaching styles. They feel the need for teaching materials being aware of and sensitive to the multicultural background of their classrooms (Favilli, 2015). Also teacher educators can see the challenge and sometimes struggle to rise to it. In any case, multiculturality should become an enriching aspect for all who are involved in education, not an obstacle.

Differences in cultures and languages make the teaching-learning process harder than it is in a homogeneous environment (Hastedt, 2016; Secada, 1992). Therefore, attention should be paid to the specifics of teaching in these circumstances. Research shows that teachers feel the need of getting the training and materials which reflect the needs of their culturally heterogeneous classes in terms of linguistic and cultural differences. Their pupils from minority cultures and/or those with a migrant background encounter even more difficulties than their native classmates in acquiring basic skills (Ulovec et. al., 2013; Moraová, Novotná and Favilli, 2015).

Educators, policy makers, and other key players in the education system have realized this some time ago, yet continue to struggle to provide teachers with the necessary support systems and materials. In the fields of languages, cultural education, and the social sciences, a lot of progress has been made in this respect. In the field of mathematics (as well as in other fields, e.g. physics, chemistry, or biology) however, there is still much to be done. Favili (2015) documented that teachers particularly need concrete teaching materials that reflect the needs of their multicultural students in terms of different linguistic and cultural backgrounds. He and his team developed a number of pilot teaching units and documents, to demonstrate how such materials can be produced, making it also clear that further work is needed to provide teachers with the necessary support.

1.2 Criteria to develop teaching materials for multicultural classrooms

In the frame of an Austrian-Czech project we developed a list of criteria that teaching materials should adhere to for them to be appropriate for multicultural classrooms. "[Such] materials should

- foster tolerance and help to overcome linguistic, cultural and other differences,
- be of interest for both minority and majority pupils,
- pay attention and value diversity,
- emphasize practical, experienced-based, active and cooperative learning,
- refer to environments familiar to all pupils,
- make use of different cultural backgrounds as "funds of knowledge" to support the learning process,
- use a variety of contexts, names and places from multiple cultures to allow children to better be able to relate to them,
- avoid cultural stereotypes and prejudice,
- use culturally responsive teaching and equity pedagogy,
- not rely heavily on complex written and spoken language,
- make use of a variety of different representations,
- be aware of and eventually make use of different notations, symbols and calculation methods,
- offer explicit links to mathematics,
- enable students to solve the problems with knowledge of mathematics accessible by them."

(Novotná, Ulovec & Moraová, 2020)

1.3 Concepts for teaching units to be used in multicultural classrooms

We analysed the teaching units in the above-mentioned project and used them to create three general teaching unit concepts specifically designed for multicultural classrooms (Novotná, Moraová & Ulovec, 2021, *submitted*):

- *Topics of interest for both minority and majority pupils*: Based on the idea that there are contexts that are equally interesting for both migrant and non-migrant students (e.g. climate change, family relations, sports etc.). The topic should be something that can be discussed with students from any country and any cultural background. Suitable topics can of course vary widely, depending on the students' background and interests. A teaching unit based on this concept can e.g. start with a discussion or a brainstorming activity, followed by an activity to connect to a mathematical topic. It is important to make a convincing connection between the context and the mathematical topic. Particularly at the end of the unit, the teacher has to come back to the originally raised issue, so that the students can be convinced that mathematics can really play an important role in solving problems in the chosen context of the unit.
- *Using cultural differences as funds of knowledge*: Seeing existing cultural differences not as a hurdle, but as a chance. The starting point is to choose a topic that exists in every culture and look at how different cultures deal with it (e.g. music, painting, cooking, names of people or places, calendars etc. It should be a topic that really every student can say (or find out) something about. A unit based on this concept could start with both migrant and non-migrant students bringing related items from their own cultural background to the classroom. These items can then be analyzed, according to the mathematical topic of the unit. The analysis may reveal similarities and differences, both are useful for the lesson! As with other multicultural topics, it is particularly important to stress that the inputs from all students are seen as equally valuable. One students' item may look simpler and plainer than another ones', but both provide equally useful information for this unit.
- *How (seemingly) simple things can be very different (and difficult) in other places and cultures*: Choosing something that seems obvious to majority students, but is completely different (and sometimes difficult) in other cultures. This allows migrant students' culture being actively included into the teaching unit, and majority students rethink their perspective of migrant students and their culture. Possible topics can be shopping, cooking, schooling etc. A possible starting point for such a teaching unit could be that students from several backgrounds (including the majority culture) report on how the chosen topic works in their

countries. It is again important to stress that just because something works different in another country, it does not mean that it is of less value or "not as good" as in the majority culture. Students (or the teacher) could bring suitable demonstration objects. The unit can then continue with either concentrating on one particular cultural/practical setting, or by comparing different settings from different countries or cultures. If possible, a teaching unit based on this concept may also discuss different mathematical notations in different countries.

2. Examples of concrete teaching units based on the concepts

To demonstrate both the feasibility and the flexibility of the concepts, we shall develop one of them – How (seemingly) simple things can be very different (and difficult) in other places and cultures – into two teaching units with different topics for different school levels. This can then also serve as a practical guideline for teachers who want to use the concepts to create their own teaching units for their specific classroom setting and the topics that they need.

2.1 Parabolas to cook with

2.1.1 Overview

This unit (its concept was developed by Pointner, 2016) is based on the idea that ecology and the environment are topics of interest for students of many cultural backgrounds. Also, it can be a good activity to start a discussion about why not everywhere in the world people can prepare food in the way and with the means that we are used to in so-called industrialized countries. The unit is intended to be used for secondary school grade 7 (age of students: 17 years). It can either be used as a one-lesson activity (to introduce parabolas and some of their properties), or as a 2-3 lesson activity if the proofs are also included.

The unit can start with a discussion activity to think about cooking with solar energy. Either the students come up with a picture of a "solar cooker" (e.g. from the Internet, see Figure 1), or the teacher introduces the picture from the teaching materials. The students can then discuss about why this "solar cooker" actually works.

Figure 1: Solar cooker (Baviere, 2018)

The remaining lesson is mainly a teacher-centred activity where certain properties of a parabola are introduced. Depending on the time, interest of students, and mathematical level of the class, the proofs in the Annexes can either be worked on by the students, introduced by the teacher, being used as study material or exam preparation, or skipped entirely.

2.1.2 Description of the teaching unit

After the introductory discussion, the definition of a parabola is introduced:

A *parabola* is the set of all points in a plane that have the same distance from both a given point F and a given line l. The point F is called the *focal point*, the line l is called the *directrix*.

Students can try to use this definition to construct a parabola point-by-point by hand. Very soon this will proof to be a fairly tiring exercise, so the use of ICT can be suggested by either the students or the teacher. Here we will demonstrate the use of the GeoGebra Geometry App.

We start with a line l and a point F (which is not on the line). We call the distance $\overline{Fl} = p$. p is also called the *parameter of the parabola*. Then we pick an arbitrary number $d > \frac{p}{2}$ and draw a parallel line with a distance d from l. Finally, we set the compass to distance d, put the needle point into F, draw a circle, and intersect it with the line that we just drew (see Figure 2). By that, we have constructed two points that have the same distance from F and l, i.e. by its definition, two points of the parabola:

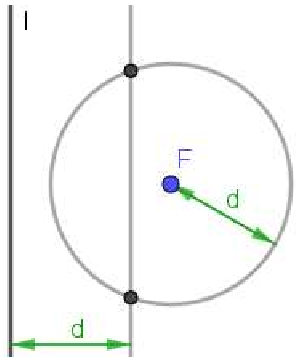

Figure 2: Construction of parabola points using GeoGebra Geometry App

By introducing a slider for the distance d and turn “trace on” for the two intersect points (see Figure 3), we can construct more points of the parabola:

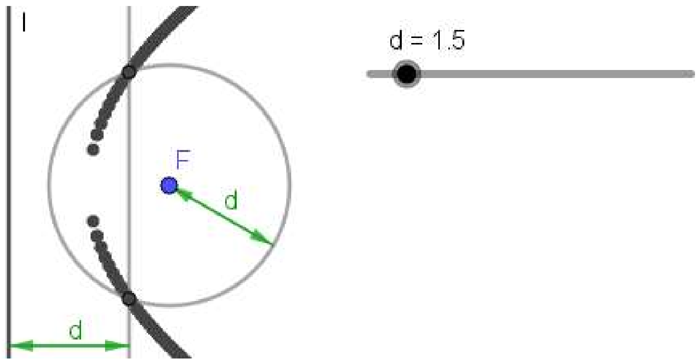

Figure 3: Construction of more parabola points by using a slider

While the definition of a parabola is useful for the construction process, it is somewhat inconvenient for a further analysis of the properties of a parabola. It would be easier to have an equation to describe a parabola. To reach this goal, we restrict ourselves to a *standard parabola* (which is a parabola whose focal point F is on the x-Axis, whose vertex $V = (0, 0)$, and whose directrix l is parallel to the y-Axis).

It is easy to see that for a standard parabola with parameter p the following properties are true:

$F = \left(\frac{p}{2}, 0\right)$ and l: $x = -\frac{p}{2}$.

With these properties, we can proof the following theorem:

For a standard parabola par with parameter $p > 0$ the following holds true: $(x, y) \in par \Leftrightarrow y^2 = 2px$

Coming back to the original question, why can one cook with a parabola (or, rather, a paraboloid)? The answer lies in the fact that a ray of light (e.g. sunlight) coming in from the “open” side of the parabola, parallel to the x-Axis, and is reflected at the inside of the parabola (which means it is reflected at the tangent to the parabola at the point where the ray hits the parabola), always passes through the focal point of the parabola. Now, if many rays of light come in that way, the energy of the sunlight is "concentrated" in the focal point and everything there (and in its surrounding) is getting very hot!

There are several ways to proof that the reflected ray is passing through the focal point. One is by again using ICT in the form of the GeoGebra Geometry App by simply constructing the incoming and reflected ray, which we demonstrate in Figure 4 below. Another is by using vector analysis, and a third one is by using differentials (the latter two can also be done with the support of ICT, e.g. with a suitable CAS, but will not be shown in this paper).

For a constructive approach, we first draw the parabola by using its equation, construct a ray parallel to the x-Axis, and intersect the ray with the parabola:

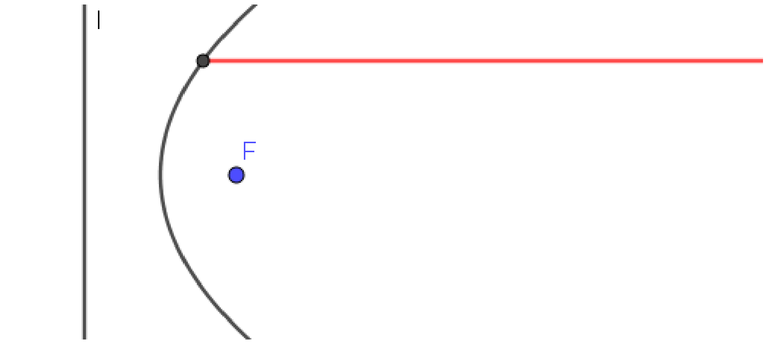

Figure 4: Incoming ray

To find the reflected ray, we construct a tangent through the intersect point, draw a perpendicular line on this tangent through the point, and reflect the ray about this line (Figure 5):

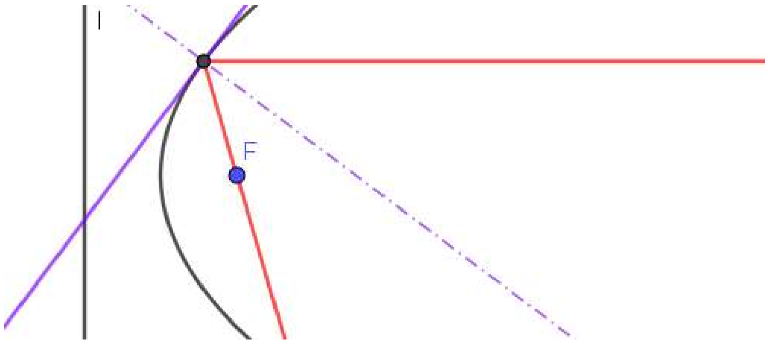

Figure 5: Reflected ray passes through focal point F

Finally, we can introduce a slider again to create several parallel rays (of incoming sunlight) and show that they all are reflected through the focal point F (see Figure 6):

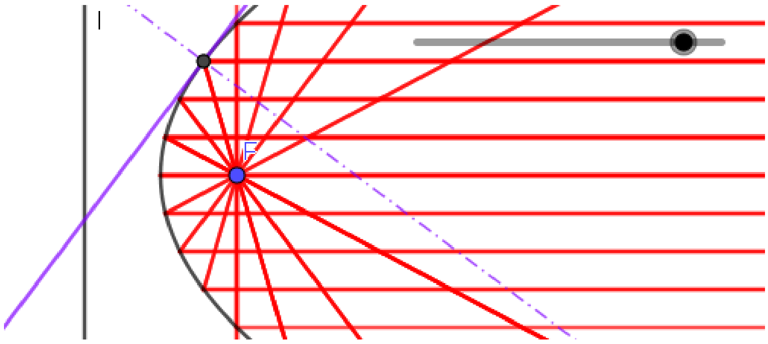

Figure 6: All incoming rays parallel to the x-Axis are reflected through F

Now of course one cannot cook with a parabola, which is a curve. But if we take a parabola and rotate it around its axis, we get a *paraboloid* (Figure 7):

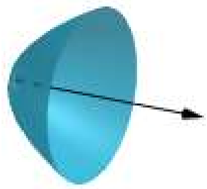

Figure 7: Paraboloid

Some three-dimensional vector geometry shows that – like in a parabola – all rays coming in parallel to the axis of rotation (here the x-Axis) are reflected into the focal point. Now we can take any reflective material (sheet metal, tinfoil, …) and form this surface with it, and we get a mirror that reflects all the incoming sunlight (and thermal radiation) into one point. If we place a pot or other cookware in the position of the focal point, the content gets heated. This is exactly how a solar cooker works. Depending on the actual construction (and of course if the sun is shining), a solar cooker can reach temperatures of 150 °C to 180 °C.

The lesson can end with a brainstorming activity about other applications of parabolas or paraboloids (satellite TV, dishes for communication and radar, SETI, etc.).

2.2 Cooking at 3000 m above sea level

2.2.1 Overview

This unit will show that the fact that the boiling point of water depends on air pressure – for most students a rather theoretical topic – has real-life influence for people living at high altitude. It is based on the idea that "(seemingly) simple things can be very different (and difficult) in other places and cultures" does not only refer to people's economic status, availability of infrastructure etc., but also to other factors. The unit is intended to be used for secondary school grade 6 (age of students: 16 years). It can either be used as a one-lesson activity for mathematics only, or can be combined with a physics lesson to more deeply examine the reasons for air pressure having an influence to the boiling point of water.

The unit can start with a lead question about why people in Lhasa (Tibet), El Alto (Bolivia), and La Rinconada (Peru) may have problems with cooking potatoes. A number of answers may come up (e.g. no electricity available, no potatoes are used in that area etc.) and can be used for discussions, also about various prejudices. Students can be lead in the right direction by mentioning that the same goes for cooking corn, and – to a lesser degree – rice, and by asking them what these three places have in common. After establishing that all three places are at very high altitudes, at least from a European point of view (Lhasa is at 3650 m, El Alto at 4100 m, and La Rinconada at 5100 m), the influence of altitude (and hence air pressure) on cooking (and boiling temperature) can be discussed. Students can then be introduced to the required temperatures to "cook" (to the point of being considered "done") potatoes (approx. 85°C, see Abu-Ghannam & Crowley, 2006), corn (approx. 80°C, see Ratnayake & Jackson, 2007) and rice (approx. 70°C, see Ratnayake & Jackson, 2007).

The lesson continues with an analysis of the functions describing the dependency of air pressure to altitude (a power function) and the dependency of the boiling point of water to air pressure (a logarithmic function). It can conclude with students looking up cooking temperatures for other foods, or a discussion about other real-life effects the reduced boiling point of water might have.

2.2.2 Description of the teaching unit

After the introductory discussion as described above, the first step is to actually find out how the boiling point of water is connected to the altitude. This can either be done by a student discussion or being introduced by the teacher. In any case it should be shown that the important factor is air pressure. Hence, to get an answer to the question how the boiling point of water depends on the altitude, we have to find out two relations: First, how does air pressure depend on altitude, and second, how does the boiling point of water depend on air pressure. Both things might be hard for students to find out (even with internet support), but they should at least try. In case the students fail to solve it, the teacher can introduce the answers.

First we try to find out the dependency of air pressure on altitude. There are several equations describing this relation, depending on the modelling of the atmosphere that is used. We shall use the International Barometric Equation (following the model of barometric scale factor):

$$p(h) = p_0 \cdot \left(1 - \frac{0.0065 \cdot h}{T_0}\right)^{5.255}$$

whereby $p_0 = 101325$ Pa (standard air pressure at sea level), $T_0 = 288.15$ K (=15°C), h is the altitude above sea level measured in m, $p(h)$ is the air pressure at that altitude measured in Pa (Brüesch, 2016).

The relation between air pressure and boiling is fairly complicated. It can be described by the Clausius-Clapeyron relation (which is a differential equation). It can however be approximated (if the temperature differences are small) by the following equation (integrated form, see Hemmert, 2000):

$$T_b(p) = T_b(p_0) \cdot \frac{1}{1 - \frac{R \cdot T_b(p_0)}{\Lambda} \cdot \ln\left(\frac{p}{p_0}\right)}$$

with $\Lambda = 40590 \, \frac{\mathrm{J}}{\mathrm{mol}}$ (enthalpy of vaporization of water at 100°C), $R = 8.31446261815324 \, \frac{\mathrm{J}}{\mathrm{mol\,K}}$ (gas constant), $p_0 = 101325$ Pa (standard air pressure at sea level), $T_b(p_0) = 373.15$ K (=100°C, the boiling point of water at standard air pressure at sea level), p is the air pressure in Pa, $T_b(p)$ is the boiling point of water at that air pressure in K.

Students can first analyse the barometric equation in a CAS. Here we shall use GeoGebra CAS App (Figure 8). A possible task could be for students to find out at what altitude the air pressure is only half as much as it is on sea level. Estimates can be taken first, then students can find out the answer with CAS (Figure 9):

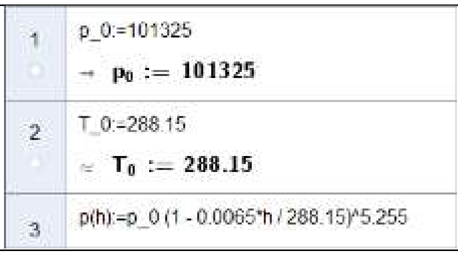

Figure 8: Entering International Barometric Equation

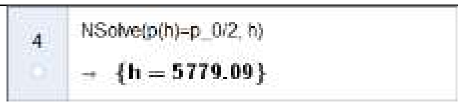

Figure 9: Analysing the equation

A graph can be drawn, using the GeoGebra Graphing App (Figure 10), to better show the relation between altitude and air pressure:

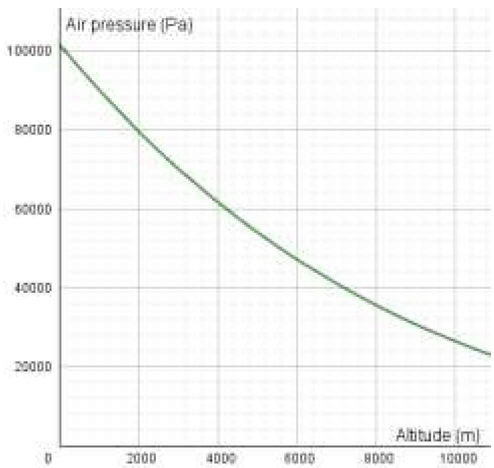

Figure 10: Relation between altitude and air pressure

Similarly, the relation between air pressure and boiling point can be analysed by CAS (Figure 11). A possible task could then be to find out what the boiling point of water is at the lowest air pressure that was ever recorded in Europe (92000 Pa in the year 1929 in Iceland) is (Figure 12):

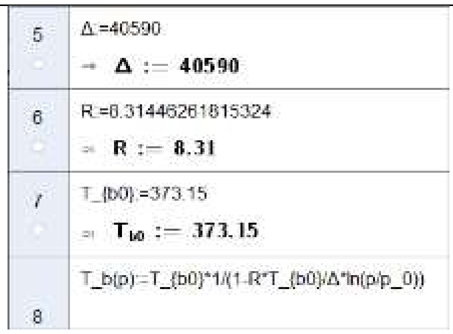

Figure 11: Analysis of the relation between air pressure and boiling point

Figure 12: Boiling point of water at lowest air pressure ever recorded in Europe

The answer might surprise students, since this is approx. 97.27°C, i.e. even a very bad low-pressure system does barely influence the boiling point.

Finally we can combine the two equations and find out the boiling point of water in the given cities. To make things easier, we also do convert the temperature into degrees Celsius by subtracting 273.15 (Figure 13):

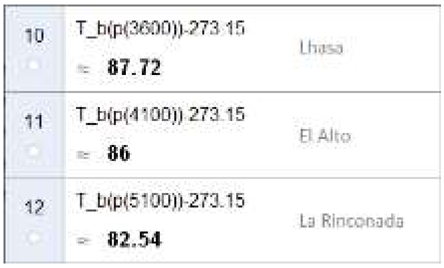

Figure 13: Analysis of the two equations

Interpreting the results, students can find that while cooking rice and corn is possible in all these places (although it may take longer than at lower altitudes), cooking potatoes in La Rinconada would probably require a pressure cooker. Finally we can use the GeoGebra Graphing App (Figure 14) to depict the relation between altitude and boiling point:

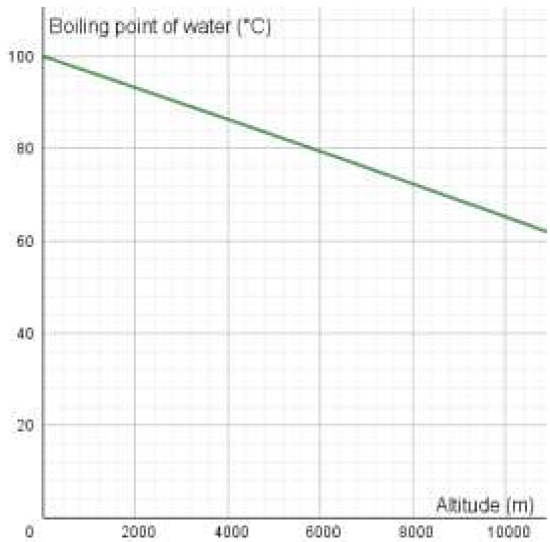

Figure 14: Relation between altitude and boiling point of water

Students can use this graph to find out the boiling point of water in the highest point of their country of origin, or the highest point in each continent etc.

3. Conclusions and outlook

The conclusions are threefold. First, it was possible to demonstrate that the concepts developed by the authors really do allow the design of a variety of teaching materials for multicultural classrooms. They are flexible to be filled with various contexts and mathematical topics. Second, the use of ICT in these example teaching units made the units much more descriptive and workable for students than a classic “paper-and-pencil” approach. And third, we are aware that this paper shows only a small number of concrete teaching units, and if we would stop here it would still be the teachers who would need to do most of the material development work. So the plan for future work is definitely to develop more teaching units based on these concepts, for both lower and upper secondary level, as well as simplified units for primary level, using a variety of contexts, to support teachers in their work in multicultural classrooms.

References

Abu-Ghannam, N. and Crowley, H. (2006) “The effect of low temperature blanching on the texture of whole processed new potatoes”, *Journal of Food Engineering*, Vol 74, No. 3, pp. 335–344.

Baviere, G. (2018): Picture of solar cooker in Lobuche, Nepal. https://commons.wikimedia.org/wiki/File:Nepal_2018-04-02_(42174187211).jpg (accessed April 13, 2021).

Brüesch, P. (2016) “Die Atmosphären der Erde, der Planeten unseres Sonnensystems und der Exoplaneten“, ETH Zürich Research Collection, p. 29.

Ebenhofer, M. and Knierzinger, A. (2007) “Multicultural Classroom - The Potential of ICT for Intercultural Integration of Children in Primary Schools”, *Proceedings of ICL 2007*, pp 1–4.

Favilli, F. (2013) “Globalization in mathematics education: integrating indigenous and academic knowledge”, *Proceedings of CIEAEM 65*, pp. 49–67.

Favilli, F. (2015) (Ed.) *Multiculturalism, Migration, Mathematics Education and Language. Teachers’ Needs and Teaching Materials*. M3EaL project, Tipografia Editrice Pisana, Pisa.

Hastedt, D. (2016) *Mathematics achievement of immigrant students*. Springer International Publishing, Cham.

Hemmert, T. (2000) “Sieden bei vermindertem Druck“, Universität Würzburg, https://pawn.physik.uni-wuerzburg.de/video/thermodynamik/r/r04_2.html.

Moraová, H., Novotná, J. and Favilli, F. (2015) “Including multicultural elements in teaching and learning mathematics at elementary level”, *Proceedings of the International Symposium Elementary Mathematics Teaching 2013 (SEMT 15),* pp. 372–374.

Novotná, J. and Ulovec, A. (2020) “Two ways of using ICT in multicultural mathematics teaching units”, *Proceedings of the 19th European Conference on e-Learning (ECEL 2020)*, pp. 380–387.

Novotná, J., Moraová, H. and Ulovec, A. (2021, *submitted*) “Three pillars for creation of teaching units for heterogeneous classes – are they suitable for elementary mathematics lessons?”, Submitted to the *International Symposium Elementary Mathematics Teaching (SEMT 21).*

Novotná, J., Ulovec, A. and Moraová, H. (2020) “Teaching mathematics to migrant or minority students: Concept for creating materials”, *Proceedings of the 19th Conference on Applied Mathematics (APLIMAT 2020)*, pp. 834–841.

Pointner, S. (2016) “Kulinarische Mathematik“, Diploma Thesis, University of Vienna, pp. 46-57.

Ratnayake, W. S. and Jackson, D. S. (2007) “A new insight into the gelatinization process of native starches”, *Carbohydrate Polymers*, Vol 67, No. 4, pp. 511–529.

Secada, W. G. (1992) “Race, ethnicity, social class, language and achievement in mathematics”, In Grouws, D. A. (Ed.) *Handbook of research on mathematics teaching and learning*, pp. 623-660, MacMillan, New York.

Ulovec, A. *et al.* (2013) “Multiculturalism in theory and teachers’ practice”, *Proceedings of the International Symposium Elementary Mathematics Teaching 2013 (SEMT 13),* pp. 297–305.

Learning Experience Design: A Framework for the Design of Online Guidance Components

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DOI: 10.34190/EEL.21.124

Abstract: Several factors, commonly referred to as threshold concepts, can act as barriers of entry for educators and students in an online learning environment. Additionally, many educators lack pedagogical training, and theoretical context, making it challenging to create effective online studies. Furthermore, they may lack personal experience in online learning. Thus, educators create courses based on physical classroom experience instead of an online learning experience, creating artificial learning thresholds. Identifying problematic areas and designing a suitable induction course can effectively introduce students to the learning environment, lowering dropout rates and decreasing online study anxiety. This study explores a process of identifying artificial learning thresholds and presents a learning experience design framework that can be utilised to overcome learning barriers while building courses in online environments. Online learning has specific requirements to that of on-campus studies that can be challenging to identify by educators. It is particularly challenging to those educators who do not have a wealth of experience developing online courses. These problematic areas often only introduce themselves as issues when the student's grades are tallied, lack of engagement is experienced or when the student drops out. This is especially true now that an epidemic has accelerated the move to online studies, often with ill-prepared and pressured educators carrying the bulk of the frustrations that students might experience. Identifying potentially problematic areas and introducing the students to the experience early and effectively in a safe environment, will reduce anxiety and stress in the students and the teachers.

Keywords: instructional design, course development, learning experience design, learning thresholds, study anxiety, artificial learning thresholds, LXID framework, technology acceptance model

1. Introduction

Most university lecturers have not had formal pedagogical training, but rather learned to teach through the so-called *apprenticeship of observation* as described by Lortie (1975). Teachers learned how to teach through being students themselves. However, many university lecturers have never been students in online courses and thus may lack even the most fundamental skills needed to design online learning experiences.

Online learning has become increasingly more important. Additionally, many university courses have migrated to online delivery through necessity. Educators may not have been adequately prepared for such migration to online learning. However, the difficulties presented by online delivery is not only experienced by educators. Many learners also experience certain artificial barriers to effective learning in an online environment, often referred to as threshold concepts (Kallia and Sentance, 2021).

This research is based on the premise that the negative impact of such thresholds can be reduced through an appropriately designed induction course that teaches learners how to learn in the specific online learning environment. However, educators are not necessarily equipped to design such induction courses.

This paper proposes a framework that will assist educators and course designers in designing induction components for online courses in order to overcome possible artificial learning thresholds among students. The purpose of the framework is to propose a procedure for designing courses so that artificial learning thresholds are not barriers to online learning. A good induction program in the form of an introduction course will reduce artificial learning thresholds. However, to design suitable introduction components, one needs to identify the artificial learning thresholds in order to make it easier for students to learn and participate in the course.

The remainder of this paper is structured as follows; section 2 explores the context for the research. Section 3 introduces the methodology. Section 4 provides an overview of the relevant literature and provides the theoretical basis of the research. Section 5 presents the framework proposed by this research whilst, section 6 demonstrates its utility through an example. Section 7 concludes the paper.

2. Research context

Online education has been increasing in popularity over the last few years. Consequently, this increased pressure on educators to move from the traditional classroom to a digital, online, or mixed delivery model (Gillett-Swan, 2017). There has been a drastic proliferation in online and degree programs across higher education institutions in recent times. Not only is this a trend among certificate or short courses, but graduate degrees are also quickly moving away from the traditional classroom-based programs toward fully online deliveries (Thompson, Leonard and Bridier, 2019).

The continual expansion of online education increases the demand for knowledge and professional programs that can guide educators through the process of teaching and developing course material (Gosselin et al., 2016; Northcote et al., 2019). Moving to online education not only brings the need to move the courses being taught into the online realm, but also raises the question of what that realm should look and feel like from a learner's perspective. With increased flexibility come increased options and opportunities (Liang and Chen, 2012; Gillett-Swan, 2017; Ruth, 2018; Baldwin, 2019). However, the possibilities and opportunities that come with online education highlight many problems in providing a unified learning experience to the learner and challenges to the educators (Gillett-Swan, 2017; Ruth, 2018; Wylie, 2020).

Often content is taken from the traditional classroom and merely placed online to be used. However, online and blended learning needs a different approach to classroom and face to face engagements (Gurley, 2018). The different approaches do not only apply to the learning strategies but also to online education' best practices'. Best practices can be defined as "a method that has been deemed more effective than other alternatives due to the positive outcome produced. A best practice is a technique or methodology that has been shown by experience or research to lead to a desired result" (Luscinski, 2017, p. 13).

University lecturers are primarily not formally trained as educators. Therefore, most lecturers base their classroom practices on what they experienced when they were students (Oleson and Hora, 2014). However, when it comes to online learning, most university lecturers probably do not have a wealth of experience to draw from with regards to how to teach their courses online (Scoppio and Luyt, 2017; Kerkhoff, 2020). Additionally, the educators are expected to provide guidance on how to learn, and in online learning there is once again often a lack of experience on how to accomplish this (Martin *et al.*, 2019).

3. Methodology

This research was conducted using a design-science paradigm. The research adhered to the seven guidelines for such research as described by Hevner, March, Park and Ram (Hevner et al., 2004). This section details how this research adheres to the suggested requirement for each guideline.

Design as an artefact - The suggested framework meets all requirements for a produced artefact, as suggested by Hevner, et al. (2004)

Problem relevance - The relevance of the research problem was argued in the introduction to this paper. Online learning has become an essential delivery mode for most universities. The relevance of ensuring that all learners have the requisite skills to benefit from this modality should be clear.

Design evaluations - The framework proposed in this research has been successfully used in a production environment to guide the creation and refinement of online induction courses at a leading vocational college in Norway. Both the framework and the induction courses were used and evaluated over several iterations with favourable results. Due to space limitations, empirical data to show the rigour of the evaluation process will be reserved for future publications.

Research Contributions - The framework itself, which meets the requirements of a research artefact as described by Hevner et al. (2004), is the primary contribution of this research.

Research Rigor – As mentioned under the guideline for evaluation, an iterative design process was followed. This process adhered to the research rigour guidelines for iterative designs in technology-based research proposed by Olivier (2004).

Design as a Search process - This guideline requires that the artefact's creation adheres to an iterative process during which a design is continuously improved over several cycles. The research spanned several iterations during which the design was continuously improved and refined, which satisfies this requirement.

Communication of Research - The produced framework has been distributed in the researcher's organisation to assist lecturing staff with the design of induction courses. This paper is the first step towards more formal communication of the research.

4. Literature and theoretical basis

Two key factors came to the fore when researching; how to address the students' learning experience and threshold concepts.

4.1 Learning experience

The assumption that many students who are born after a certain date are digital natives and do not need to be taught how to learn online, has been shown not to be a definitive truth (Gillett-Swan, 2017; Warf, 2019). For example, students that demonstrated competencies in social media and mobile use, still failed to use relevant platforms to upload and share files, create documents, read articles, or use calendars (Blayone *et al.*, 2018; Warf, 2019). Online learning environments can be an entirely autonomous learning experience or set up to be a one-on-one teacher-student environment where every action is tracked (De Freitas, Morgan and Gibson, 2015). On the one hand, online presence between educator and learner can be perceived by learners as vastly more engaging and personal than a physical classroom (Reese, 2015).

On the other hand, online learning could enable autonomous and self-paced learning scenarios, but this could lead students to experience anxiety and a feeling of being on their own (Reese, 2015). For example, joining a physical lecture in a classroom environment may only involve one-way communication, whereas a discussion and collaboration using a text-based group messaging system or discussion forum can be very interactive. The freedom that autonomous learning provides by enabling self-paced progression could also lead to the potential lack of student engagement and the ability of the educator to spot the lack of progression (van der Sluis, van der Zee and Ginn, 2017). The case where progression and engagement are not tracked could lead to student dropout before intervention by the educator can occur (van der Sluis, van der Zee and Ginn, 2017). These progression and engagement issues contrast with studies showing that making material and activities that are compulsory available, as soon as possible for as long as possible, help ease anxiety in students and lead to better results. (Muir *et al.*, 2019). Students may simply not participate in the course because they lacked a fundamental understanding of the environment, what is expected of them, and what to expect from the course delivery. Consequently, in order to have a positive and engaging online learning experience, the student needs to be equipped with the skills for online learning (Dumford and Miller, 2018; Keskin and Yurdugül, 2020). The interactive learning environment is crucial in determining whether the learning experience is pleasant or unpleasant. However, all stakeholders involved in the course development can contribute to a student achieving optimal learning (Fournier and Kop, 2015).

4.2 Thresholds concepts

A relevant development in online education is the notion of threshold concepts, which are areas of learning that create anxiety and uncertainty. These concepts play a key role in the student dropping out or acquiring new knowledge (Kilgour *et al.*, 2019). Threshold concepts can provide educators with a valuable way of thinking about the barriers to entry a student may have in learning essential, hard to grasp knowledge (Morley, 2020). It is important to note that while a framework like Universal Design for Learning (UDL) exists, the focus in UDL is on inclusive content of the course material There are still challenges regarding how the online student experiences the environment and the aspects of interaction (Khan *et al.*, 2017). Learning thresholds are frequently created in areas outside the course topic as a result of assumptions about the learner's skills and abilities. For example, an educator might incorrectly assume that a student is a 'digital native' and will know how to upload a file to an LMS. These assumptions could create learning thresholds for the student because of the technologies introduced in the course (VanOostveen, Desjardins and Bullock, 2019).

There are two broad categories of learning thresholds. The first of these deals with thresholds that require the learner to have a certain level of prerequisite knowledge. These thresholds are inherent to the subject discipline. However, the second type of learning threshold is artificial in that it creates a barrier to learning that is unrelated to the subject matter. For example, unfamiliarity with a particular online component or tool. These learning thresholds can lead to different challenges in student participation in the same course. This paper focuses on the second group of threshold concepts which will be referred to as artificial learning thresholds (ALT's), as they could prevent the student from participating in the material and experience barriers that should not exist.

Previous research reveals that students tend to have higher anxiety when a course begins. However, the anxiety reduces when they have more experience in the study environment (Amushigamo, Hidengwa and Herman, 2018; Muir *et al.*, 2019). Having an induction process for online course environments can be vital for student success. However, such an induction process should be specifically adapted per given course, since modalities, course requirements, learner management systems, user interfaces, and technologies might differ between courses. The ability to learn online can have many underlying factors that also play a role in the learners' ability to finish the course online (Gray and DiLoreto, 2016). Intrinsic motivation, self-efficacy, knowledge of previous learning, specific technical skills such as manipulation of streaming video, web browsers, computer and device literacy could all influence the quality of the learning experience (Wu and Chen, 2017; Li and Keller, 2018).

Another factor that can cause an ALT is the willingness of the student to engage with the technologies used. The Technology Acceptance Model (TAM) is a widely used model to explain the likelihood of humans using technology. In TAM, three factors determine the likelihood of accepting technology. Firstly, the perceived usefulness of the technology, the perceived ease of use, and the attitude towards using the technology (Taherdoost, 2018). The TAM model suggests that if users perceive technology as complicated or challenging, they will be unwilling to engage and participate (Wu and Chen, 2017). By introducing students to a low risk, high reward activity upfront, educators can increase the perceived ease of use whilst simultaneously increasing the perceived usefulness. Developing ways to help students overcome artificial learning thresholds will allow students to concentrate on the actual focus of study.

Educators need guidance on how to introduce the student to an environment in an engaging and motivating way (Scoppio and Luyt, 2017). The process must introduce the essential elements to get the student comfortable with the layout and assessment strategy, providing an environment that encourages engagement and continuation. A key element in this aspect is student induction and orientation (Brunton *et al.*, 2018).

Identifying learning thresholds is fraught with difficulties, especially when the course is created for the first time. Two of the most fundamental problems include the method to be used and the participants that must be involved. A best-suited method for finding learning thresholds has yet to be identified (Kallia and Sentance, 2021). However, the researcher believes that it is possible to create a pragmatic framework for introducing students to online learning and overcoming ALT's.

5. Conceptual framework

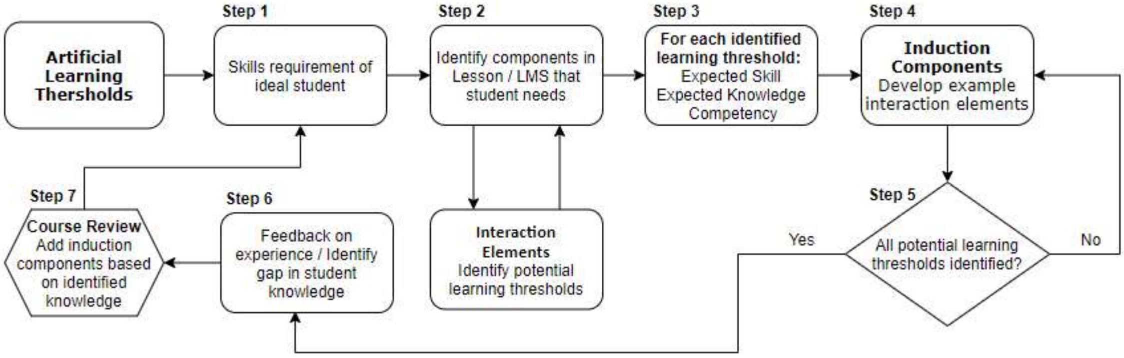


Figure 1: Learning experience induction design framework (LXID framework)

Educators need to ensure that the student demonstrates sufficient knowledge in using the learning environment and tools needed to engage with the studies. To evaluate the knowledge of the environment, there needs to be a way to gauge the skills and competency gaps in an unintimidating way. This is a key factor in overcoming ALT's that may exist, building confidence in the student, and creating a positive learning experience (Keller, 2016). Conducting a learning experience design (LXD) necessitates considering current learning skills, competency, and capability when formulating the design. The design of learning experiences combines multiple design disciplines and the field of education. LXD incorporates interaction design, user experience design, graphic design, and game design. These design approaches are combined with educational, training, and development principles, instructional design, cognitive psychology, and neuroscience (Picciano, 2017). The UDL framework mentioned in 4.2, could be helpful to apply together with the framework proposed in this research when looking at building more inclusive course material for a diverse group of students. Without high fidelity prototyping or live site usability testing, it will be difficult to develop all the potential learning thresholds that the environment could contain when the course is first developed. The potential learning thresholds should be identified, at first, using a tacit knowledge approach if no student learner experience test can be completed beforehand. Developing an introductory course focusing on the learning environment and interaction elements is vital. Furthermore, by iterating on the course based on student feedback, knowledge about what the student finds as a learning threshold can move from tacit to explicit (Keller, 2010; Brunton *et al.*, 2018; Baldwin, 2019).

In order to identify the artificial learning thresholds within the course environment, the course developer will need to look at the following set of criteria:

- General Competency*:* Define general competencies that are overarching on all components.
- Interaction Components: Identify interaction components where the student needs to interact with the content, learner management system (LMS) and other content technologies such as instant messaging.
- Component Competency: Define what the specific competencies are for each of the particular components that were identified.
- Knowledge: Define the knowledge that is needed to understand, interact and complete tasks with this component.
- Skills: Define the skills needed to complete the task.

Once the interaction components and knowledge needed to use them are identified, the educator should design and develop the induction elements. The induction elements should be available at the beginning of the course. Typically, as part of an introduction to the course which explains the rest of the study environment, course layout and functions.

The induction elements should mirror the elements used in the course material and the rest of the LMS. For example, suppose an image is to be submitted in the course. In that case, the induction element in the introduction course, must require the student to submit an image in the same manner with instructions on how to do this. Introducing the induction elements early and without consequence to grades and negative feedback is key to encourage engagement and a positive attitude to perceived ease of use. Introducing a positive feedback loop at this stage, such as a grade or badge is beneficial to give the student a sense of confidence in the use of the element (Keller, 2016). After the students have received a grade for the induction course there must be a way for the student to provide feedback on the experience. Successful completion could even be a requirement to unlock the rest of the course. This will aid the educator in knowing which students have overcome the ALT's and which students need guidance. In the case of self-paced non-facilitated courses such as some MOOCs, the grades can have specific feedback that points to help documentation or videos explaining the concepts again. The course designer should build in a revision management process to look at the feedback and evaluate perceived ALT's using the student responses. This ensures that the educator can identify what the students perceive as challenging, as discussed in section 4.2. When a revision is complete, the course designer can iterate on the introduction course's design by including revised induction elements.

6. Demonstrative example

Developing the introduction course should be based on elements and information that is easy to understand and gives knowledge of the course and environment. An LMS examination input box interaction element was used as a simple example to showcase the LXID framework's applicability on a specific interaction element that could generate an ALT. The default quiz input box example is shown in Figure 2.

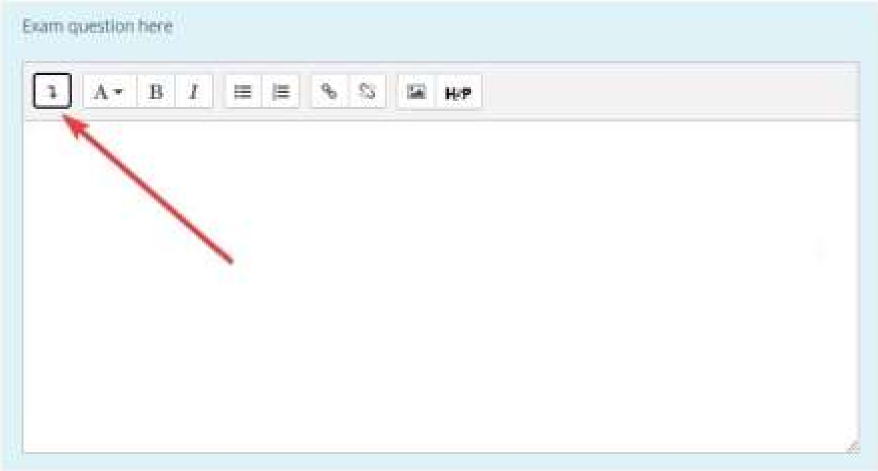


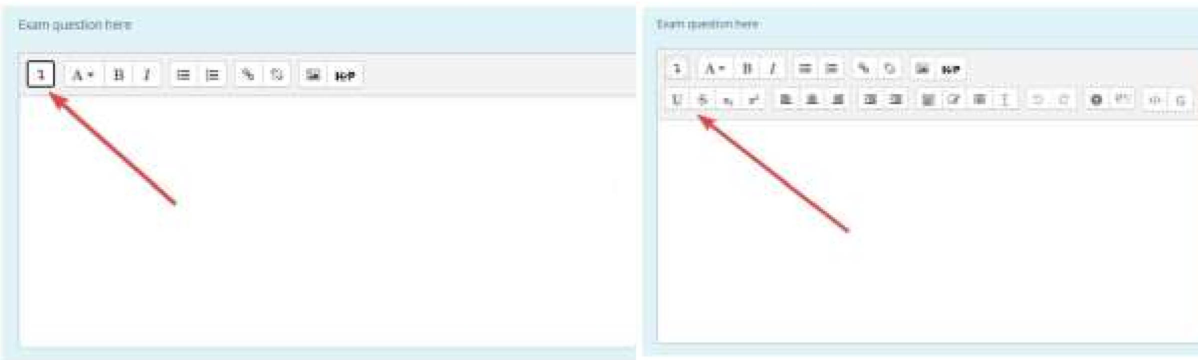
Figure 2: Moodle LMS exam quiz input box

Step 1: As a first step course designer should identify the skills an ideal student should have.

Step 2: Identify all interaction elements within the study environment and course material that the student needs to complete in the overall course effectively. Experience and assumptions from the educator can inform the first iteration. During subsequent reviews, this list might be altered.

Step 3: Steps 3 and 4 will be repeated per interaction element identified in step 2 of the LXID framework. In this example, the Moodle exam input box was identified. For example, the designer identifies that the students would need the knowledge to answer exam questions and know how to identify the box, additional tools, and some of the text editing tools. They would need the skills to do so by using Moodle's default exam input box.

Step 4: The designer creates a question that necessitates the student to use the tools in the input box as they would be required to do in the main course. Identify hidden or hard to use toolbars and toolboxes in the interaction element. Referring to Figure 3, the input boxes have additional tools hidden under a relatively obscure icon, as indicated by the arrow shown in Figure 3 (a), and are often missed. When clicked, it reveals an additional row of tools, as shown in Figure 3 (b). Thus, in this example, the course designer can ensure that if any additional tools are needed to answer the exam question, details on how to access these tools are covered by the induction material. In the introduction course, a video can be shown where this icon is clicked to reveal the additional tools as well as have the student practice it in an induction element.



(a) Additional tools icon

(b) Toolbar visible

Figure 3: Additional tool icon dropdown button and additional tools toolbar

Figure 4 shows an example of a multiple-choice question. When questions are completed, they can provide important feedback to provide extra information. This aids in having the student build a connection between where to navigate back to the content; thus, even wrong questions can provide a positive engagement experience. The format and presentation of the questions and comments should be the same as those the student will encounter in the actual course. These induction interaction elements help set student expectations for interactive elements they may encounter in the exam.

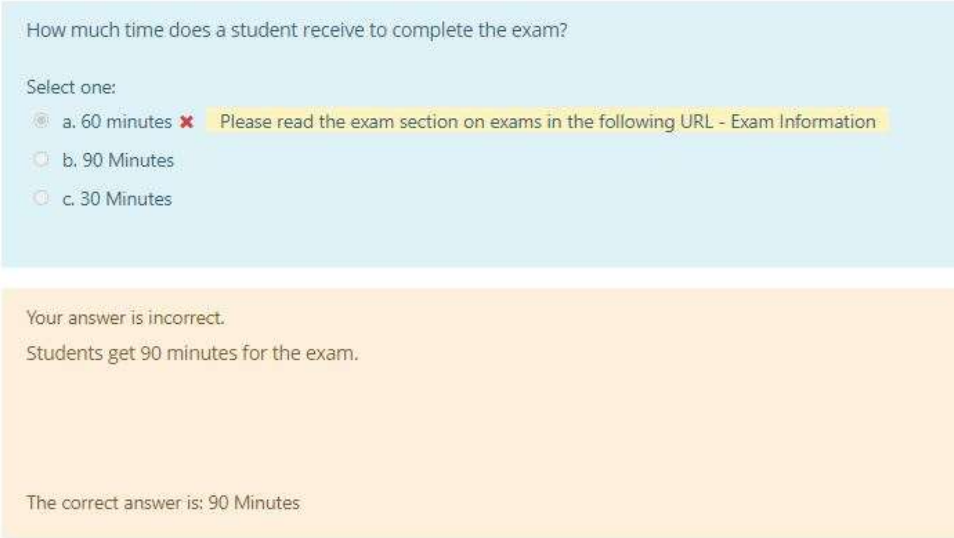


Figure 4: Multiple-choice questions

Step 5: If all ALT's are identified the designer can continue to the next step.

Step 6: Create an open-ended feedback area that the students are required to complete. The feedback step is essential to get feedback from the specific students currently participating in the course. Feedback of this nature will inform the educators if the induction components need to be iterated upon to alleviate the ALT's identified.

Step 7: Review course and iterate on induction component and identified ALT's.

After completing the induction course following the LXID framework, the course structure could look as depicted in Figure 5. The structure depicted is a high-level overview with minimal elements shown. The interaction elements (I.E) are all elements identified that could produce ALT's and are presented in different areas of each course or topic. As shown in Figure 5, all I.E.'s are addressed in the Induction course (Introduction course).

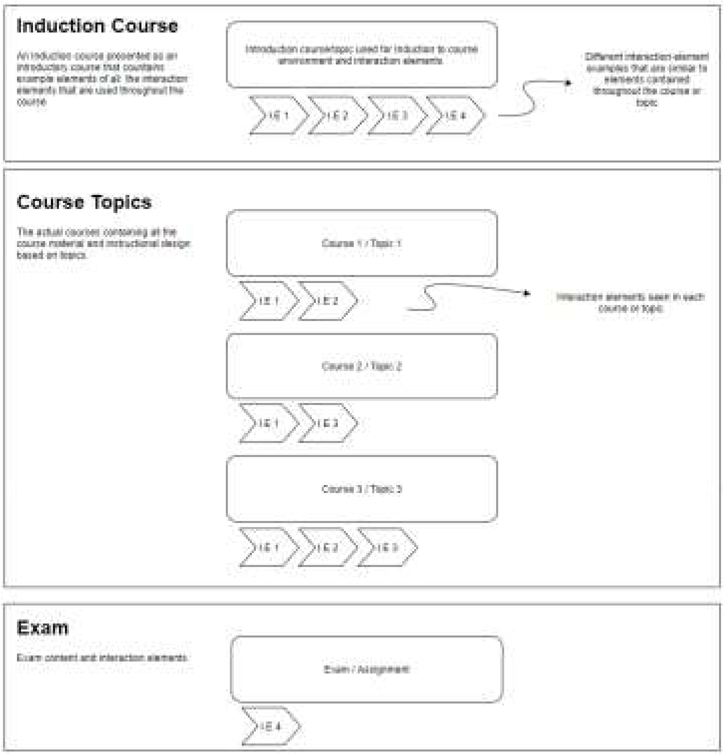


Figure 5: Template model of a designed course

7. Conclusion

Many educators are not necessarily experts in the field of online learning. Most educators are disciplinary specialists at a university level without a strong pedagogical or learning experience design background. Additionally, educators may not have experienced online learning while they were students themselves. As such, they do not have a body of online learning experience to draw upon when designing courses. These educators may not understand which factors could artificially act as learning thresholds when designing a new course for online delivery. This LXID framework provides a guide to assist such lecturers in overcoming such ALT's through appropriately designed induction elements for online courses. The framework has been used and tested in a production environment. Educators reported that the use of the framework made it easier to design the appropriate elements for use in the course, with fewer problems reported by students. Furthermore, student evaluation in the courses showed that these induction components had an improved student learning experience and had an overall positive effect. However, formal verification based on student experience data has not yet been published. Future work will focus on this.

References

Amushigamo, A. P., Hidengwa, M. H. and Herman, S. N. (2018) "Enhancing Large Classes With Active Learning Pedagogical Skills," in, pp. 331–348.

Baldwin, S. J. (2019) "Assimilation in Online Course Design," *American Journal of Distance Education*, 33(3), pp. 195–211.

Blayone, T. J. B. *et al.* (2018) "Surveying digital competencies of university students and professors in Ukraine for fully online collaborative learning," *Technology, Pedagogy and Education*, 27(3), pp. 279–296.

Brunton, J. *et al.* (2018) "Head start online: flexibility, transitions and student success," *Educational Media International*, 55(4), pp. 347–360.

Dumford, A. D. and Miller, A. L. (2018) "Online learning in higher education: exploring advantages and disadvantages for engagement," *Journal of Computing in Higher Education*, 30(3), pp. 452–465.

Fournier, H. and Kop, R. (2015) "MOOC learning experience design: Issues and challenges," *International Journal on E-Learning: Corporate, Government, Healthcare, and Higher Education*, 14(3), pp. 289–304.

De Freitas, S. I., Morgan, J. and Gibson, D. (2015) "Will MOOCs transform learning and teaching in higher education? Engagement and course retention in online learning provision," *British Journal of Educational Technology*, 46(3), pp. 455–471.

Gillett-Swan, J. (2017) "The Challenges of Online Learning: Supporting and Engaging the Isolated Learner," *Journal of Learning Design*, 10(1), p. 20.

Gosselin, K. P. *et al.* (2016) "Development of an Evidence-based Professional Learning Program Informed by Online Teachers' Self-efficacy and Threshold Concepts," *Online Learning*, 20(3), pp. 178–194.

Gray, J. A. and DiLoreto, M. (2016) "The Effects of Student Engagement, Student Satisfaction, and Perceived Learning in Online Learning Environments This," *NCPEA International Journal of Educational Leadership Preparation*, 11(1), pp. 98–119.

Gurley, L. E. (2018) "Educators' preparation to teach, perceived teaching presence, and perceived teaching presence behaviors in blended and online learning environments," *Online Learning Journal*, 22(2), pp. 197–220.

Kallia, M. and Sentance, S. (2021) "Threshold concepts, conceptions and skills: Teachers' experiences with students' engagement in functions," *Journal of Computer Assisted Learning*, 37(2), pp. 411–428.

Keller, J. M. (2010) *Motivational Design for Learning and Performance*, *Motivational Design for Learning and Performance: The ARCS Model Approach*. Boston, MA: Springer US.

Keller, J. M. (2016) "Motivation, Learning, and Technology: Applying the ARCS-V Motivation Model," *Participatory Educational Research*, 3(2), pp. 1–15.

Kerkhoff, S. (2020) "Collaborative Video Case Studies and Online Instruments for Self-Reflection in Global Teacher Education," *Journal of Technology and Teacher Education*, 28(2), pp. 341–351.

Keskin, S. and Yurdugül, H. (2020) "Factors Affecting Students' Preferences for Online and Blended Learning: Motivational Vs. Cognitive," *European Journal of Open, Distance and E-Learning*, 22(2), pp. 72–86.

Khan, A. *et al.* (2017) "Active learning: Engaging students to maximise learning in an online course," *Electronic Journal of e-Learning*, 15(2), pp. 107–115.

Kilgour, P. *et al.* (2019) "Threshold concepts about online pedagogy for novice online teachers in higher education," *Higher Education Research & Development*, 38(7), pp. 1417–1431.

Li, K. and Keller, J. M. (2018) "Use of the ARCS model in education: A literature review," *Computers and Education*, 122(May 2017), pp. 54–62.

Liang, R. and Chen, D.-T. V. (2012) "Online Learning: Trends, Potential and Challenges," *Creative Education*, 03(08), pp. 1332–1335.

Lortie, D. C. (1975). Schoolteacher: A sociological study. Chicago, IL: University of Chicago Press.

Luscinski, A. (2017) "Best Practices in Adult Online Learning," *ProQuest LLC*.

Martin, F. *et al.* (2019) "Award-Winning Faculty Online Teaching Practices: Roles and Competencies," *Online Learning*, 23(1), pp. 184–205.

Morley, C. (2020) "Towards the co-identification of threshold concepts in academic reading," *Journal of University Teaching and Learning Practice*, 17(2).

Muir, T. *et al.* (2019) "Chronicling engagement: students' experience of online learning over time," *Distance Education*, 40(2), pp. 262–277.

Northcote, M. *et al.* (2019) "A professional learning program for novice online teachers using threshold concepts," *Online Learning Journal*, 23(4), pp. 336–353.

Oleson, A. and Hora, M. T. (2014) "Teaching the way they were taught? Revisiting the sources of teaching knowledge and the role of prior experience in shaping faculty teaching practices," *Higher Education*, 68(1), pp. 29–45.

Olivier, M. S. (2004). *Information Technology Research: A practical guide for computer science and informatics.* (2nd ed.). Van Schaik Publishers.

Picciano, A. G. (2017) "Theories and Frameworks for Online Education: Seeking an Integrated Model," *Online Learning*, 21(3), pp. 166–190.

Reese, S. A. (2015) "Online learning environments in higher education: Connectivism vs. dissociation," *Education and Information Technologies*, 20(3), pp. 579–588.

Ruth, S. (2018) "Faculty Opposition to Online Learning: Challenges and Opportunities.," *International Journal of Technology in Teaching and Learning*, 14(1), pp. 12–23.

Scoppio, G. and Luyt, I. (2017) "Mind the gap: Enabling online faculty and instructional designers in mapping new models for quality online courses," *Education and Information Technologies*, 22(3), pp. 725–746.

van der Sluis, F., van der Zee, T. and Ginn, J. (2017) "Learning about Learning at Scale," in *Proceedings of the Fourth (2017) ACM Conference on Learning @ Scale - L@S '17*. New York, New York, USA: ACM Press, pp. 131–140.

Taherdoost, H. (2018) "A review of technology acceptance and adoption models and theories," *Procedia Manufacturing*, 22, pp. 960–967.

Thompson, C. J., Leonard, L. and Bridier, N. (2019) "Online discussion forums: Quality interactions for reducing statistics anxiety in graduate education students," *International Journal of E-Learning & Distance Education*, 34(1), pp. 1–31.

VanOostveen, R., Desjardins, F. and Bullock, S. (2019) "Professional development learning environments (PDLEs) embedded in a collaborative online learning environment (COLE): Moving towards a new conception of online professional learning," *Education and Information Technologies*, 24(2), pp. 1863–1900.

Warf, B. (2019) "Teaching Digital Divides," *Journal of Geography*, 118(2), pp. 77–87.

Wu, B. and Chen, X. (2017) "Continuance intention to use MOOCs: Integrating the technology acceptance model (TAM) and task technology fit (TTF) model," *Computers in Human Behavior*, 67, pp. 221–232.

Wylie, N. (2020) "Face-to-face to online: PhD academic writing @Maastricht University," in *Innovative language teaching and learning at university: treasuring languages*. Research-publishing.net, pp. 13–19.

Trainee Teachers Preparation for Developing of Pre-School Children Information Literacy and a Computational Thinking

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DOI: 10.34190/EEL.21.100

Abstract: The development of information literacy and computational thinking, respectively algorithmic thinking, has become an integral part of the education for pre-school children in recent years. In this context, it is necessary to develop as well the relevant competencies by the students of pre-graduate studies in their field of studies. The aim of the study is to present the possibilities and ways of undergraduate students education through the theoretical analysis of information literacy and computational thinking. The study presents possible perspectives on the development of information literacy and computational thinking in the context of contemporary undergraduate students´ education, thus it illustrates the possibilities in educating of pre-school children not only with using various teaching activities, robotic programmable toys or educational robotics.

Keywords: information literacy, digital literacy, computational thinking, algorithmic thinking, model of education, pre-school education

1. Introduction

The long-term strategies of the Ministry of Education and Sports (MŠMT, 2018) lead directly to national curricular reform not only in the field of Information and communication technologies (NÚV, 2018). That's why the faculties preparing future teachers must respond to these changes as well. Students need to be encouraged to develop not only their digital and information literacy but also computational thinking. Faculties of education (at least those involved in the PRIM project imysleni.cz) transfer these current concepts to students not only for their own development, but also with the promise that the students will further develop these competencies in pupils at all levels of education in their fields or specializations. These strategies can be applied even to the youngest children in preschool age, and therefore it is necessary to provide training also for undergraduate students focusing on studying the Kindergarten Teachers´ Training programme.

Development of digital literacy or computational thinking is not necessarily related only to the use of digital technology itself, but responds to the current needs of society. Really important for today is for example security and behaviour in the digital world, which can be addressed through unplugged activities. Interactive technologies, robotic programmable toys and educational robotics also come to the forefront of the interest of children, parents, and teachers not only in kindergartens. All these devices are always dependent on the well prepared activities for pupils, as well as the teaching methods, forms and means that teachers implement through them.

The untargeted use of any device or mean carrying the potencial for child development does not necessarily develop the required thinking or competencies itself. That's why targeted and well-advised use of methods and means entails the necessary training of teachers both in terms of technology and pedagogy both in bachelor's and master's studies. This is as well current strategy and aim at the Faculty of Education at Charles University. One of the prepared models was prepared, verificated and now presented in this methodology study.

2. Terminology

The terminology in the Czech Republic is gradually becoming clearer in terms of the typology of literacy and thinking. Digital and information literacy as well as computational and algorithmic thinking are currently the most used terms in the field of information and communication technologies. The mentioned ways of development of pupils and students are discussed and developed across various fields and subjects. These aspects are also supported at national level through various types of national projects.

The terms overlap in their content, which is evident in the following terminological analysis. This is to some extent due to historical consequences, fields where they were of major importance, as well as national and international efforts to develop a particular type of thinking or literacy.

Digital literacy in Czech consciousness is interpreted depending on for example DigComp 2.0 (Carretero, 2016) and other relevant documents issued by the European Union (Ferrari, 2013) (Carretero, 2017). Digital literacy present a set of digital competencies that are divided into following areas:

- Information and data literacy,
- Communication and collaboration,
- Digital content creation,
- Safety,
- Problem solving,
- and Technological Competencies are added to this concept (Jeřábek, 2018).

This literacy is understood as interdisciplinary. It thus enters various fields and becomes a natural part of them. It can be demonstrated in a lot of ways and examples. Students and pupils can draw geometric objects through special software, create graphs using a spreadsheet editor in Mathematics. In Civics they can also get acquainted with the ways of communication through digital technologies and behaviour in social media, thus with Netiquette.

The above-mentioned areas of digital competencies are also important in pre-school education, where children can meet for the first time with specific situations, activities or even facilities suitable for the development of digital literacy in a formal educational institution. Even in the project Support for the Development of Digital Literacy (digigram.cz), the youngest children in kindergartens are engaged. There are six interesting activities focused on different means, and the Bee-Bot robotic programmable toy is also not missing.

Although information literacy can also be understood as a part of Digital Literacy in the competency Data and Information Literacy, its separate definition is historically mainly related to the field of librarianship. In the Czech Republic, information literacy is defined according to European standards as the ability to work comprehensively with information, i.e. its finding, acquisition, assessment, processing, representation, presentation, sharing and cooperation, while being aware of ethical, security and legal standards and the use of the potential of digital technologies (digigram.cz).

Computational thinking is more focused on solving a problem, therefore also on the problem´s formulation, its analysis, the division of the problem into its parts (subproblems), and finding and testing the procedures of specific and generalized solutions (youtube.com). It can be said that computational thinking is a set of methods aimed at solving a problem, which includes both its expression and solution (Wing, 2006). Its three basic points of support are Abstraction, Automation and Analysis. Abstraction is understood as an accurate expression of the problem that is being solved, Automation as a solution to a problem with all its necessary components and Analysis as an evaluation of the solution (its generality, transferability and practical implementation itself) (Wing, 2006).

The base of this theory does not directly focus on using technologies at schools. However, it is really important to think about computational thinking in education in terms of the current development, where the use of digital means is an integral part of everyday life. One of the possible solutions at schools is the foundations of methods and forms for creating procedures on how to solve problems in specific environments and thus develop computational and algorithmic thinking. There are four main pillars in terms of the practical implementation of computational thinking (eduskop.cz, bbc.co.uk):

- decomposition – division of the whole problem that is being solved into smaller realizable parts,
- patterns and sequences - searching for repetitive similarities,
- abstraction - capturing the structure of the problem and selecting the information necessary for solution,
- algorithm – design of a procedure by which the problem can be solved step by step, or rules that lead to the solution of the problem.

It is therefore necessary to highlight not just programming knowledge and skills, but other aspects that emphasize, for example:

- cooperation,
- perception of context (Brdička, 2014),
- developing of logical thinking,
- knowledge and information structuring,
- planning and managing systematic activities (timemanaging).

The above-mentioned algorithmic thinking is then more oriented on the application of the algorithm itself, its modification, or verification of its correctness and error finding. Last but not least, it is the writing of the algorithm itself, which can be implemented in various environments, including children's programming languages such as Scratch (scratch.mit.edu), MakeCode (www.microsoft.com) or Python (python.org). Algorithmic thinking is actually a way to get a solution to a specific problem while respecting a set of rules that are important both for the algorithm itself (algorithm properties) and for the environment in which the algorithm is created.

Efforts to develop computational and algorithmic thinking in the Czech Republic are also (not only) implemented through the national project Support for the Development of Computational Thinking (imysleni.cz). Among other things, this project aims to show and introduce a different way of thinking about the subject Informatics to Czech schools. It presents 14 textbooks and other more activities. Two of them are dedicated to the development of children in kindergartens as well. It is really important for teachers to prepare them because of the change of national curricular documents in the Czech Republic.

3. State of the topics in this field in the Czech Republic

In January 2021, the Ministry of Education, Youth and Sports presented the final version of the revised curricular documents for primary schools. There are significant changes in the chapter devoted to the educational area of Informatics (formerly Information and Communication Technologies) in this basic document. Some additional chapters were modified at the same time. The changes were in the content of the educational area (specifically the so-called expected outcomes, i.e. competencies that students have at their disposal after completing individual educational units) and in modification of time allowances for educational fields / subjects corresponding to the content changes. In the field of Informatics, the educational content is completely changing, with a new direction to the development of computational thinking, especially within the given educational area, as well as digital literacy. The development of pupils is also expected across other educational areas and fields / subjects including interdisciplinary relationships. The importance of this educational area is documented by the significant increase in the minimum number of teaching hours.

The presented curricular revision for primary schools has a direct impact on other levels of education. Just as it is assumed that the new profile of a primary school graduate will be taken into account when continuing further studies at higher levels of the school system, there is also a need to prepare starting points for primary school education at the pre-primary level. Continuity is expected between the last year of kindergarten and the first years of elementary school. In this sense, modifications of curricular documents for kindergartens are being prepared in terms of content, taking into account the need to create preconcepts of computational thinking and digital literacy for future elementary school students.

Another area that reflects the editing of curricular documents is the area of training of future teachers at universities and as well focused on pre-primary education. Just as courses focused on the development of computational thinking and digital literacy were included in the educational programs of students in the field of primary education, there were prepared similar modificated model implemented as a compulsorily part of the educational programs of students studying the field of pre-primary pedagogy. This model was built on specific didactic aspects, methodologies and theories.

4. Possible approaches to the development of literacy and thinking in kindergarten

The theory of students´ preparation is based mainly on acquainting students with the constructivist and constructionist conception of education described by the main representatives J. Piaget (1955) and S. Papert (1991). The contribution of educational technologies in the implementation of this approach lies primarily in the support of activities that are based on teamwork and support the process of knowledge building, with the support of teaching materials, have an easy-to-understand intention, goal, and meaning for students and solve real-life problems. The intention is therefore to present primarily such activities that are meaningful, authentic, and also have a social dimension.

Active and reflective methods predominate from the methodology point of view, in which work is performed on "experiments" or problems are solved in a targeted manner so that they correspond to the abilities, interests, and talents of the pupils. Problem-oriented methods are also represented, where groups and individuals are looking for the solutions to real-life problems that are more or less based on using technology. In addition, each team member can have a unique role in strengthening their own motivation as well as critical and analytical thinking, and lead children to the ability to learn in an easier way.

The provided theoretical and methodological knowledge should help students to lead their students to actively acquire or construct knowledge and skills from relevant disciplines as well as to further develop various key competencies of students needed for life in the so-called information society (information literacy, support for computational thinking) and understanding of the basic principles of operation of ubiquitous technologies and complex mechanisms (e. g. electronic home robots, robotic vacuum cleaners).

However, theoretical knowledge must necessarily be supported by demonstrations and short practical exercises and thus provide students with the opportunity to get acquainted in practice with the methods and means mentioned above. In this area, it is mainly about getting acquainted with the constructivist approach to building knowledge and skills in conjunction with available technological means and didactic techniques, testing their functions in practice, and applying didactic procedures suitable for individual teaching situations.

The main themes that meet the above-mentioned theoretical and didactic aspects were selected for this purpose, which can be used to successfully develop algorithmic thinking, information and digital literacy as well as important competencies in the professional and social field.

The first unit, which is certainly appropriate to include just after the necessary theoretical introduction, is the unplugged method. Within this topic, various examples of possible activities should be presented, which are simple to implement, require only a small amount of tools, support a collaborative approach, and are independent of computers, compilers, browsers and the Internet connection (Cortina, 2015). Inspiration for implementation of suitable unplugged activities can be taken both from Czech sources, including, for example, the methodological manual for the development of algorithms for children (Maněnová et al, 2020) created within the PRIM project, as well as from foreign materials and portals which include, for example, the set of activities and other materials created at the University of Canterbury under the name “Computer Science without a computer”, available at csunplugged.org.

Students can come up with their own proposals for unplugged activities, which should be subjected to a subsequent group discussion and possibly further developed in a team. The teaching will take place in accordance with the acquired teaching methods, and students will try the whole process of implementing the activity. For example, they can choose a specific activity or design it, prepare it, introduce it to their colleagues and try to implement it. During this process, there is a great opportunity to obtain feedback, impulses for improvement, and possible suggestions to streamline teaching. It can be the execution of pre-given simple commands (go forward, turn, make a sound ...) interpreted verbally, or using graphic symbols, controlling a classmate as a robot, navigating a maze, or various variations on children's games (e.g. drawing the way to a treasure).

Another possible approach to developing algorithmic thinking is the use of robotic programmable toys for preschool children. This topic should include an introduction of the most common programmable toys in the Czech Republic like Bee-Bot or Ozobot, which can be supplemented by other specific alternatives such as Code-a-pillar, Dash & Dot, Sphero, or many others depending on the current offer. Activities with these resources should once again be conducted in the direction indicated by the theoretical basis, in terms of the use of didactic methods. It is very desirable to apply especially problem-oriented activities. It could be finding the fastest way to the destination, avoiding obstacles, drawing a route to the treasure, a walk around the zoo, morning hygiene, etc. For inspiration, it is again possible to use Czech sources, such as the already mentioned material "Algorithmization using robotic toys for children under 8 years" (Maněnová et al, 2020), as well as international portals such as tts-international.com and related video activities on the YouTube platform, or supported provider materials of related technologies.

An integral part of developing computational thinking is interactive technology, especially in terms of its broad penetration into all other related topics. Students should be well aware of the possibilities of using common touch devices (tablets, smartphones) in teaching, depending on their hardware configuration and equipment. Basic technical parameters (resolution, camera, GPS, accelerometer, compass, etc.) and the possibility of connecting to other devices (BT, Wi-Fi, connectors ...) certainly play a role here. Other factors that will determine the inclusion of interactive technologies in a school will also be the type of operating system used, as well as affordability. The main parameters of equipment selection should not be neglected from the point of view of inclusion in teaching, such as the issues of power supply, equipment protection, or compatibility with other technical means. The didactic part of the topic consists in the presentation of suitable activities with tablets (or smartphones) in a classroom and for outdoor-learning (navigation, mapping) such as treasure hunting, maze walking, etc.

Students should have the opportunity to get acquainted with specific interactive technologies designed specifically for schools. This includes introducing the possibilities of technologies such as interactive whiteboards, tables and carpets. In addition to the technical specifics of individual devices, it is relevant to present the main principles of working with school interactive technology. Emphasis should be placed on the didactic specifics of creating teaching materials and explaining the recommended principles for creating interactive presentations. It is possible to find a number of examples of good practice from the Czech environment, such as the portal veskole.cz and international sources such as learningapps.org. However, students should primarily try out the available types of interactive techniques in a group directly during full-time teaching.

In connection with the introduction of interactive technologies, we cannot omit relevant educational applications and especially selected propaedeutic programmable environments for the development of computational thinking, like LightBot (lightbot.com), GalaxyCodr (galaxycodr.com), etc.

A very important approach to the development of computer thinking is educational robotics. Within this topic, the possibilities of using robotic systems such as LEGO Coding Express (programmable train), LEGO Duplo sets, but also other alternatives, such as the Botzees kit, are presented. Educational robotics is a powerful and flexible educational tool with a great motivating factor. It allows children to build their own robot (robotic toy) and control it through easy programming languages. Its potential also lies in the possibility of involving children in solving project and problem-oriented educational activities. Robotic devices used in the field of education can play the role of tools developing children's technical thinking, imagination and creativity, without a reference to one limited theme, but on the contrary with considerable interdisciplinary overlap.

Important part of all the indicated methodological approaches to the development of information literacy and algorithmic thinking in preschool children is the ongoing inclusion of feedback activities. For each topic, a constructive discussion between the participants should take place continuously or at the end, enabling a better fulfilment of the set goal. Sufficient time should be provided for independent and team creation of specific outputs and their presentation, argumentation and subsequent reflection leading to obtaining the necessary feedback and incentives to further improve or develop the required competencies.

5. Verification of a model solution in the preparation of undergraduate students of pre-primary education

During the preparation of the new accreditation for pre-primary education and the coming changes in national curriculum a model of education was prepared in the field of Teacher Training for Kindergartens. This model focuses on the development of computational thinking and digital literacy of both pre-school children and especially the approach to the training of future teachers in kindergartens were already taken into account.

The concept of two consecutive courses Basics of Information Pre-literacy for Preschool Education I. and II. take a part of this model. The main goal was to acquaint students with different types of activities and the use of different means and environments in the education of preschool children. A similar change occurs in the following master's study, where the main added value is the pedagogical-didactic coverage of the whole issue. In order to maintain a specific line in this study, the authors focus only on the concept in the bachelor's studies.

Both courses were included among the subjects in the accreditation of the field of Teacher Training for Kindergartens at the Faculty of Education in the academic year 2017/2018 for the first time. Students in this field had the opportunity to get acquainted with the development of information and digital literacy and computational and algorithmic thinking in kindergarten children within the standard study trajectory, which was a topic to which only students of primary and secondary school teaching had had access. As the proposed reform of the Framework Educational Plans assumes that information literacy and algorithmic skills will be built and further developed in children from the lower grades of primary school, it is highly desirable that teachers in institutions providing pre-primary education are acquainted with the issue. They should be also prepared for possible participation in activities leading to the development of basic information literacy implemented at the level of pre-school education.

Mostly theoretically oriented compulsory course Basics of Information Pre-Literacy for Preschool Education I. should acquaint students with the importance of information pre-literacy in preschool children and equip them with relevant knowledge for working with modern technologies, technical equipment and their software support. The course is therefore designed as an introductory insight into the issue and it also has a consolidating character. The main goal is to present the possibilities of developing information and technical activities of children in kindergarten and to present creative activities mediated by technology, i.e. a detailed acquaintance with the development of information literacy and algorithmic thinking in preschool children. The content of the course focuses on formation of knowledge aimed at supporting constructive pre-primary education through interactive devices, kits and didactic toys, digital learning materials and the possibility of creating the basics of algorithmic thinking in children in kindergartens. All activities and developed competencies are fully in line with the defined possible approaches to the development of literacy and thinking in future teachers in kindergartens with focus on eight basic topics: Online resources, Mobile technologies, Cloud services, Interactive technologies, Do it yourself method (DIY), Fundamentals of Algorithmization and Programming, Educational Robotics and "Unreal" Reality (Virtual, Augmented and Mixed Reality).

Practically oriented compulsory-optional course Basics of Information Literacy for Preschool Education II. builds on and complements the previous course, where in the second year of study students learn about specific activities, the use of tools, environments and methods for the development of computational and algorithmic thinking in kindergarten children and their digital literacy. The course is practically and skilfully oriented. The aim of the course is to develop students in the field of Kindergarten Teacher Training and, based on theoretical knowledge, to apply the appropriate technical means and environment to preschool education. The content focuses on the formation of skills while working with interactive devices, educational robotics, and robotic programmable toys and without them. Five units were selected from possible defined approaches to the development of literacy and thinking in children in kindergarten depending on the previous course: Unplugged methods in the development of digital literacy of computational thinking, work with robotic programmable toys focused on Bee-Bot and Ozobot, work with educational robotics focused on LEGO WeDo 2.0 and work with interactive technologies focused on interactive whiteboards and interactive panels.

This model was implemented in two consecutive academic years, in the first as a pilot and in the second with subsequent revisions after reflections by teachers and depending on the reactions of students in both full-time and part-time study.

	Basics of Information Literacy for Preschool Education I.		Basics of Information Literacy for Preschool Education II.	
	full-time	part-time	full-time	part-time
2017/2018	25	28	-	14
passed	25	24	-	11
2018/2019	30	25	19	11
passed	28	23	17	9

Students were formed from groups of the first and second year of bachelor's study. In the course of the academic year 2017/2018, a total of 67 students participated in the courses with a success rate of 89.55%. In the following year 2018/2019, 85 students were enrolled in both courses with a success rate of 90.59%.

The repeated implementation of the subject Basics of Information Literacy for Preschool Education I. in full-time and part-time form of study in two consecutive academic years made it possible to reflect on the course of teaching and verify the modifications of the course content and the forms of teaching applied by teachers in practise. The changes were based on a thorough analysis of teaching meetings conducted by teachers after the end of the relevant course block and on feedback received from students.

This subject had an exclusively theoretical character in the pilot year of teaching. Students got acquainted with the main starting points of the concepts of digital literacy and informatic thinking and gained the knowledge needed to support the development of these concepts in preschool education. They were oriented as well in a diverse technological base enabling the implementation of educational activities developing digital literacy and informatic thinking in pre-primary education.

The teachers' own analyses and the feedback received from students after the first run of the course showed that in order to meet the set educational goals. it will be appropriate to combine the originally theoretical content of the course with at least some basic practical content component. The results of the evaluation of the pilot implementation of the course also showed the need to expand the content of the theoretical part with components focused on deeper knowledge and analysis of the importance of didactic and methodological aspects of educational activities aimed at developing digital literacy and computer thinking of preschool children.

With regard to the findings, greater emphasis was placed on student activities to develop their pedagogical skills and competencies needed for the successful implementation of activities in the second year of implementation of the course. Some general theoretical components were repressed in the content of the course and more space was given to methodology and didactics. In the sphere of practical activities, which was additionally incorporated into the subject compared to the pilot run, students were given the opportunity to try out touch mobile technologies, including appropriate application equipment used in pre-school education, selected programmable toys and LEGO robotic kits, also intended for pre-primary education. The practical activities took the form of a basic familiarization closely linked to the theoretical level. After the re-analysis of teaching and feedback, the scope of the newly included part of the course appears to be meaningful and sufficient after the implementation of the second run, even given that this course is a prerequisite for the follow-up course that further develops the issue.

In the pilot implementation of the subject Basics of Information Pre-literacy for Preschool Education II., only in the part-time study teacher's reflection follows that too time-consuming content is chosen for the implementation of the course, which cannot be relevantly implemented under the time conditions of the given accreditation. Due to this finding, the number of activities in individual topics was reduced in the following year and more space was given for students' experimental activities, especially with robotic programmable toys Bee-Bot and Ozobot, and the LEGO robotic kit. The units focused as well on interactive whiteboards and panels. This change was subsequently tested in the next year of the course implementation, both for full-time and part-time students.

Students reacted positively to unplugged activities during the lessons and were fascinated mainly by working with the robotic toy Bee-Bot, the second alternative Ozobot was mostly considered difficult when implemented with preschool children. They considered interactive whiteboards and panels to be interesting and attractive work, but on the other site students recommended that only with a small group of children and with a suitably prepared activity can this type of technology be successfully used. The discussion then showed that they could imagine simultaneously working with all types of equipment within a specifically oriented project day.

6. Conclusion

The changes that are currently taking place within the Czech national curriculum in education and which are supported within various projects in the Czech Republic must be necessarily responded to by the universities focusing on teacher training not only for the preparation of teachers for primary and secondary education, but of course at the lowest level in pre-primary education. There takes place a great necessity to change students thinking about children education: not just to teach only how to operate with equipment like computer or smartphone and learn how to technically used and control all functions of the applications, but to think about the effectively a correctly used in specific situation and to create and model their ideas and information. That's why the presented model is focused on computational and algorithmic thinking, and digital literacy.

The possibilities of how to do it is to improve students in the specific themes, like educational robotics, robotic programmable toys and interactive technologies with respect to didactic forms and methods, as well as to prove and develop their own digital literacy and computational thinking.

This methodological study shows the real and successful implementation of the development of computational thinking and digital literacy in the study of pre-primary pedagogy on the basis of theoretical aspects based on both the current requirements of society and psychological-pedagogical paradigms. These efforts to innovate model of two subjects, that prepare students focusing on kindergartens towards topics related to the development of computer thinking and digital literacy, is the first steps to increase literacy and the development of the specific type of thinking in preschool children.

This is just the beginning of how to prepare the new generation for real competencies of the 21st century. Everything begins in kindergarten, that's why the students studying preschool education should be well prepared.

References

Brdička, B. (2014), *Informatické myšlení jako výukový cíl*, [online], https://spomocnik.rvp.cz/clanek/18689/INFORMATICKE-MYSLENI-JAKO-VYUKOVY-CIL.html

Carretero, S., Vuorikari, R. et al. (2016) *DigComp 2.0: The Digital Competence Framework for Citizens. Update Phase 1: The Conceptual Reference Model*, Publication Office of the European Union, Luxembourg, https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework

Carretero, S., Vuotikari, R et al. (2017) *The Digital Competence Framework for Citizens: With eight proficiency levels and examples of use,* Publications Office of the European Union, Luxembourg, http://publications.jrc.ec.europa.eu/repository/bitstream/JRC106281/web-digcomp2.1pdf_(online).pdf

Cortina, T. (2015) "Reaching a broader population of students through unplugged activities." *Communications of the ACM*. http://dl.acm.org/citation.cfm?doid=2739250.2723671

ČŠI (2015) *Metodika pro hodnocení informační gramotnosti,* [online] ,Česká školní inspekce, Praha, http://www.niqes.cz/Niqes/media/Testovani/KE%20STA%C5%BDEN%C3%8D/V%C3%BDstupy%20KA1/P%C5%99G/Metodika-pro-hodnoceni-rozvoje-PrG.pdf

Ferrari, A. (2013) *DIGCOMP: A Framework for Developing and Understanding Digital Competence in Europe*, Publication Office of the European Union, Luxembourg, http://ftp.jrc.es/EURdoc/JRC83167.pdf

Jeřábek, T. et al. (2018) VM1.1 - *Koncept digitální gramotnosti*, Vol 2, [online], https://pages.pedf.cuni.cz/digitalni-gramotnost/files/2019/06/VM1.1-Koncept-DG.pdf

Maněnová, M. and Pekárková, S. (2020) *Algoritmizace s využitím robotických hraček pro děti do věku 8 let*, [online], Univerzita Hradec Králové, https://imysleni.cz/ucebnice/rozvoj-informatickeho-mysleni-s-vyuzitim-robotickych-hracekv-materske-skole-a-na-1-stupni-zs.

MŠMT (2019) *Strategie vzdělávací politiky ČR do roku 2030+*, [online], MŠMT, http://www.msmt.cz/vzdelavani/skolstvi-v-cr/strategie-2030

NÚV (2018) *Návrh revizí rámcových vzdělávacích programů v oblasti informatiky a informačních a komunikačních technologií,* [online], NÚV, http://www.nuv.cz/t/revize-rvp-ict

Papert, S. and Harel, I. (1991) *Constructionism: research reports and essays 1985–1990 by the Epistemology and Learning Research Group*, the Media Lab, Massachusetts Institute of Technology, Ablex Pub. Corp, Norwood, NJ.

Piaget, J. (1955). *The Child's Construction of Reality*. London: Routledge and Kegan Paul.

Procházka, J., Lapeš, J. and Tocháček, D. (2020) *Robotika s LEGO® WeDo pro 1. stupeň základní školy*, [online], Univerzita Karlova Pedagogická fakulta, https://imysleni.cz/ucebnice/edukacni-robotika-s-lego-wedo-2-0-pro-1-stupen-zakladni-skoly

Repenning, A. (2016). *Computational Thinking Tools. IEEE Symposium on Visual Languages and Human-Centric Computing*, [online], https://www.researchgate.net/publication/309916650_Computational_thinking_tools

Wing, J. (2006), *Computational Thinking. Communications of the ACM*. 49. 33-35. 10.1145/1118178.1118215.

Teacher Motivation During the Corona Crisis, Facing "Black Screens" and Missing "Watercoolers"

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DOI: 10.34190/EEL.21.025

Abstract: There are several studies on how to motivate students. This is accomplished by flipping the classroom, by using student-active methods, games, simulations, etc. But how to motivate the teacher/lecturer in online education? It is often a very lonely experience to be an online teacher, as many students may not be comfortable interacting in this medium. Teachers and lecturers are obliged to keep up with the minimum standard of technology decided by their university/employer. But for teachers and lecturers, e.g., in music education, who are musicians, have degrees in history or a second language and are not tech geeks, or who are even close to using tech stuff other than their cell phones, TV set and the like, to keep up with education tech might feel like a daunting task. Regarding providing online education for them, it might be a matter of just connecting to an existing, well-tested system. However, the corona crisis has made many non-tech teachers and lecturers take the leap into a more online world of education. But with this, new issues arise, such as "black screens", from a classroom where one can ascertain to a certain extent whether the students are grasping the communicated lessons, to black screens where the lecturer needs to rely on the students' feedback to confirm the learning outcome. Nonetheless, for a various number of reasons, there are few students who respond. The way academics have seemed to lend a hand and share experiences, know-how and otherwise been helpful to each other, may have helped regarding the motivation to lecturing online, and to learn to handle more tools that are helpful for online education. Getting and feeling support from fellow teachers and lecturers can be a source of motivation. Yet, even the "watercooler" is no longer available. The paper shows research among the faculty staff at the Inland Norway University of Applied Sciences, Business School – Faculty of Economy and Social Sciences. The focus of the research has been what has motivated them to make use of digital tools for lecturing, and what they are motivated to continue using after the corona crisis has finally passed.

Keywords: motivation theory, self-efficacy, black screens, e-learning, missing "watercooler"

1. Introduction

The Inland Norway University of Applied Sciences has been a substantial provider of online courses for many years now. However, most of the lecturers have lectured face-to-face in classrooms. As a result of the Covid-19 pandemic and subsequent lockdown, it became paramount to provide all courses and concurring lectures online, since campuses were closed for students and faculty staff. Not only did the lecturing have to be offered online, but from a home office more or less equipped for the task. This also spurred the development of tutorials for the lecturers, now in home offices. Tutorials provided in the Learning Management System (LMS) enabled the lecturers to produce lectures and complete courses, and as the crisis became prolonged, another two semesters of lecturing online. Although this emerged from a crisis (Coombs, 2019), the general perception among the faculty staff and students is that this has been a successful transition, particularly when taking the circumstances into account.

In this paper, we will use as the starting point a survey conducted at the Inland Norway University of Applied Sciences. The purpose of the survey was to map students' experience of teaching and experienced learning outcomes during the COVID-19 shutdown. The survey unveils a discrepancy between full- and part-time students regarding the perceived loss of learning outcome, regardless of teaching methods. The full-time students experienced the online lecturing as less rewarding than the part-time students.

The survey further shows that students have experienced social isolation, with a lack of social contact and collaboration with other students, as well as contact with lecturers during the pandemic having had a negative effect on the learning outcome. This lack of social contact between the students has resulted in many "black screens", as nearly half the students tend to feel "exposed" when they have their camera on. They prefer not to be visible, although they also report that this reduces their learning outcome (Marek, Chew and Wu, 2021).

Some lecturers experience that the aliases behind the black screens also do not take part in any groupwork or other student-active pedagogical approaches in the lectures. “Black screens”, and a lack of taking part in groupwork and other activities, challenge some of the approaches suggested for the lecturers. It is the lecturers' responsibility to initiate interaction and dialogue during classes, though inexperienced lecturers in the online medium may find this situation somewhat challenging. According to Moore (1997), it is a matter of finding a balance between the presentation of the academic content and interaction and dialogue.

Another assumption is that it is a very lonely task to sit in solitude in front of a camera, and that one may experience it as a strain. There may be very little feedback when one does not meet face to face. When students turn off the screens, there will be less interaction between students and lecturers, and less feedback to lecturers on their teaching.

A third assumption is that it is experienced as over-extensive work to learn new tools. To teach online requires twice as much from the lecturers, as the lecturers and students are geographically distant from each other, and thus physically separated. We assert that to not see the students’ non-verbal signals will require more from a lecturer when the lecturer and students communicate through digital tools. The lecturers are forced to conduct online education; our investigations show that the lecturers are more motivated to use new digital tools in ordinary lectures.

Not having a choice and facing unforeseen obstacles, such as black screens and less contact with peers, the lecturers have carried on and finished nearly three semesters online. We assert that this is due to motivational factors beyond that of “ordinary” work motivation.

Hence, our research question is:

How has the Covid-19 crisis affected teacher motivation?

In the following, we will present the theoretical foundation that has enlightened our study, followed by our results and discussion. We then conclude and suggest further research.

2. Theoretical foundation

Work motivation has been, and still is a research field of immense interest. From Elton Mayo’s research in the Western Electric Company in Hawthorne, the results of his investigations culminated in a “new” direction within an understanding of what was to become the “human relations” direction within organizational theory (Mayo, 1930; Hatch, 2018). The understanding that there are aspects about work other than monetary motivation was described by Herzberg, in dividing motivational factors into the intrinsic (motivators) and extrinsic (hygiene), where the intrinsic, like being recognized and achievement of support in job satisfaction, and extrinsic, like wages, though not necessarily contributing toward job satisfaction (Herzberg, 2017).

Maslow’s hierarchy of needs (1981) is useful regarding a basic understanding, in which the physiological needs are the basics, before safety and social needs, thereby supporting the ego and finally self-actualization. Even so, Vroom’s theory depicts how employee effort leads to performance, which in turn will lead to rewards that are either negative or positive. The negative rewards will demotivate, while conversely, the positive may support motivation (Vroom, 1964). From a managerial point of view, behaviours that lead to positive outcomes should be repeated and reinforced, while to the contrary and according to Skinner (2019), behaviours that lead to negative outcomes should be negatively reinforced.

Vroom’s definition of work motivation is “a process governing choices made by persons or lower organisms among alternative forms of voluntary activity” (Vroom, 1964; Kleinginna and Kleinginna, 1981). The “process” in this case is governed by the crisis and by the choices made available to the teachers.

Another definition of motivation is offered by Silverman (Silverman, 1971; Kleinginna and Kleinginna, 1981): “Motivation concerns those events – the pushes and pulls that move us to action… variables that activate, energize and frequently direct behaviour.” The “pushes and pulls” are again the crisis and the available options for the ongoing work. Learning something new, and by mastering the new tools, may activate and provide the energy to try new ways of utilizing the technology. This also applies to Wlodkowski’s (1978) definition:

"Motivation is the word used to describe those processes that can: a) arouse and instigate behaviour; b) give a direction or purpose to behaviour; c) continue to allow behaviour to persist; and d) lead to choosing or preferring a particular behaviour."

This points toward Bandura's (Bandura, Freeman and Lightsey, 1999) (Bandura, 1978, 2006; Bandura, Freeman and Lightsey, 1999) self-efficacy. Perceived self-efficacy is a "judgement of capability to execute given types of performances" (Bandura, 2006, p.309). Bandura also states: "The outcomes people anticipate depend largely on their judgments of how well they will be able to perform in given situations" (Bandura, 2006, p.309). This means that what the teachers have expected to be able to achieve largely depends on how well they think they can perform. Low expectations may therefore lead to a high perceived self-efficacy if they succeed, while high expectations may lead to a low perceived self-efficacy if they feel that they have not succeeded. The individual's belief in mastery regarding a task has a central meaning regarding the introduction of new digital work methods. Resistance to change is quite common, and is often associated with extra work that may seem stressful if the workers do not experience competence and coping skills. It is important to have common goals, good training and support from your colleagues. Having coping skills is essential to success regarding the introducing of digital tools.

In his transactional distance theory, Moore (1997) emphasizes that to succeed with an online teaching dialogue and communication are important. His theory includes "the universe of teacher-learner relationships that exist when learners and instructors are separated in space and/or time" (Moore, 1997). Moore (1997) called these universes, which exist between teacher and learner relationships when they are separated by space and/or time for the transactional distance. Online teaching results in an interaction between teachers and learners in a context having the special characteristics of a separation of teachers from learners. This psychological and communication space is termed transactional distance. According to Moore (1997), videoconferencing as media will permit a more intensive, more personal and more dynamic dialogue than can be achieved in using a recorded medium. Audio conferencing systems are therefore likely to reduce the transactional distance more effectively than programmes using recorded media.

If teachers experience low subjective coping skills and are insecure, the probability of having them use the digital tools is low, so they will consequently reduce their efforts and their goal. One can assume that it is important that co-workers who experience positive coping skills feel competent and have faith in themselves. Co-workers with a low sense of coping skills have a tendency to lower their aims or give up, and become sensitive regarding negative feedback or even a lack of feedback. They will often react negatively and defensively. A person with positive coping skills makes a greater effort regarding difficult challenges, and will react positively and offensively towards negative feedback (Bandura, Freeman and Lightsey, 1999). There are of course large individual differences in the degree of coping skills and input when new digital work methods are introduced.

Digital communication may be challenging because of the vastness of the information, whereas nonverbal evidence may be reduced through a camera; it may thus be difficult to achieve two-way communication when there is little non-verbal evidence and little spontaneity in the communication process. Mediation without words often occurs spontaneously, and non-verbal expressions such as eye contact, touch, body movements and facial expressions are non-existent. Non-verbal communication and behaviour may be important in regard to explaining or disturbing the meaning in verbal communication, and misunderstandings may arise (Daft and Lengel, 1986).

Self-determination theory (SDT) (Deci and Ryan, 2012) distinguishes between autonomous motivation and controlled motivation. The autonomous motivation is a combination of intrinsic motivation and extrinsic motivation that people "have identified with an activity's value, and ideally will have integrated it into their sense of self" (Deci and Ryan, 2012), thereby allowing the persons to experience volition. Conversely, the controlled motivation is both external and introjected regulation that may pressure people to behave, think or feel in a special way. The feeling of competence, relatedness and autonomy are strongholds within SDT, although there are individual differences in the levels of these components.

Regarding work motivation and SDT, the same "rules" apply; people take part in an activity because they enjoy it or find it interesting (intrinsic motivation). Being controlled, such as by using extrinsic rewards, leaves the persons with a sense of pressure and demand for carrying out an action (Gagné and Deci, 2005). Cardinal to SDT is that if the autonomy is supported in a social context, people's level of identified and integrated motivation for an activity will be enhanced. Studies also show that people who receive feedback and rewards in a social setting supporting autonomous behaviour enhances the intrinsic motivation (Gagné and Deci, 2005). This also applies to autonomous-supportive managerial behaviour towards employees. In allowing a workforce to be autonomous and support initiatives, and rewarding it accordingly, will ultimately enhance the worker's intrinsic motivation. Also, enabling the workforce to understand the importance of different initiatives provides an extrinsic motivation (Gagné and Deci, 2005).

Gagné and Deci (2005) also refer to "organizational citizenship", which is a concept that includes "voluntarily behaviour", such as helping colleagues to have a positive impact on motivation, unless it is performed to solely promote self-interests toward management.

Collaboration and cooperation are important within social learning theory (Vygotsky, 1980), and can be within groups or teams (Hjertø, 2013). There are several different definitions of both the term collaboration and cooperation. In a literature review seeking to determine the differences Castañer and Oliveira (2020, p. 986) propose a redefinition based on this review to be: "Collaboration refers to voluntarily helping other partners to achieve IOR [Inter Organizational Relationships] (common) goals or one of more of their private goals". They further state that "the cooperation refers to the attitude, behaviour and outcome of the implementation of those goal as agreed on" (p. 994). A further definition of cooperation is offered by Salvato, Reuer and Battigallli (2017, p 963) as: "Joint work performed by persons who share a common goal, where the alignment of interest is central" , and collaboration as "Act of working together by two or more persons to accomplish something". Based on these inputs, our preferred understanding of collaboration is about helping other to achieve common and private goals, and that cooperation is about agreeing on common goals and working together to achieve them.

Collaboration on learning may be done in Communities of Practice (CoPs) (Lave and Wenger, 1991; Wenger, 2011). However, a collaboration and cooperation that extend outside the classroom/online lecture does require personal contact. The contact and social relations that students obtain in an ordinary classroom where there are possibilities to mingle in-between the classes, during lunchtime or during breaks, may be undervalued. Within blended learning, it is also possible to induce collaboration regarding groupwork on mandatory assignments. The assignments may be about their workplace and workplace-related or other areas, which may have some relevance regarding work (Priniski, Hecht and Harackiewicz, 2018; Vold and Haave, 2020). The assignments may be training for being enabled to bring the learning back to the workplaces. Assignments allow for reflection (Schön, 1984, 1987), and it is possible to organize assignments during the sessions with the teacher (both live and/or online) that spur reflection in such a way that they can reflect prior to, during and after the assignment. This resembles the reflection that we see in Kolb's (1984) experiential learning cycle.

Previous investigations (Haave, Hole and Vold, 2016) show the importance of the "small talk" shared by the students during, for example, breaks may be more important for the learning outcome of the students.

This "small talk" has also been recognized as "watercooler talk" (Navrbjerg and Minbaeva, 2020). The informal contact and exchange of information, courtesies and "gossip" at the watercooler is important for the organization, as it may lead to forming CoPs, while also possibly being a way of sharing knowledge. Being in a home office distances many workers from a social setting, with both the mental and physical distance possibly taking its toll on many workers. Whether feeling included or excluded will impact on work performance. Combined with the physical distance, questions like "Do I deliver enough?", "Am I qualified for this?" and worries about the job situation ("Will I have job in the future?") may have a negative effect on work performance (Navrbjerg and Minbaeva, 2020).

2.1 Material and psychological tools

According to Vygotsky (2001), all interaction must be seen in relation to the tools used. Vygotsky (2001) distinguishes between psychological and material tools. Psychological tools (thinking and language) are means of communication and interaction between people, and are used together with material tools. For example, material tools can be a computer. Psychological tools, such as communication, are used together with material tools.

To achieve increased student activity and engagement using Zoom (and thus avoid black screens), a study from the United States (Lee *et al.*, 2021) shows that students should to a greater extent be given opportunities to share themselves and relationships that are emotionally close to them. The teaching must be experienced as meaningful. They suggest three activities that can contribute to a more authentic engagement in the digital classroom, and even moments of joy: The first activity is "Show & tell", in which both students and teachers present a digital page in, for example, Google Slide, which is called "This is me". This contains conditions that are perceived as meaningful, such as leisure activities, favourite music and engagements like #Blacklivesmatter. The other is a personal project. Based on the principles of participatory theory, students work on a project over a longer period of time, which includes a topic that has personal significance for them in relation to the subject, e.g., art and the internet, harassment on social media, political polarization and mental health under Covid-19. The third and final activity is to give a positive response to fellow students to contribute to a learning environment, in which students feel a greater degree of security, trust and openness. All activities are about being seen, heard and feeling welcome, and contribute to a greater degree of "closeness" in a digital classroom.

3. Methodological approach

We chose a quantitative study (Cohen, Manion and Morrison, 2002) using a net-based freeware survey developed at the University of Oslo called “Nettskjema” (see: https://www.uio.no/english/services/it/adm-services/nettskjema/). This was chosen because we have had a limited amount of contact with our fellow colleagues. Some lecturers have worked together, though not all, so to reach as many as possible a survey was chosen as the best approach.

The number of respondents was 15, and the survey was sent to a department with approximately 40-45 faculty staff members. This means that it was only approximately 30% of the faculty staff who replied. Hence, our results can only indicate a trend, and not determine the truth.

4. Results and discussion

All of our colleagues who took part in the survey used Zoom, whereas some also used other tools for videoconferencing. Zoom was introduced in March of this year, so most of our colleagues have not been using it for that long. Approximately half the respondents have used “Breakout rooms”. Here, the students are in smaller groups.

This shows that all of the participants in the study have learned a new tool, and half have explored different features in this tool. Having and utilizing the dividing of the students into smaller groups allows the teachers/lecturers to follow up with the students when they are given a task.

Even if the students and lecturers are separated in space, this feature, combined with that they are fewer per group, will make it easier to reduce Moore's transactional distance (Moore, 1997).

Regarding the gaining of contact with the students, six out of 13 claim that it is difficult to get a conversation going with the students. However, only four out of 15 claim to feel alone. Seven out of 13 only saw black squares and not faces, although seven out of 13 claim to have established good discussions in the digital classroom.

This may be due to a sense of a transactional distance (Moore, 1997), which may cause the students to be reluctant to answer or provide feedback. It may also be due to the lack of nonverbal communication, which may trigger the students in a “live” classroom setting. The lack of nonverbal communication may feel alienating; consequently, the students may feel extremely exposed when asking questions (Daft and Lengel, 1986).

This lack of contact may lead to a sense of not achieving, or not being able to perform optimally. This in turn may lead to what Navrbjerg and Minbaeva (2020) describe in their model about not being able to deliver.

A total of 86% claim to have cooperated with colleagues, while cooperation with other lecturers has been very important for many (nine out of 14). Thirteen out of 14 have also received help from other colleagues, while nine of 14 claim they have helped others. Twelve of 14 confirm that it was a true support to work with others, while 13 of 14 want to continue cooperation with one or more colleagues.

This confirms the social learning theory (Vygotsky, 1980), as the collaboration and cooperation have been rather extensive. The lecturers have cooperated in order to figure out how to use the tools provided to them. Some lecturers have a greater experience using different tools, and even though we have not collected data on whether it was the experienced ones who helped the less experienced ones, there is a reason to assume that this is what occurred. This resembles the CoP collaboration that Lave and Wenger (1991) refer to. This also confirms the importance of social support within SDT (Deci, Connell and Ryan, 1989; Gagné and Deci, 2005; Deci and Ryan, 2008). Keeping up motivation requires social support in autonomous settings. We also detect a certain "organizational citizenship" as people seem willing to share good ideas.

The lecturers felt very motivated to learn new tools (93%), and to make streaming videos (64%). The faculty staff was also motivated to make use of the tools after the corona crisis (93%). Only 7% of the faculty staff experienced low mastery and stress. The main motivational factors for learning new tools, and to help endure this semester, were a sense of duty, and that they were motivated by the crisis itself. The lecturers' response on wanting to use the tools after the crisis shows that they have had a sense of personal mastery. The low number that reported on stress and a low mastery help to confirm this. And even if the motivational factor for learning new tools has been the crisis, it is encouraging to read that they will also use some of the tools as part of their educational tools after the crisis. This implies a sense of self-efficacy (Bandura, 1997) as they see an extensive use for the tools, so we may therefore assume that they have plans for how they can use them. This is somewhat contrary to a study by Marek, Chew and Wu (2021), who conducted an international study among higher education institutions about transferring the education to online and digital media during the Covid-19 pandemic. Their findings show that the teachers experienced a high level of stress and an increased workload.

The news about the international and national crisis the Covid-19 virus and the sense of urgency in the educational sector to "carry on", we may assume have promoted the sense of importance of the work as lecturers and thus motivated for learning tools in order to keep up the ordinary work (Gagné and Deci, 2005).

5. Conclusion

To answer our research question: "How has the Covid-19 crisis affected teacher motivation?", we can conclude the following:

The crisis caused a lot of faculty staff to learn new tools. This was through the help of IT services, as well as by colleagues. This social learning has been a positive feature, and may have contributed to the feeling of personal mastery and self-efficacy (Bandura, 1997). It may also have aided in the process of working with the tools to such a degree that they considered using the tools upon returning to ordinary on-campus lecturing. This implies a positive effect on teacher motivation.

Most of the staff has had to work rather autonomously, and through our investigations we assert that most of the respondents have a sense of being motivated both intrinsically through their mastery and perceived self-efficacy, and extrinsically through their feedback from their superiors and peers (Bandura, 1991; Gagné and Deci, 2005; Deci and Ryan, 2012).

The students are not as active as the faculty staff would like them to be. This may be due to the transactional distance (Moore, 1997) caused by the transition to an on-campus and live setting, and into a digital online setting. The lack of nonverbal communication lost due to this transition may also have contributed to this (Daft and Lengel, 1986). Although this may contribute to a negative motivation, we assert that the collegial support helps to counter this.

Our total impression is that despite setbacks and less motivational factors, such as "black screens", missing "watercooler talks" and a low rate of communication with students, the intercommunication with colleagues are supporting the motivation, and that the total motivation for the work is high (Vroom, 1964; Silverman, 1971).

5.1 Further research

We would suggest extending the research with a qualitative approach. In-depth interviews with our colleagues would provide us with more substantial data, as this would support the validity and reliability of our data (Cohen et al., 2011).

Since this would be a period after the survey, it would also be beneficial to include a reflective look at the crisis when it was at its peak. It would also be possible to confirm (or not) whether or not they later used the tools as they claimed in the survey.

It would also be interesting to look at the long-term effects of working from home. Issues like: Will the collegial cooperation and collaboration sustain themselves during a long-term crisis? What managerial issues arise over time? And what will be "the new normal", with a focus on sustaining the motivation of the teachers? Hence, the research should be followed up, both to look at the short-term effects, but also to look at the long-term effects on the motivation of teachers.

Equally important is investigating the long-term effect of the excess workload that has followed the conversion to online education (Marek, Chew and Wu, 2021).

Acknowledgements

We would like to thank our colleagues at the Inland School of Business School and Social Sciences who took the time to help us with the survey in the middle of some very hectic days. We appreciate it very much, and will share our findings with you.

References

Bandura, A. (1978) 'Reflections on self-efficacy', *Advances in behaviour research and therapy*, 1(4), pp. 237–269.

Bandura, A. (1991) 'Social cognitive theory of self-regulation', *Organizational behavior and human decision processes*, 50(2), pp. 248–287.

Bandura, A. (2006) 'Guide for constructing self-efficacy scales', *Self-efficacy beliefs of adolescents*, 5(1), pp. 307–337.

Bandura, A., Freeman, W. H. and Lightsey, R. (1999) 'Self-efficacy: The exercise of control'. Springer.

Castañer, X. and Oliveira, N. (2020) 'Collaboration, coordination, and cooperation among organizations:: Establishing the distinctive meanings of these terms through a systematic literature review', *Journal of management*, 46(6), pp. 965–1001. doi: 10.1177/0149206320901565.

Cohen, L., Manion, L. and Morrison, K. (2002) *Research methods in education*. routledge.

Coombs, W. T. (2019) *Ongoing crisis communication : planning, managing, and responding*. Fifth Edit. Thousand Oaks, California: Thousand Oaks, California: SAGE Publications, Inc.

Daft, R. L. and Lengel, R. H. (1986) 'Organizational information requirements, media richness and structural design', *Management science*, 32(5), pp. 554–571.

Deci, E. L., Connell, J. P. and Ryan, R. M. (1989) 'Self-determination in a work organization.', *Journal of applied psychology*, 74(4), p. 580.

Deci, E. L. and Ryan, R. M. (2008) 'Self-determination theory: A macrotheory of human motivation, development, and health.', *Canadian psychology/Psychologie canadienne*, 49(3), p. 182.

Deci, E. L. and Ryan, R. M. (2012) 'Self-determination theory.'

Gagné, M. and Deci, E. L. (2005) 'Self-determination theory and work motivation', *Journal of Organizational behavior*, 26(4), pp. 331–362.

Haave, H. M., Hole, Å. S. and Vold, T. (2016) 'Educating Managers in Knowledge Intensive Organizations', in. Academic Conferences and Publishing International.

Hatch, M. J. (2018) *Organization theory: Modern, symbolic, and postmodern perspectives*. Oxford university press.

Herzberg, F. (2017) *Motivation to work*. Routledge.

Hjertø, K. B. (2013) *Team*. Bergen: Fagbokforl.

Kleinginna, P. R. and Kleinginna, A. M. (1981) 'A categorized list of motivation definitions, with a suggestion for a consensual definition', *Motivation and emotion*, 5(3), pp. 263–291.

Kolb, D. A. (1984) *Experiential learning : experience as the source of learning and development*. Englewood Cliffs, N.J: Prentice-Hall.

Lave, J. and Wenger, E. (1991) *Situated learning: Legitimate peripheral participation*. Cambridge university press.

Lee, A. Y. *et al.* (2021) '"Bringing you into the Zoom": the power of authentic engagement in a time of crisis in the US', *Journal of Children and Media*, 15(1), pp. 91–95.

Marek, M. W., Chew, C. S. and Wu, W.-C. V. (2021) 'Teacher experiences in converting classes to distance learning in the COVID-19 pandemic', *International Journal of Distance Education Technologies (IJDET)*, 19(1), pp. 40–60.

Maslow, A. H. (1981) *Motivation and personality*. Prabhat Prakashan.

Mayo, E. (1930) 'The human effect of mechanization', *The American Economic Review*, 20(1), pp. 156–176.

Moore, M. G. (1997) 'Theory of transactional distance', in Keegan, D. (ed.) *Theoretical Principles of Distance Education*. Routhledge, pp. 22–38.

Navrbjerg, S. E. and Minbaeva, D. (2020) *Virtual management during corona-crisis: Report 1: Qualitative studies (translated from Danish:Virtuel ledelse under corona-krisen: Rapport I: De kvalitative studier)*. FAOS.

Priniski, S. J., Hecht, C. A. and Harackiewicz, J. M. (2018) 'Making learning personally meaningful: A new framework for relevance research', *The Journal of Experimental Education*, 86(1), pp. 11–29.

Salvato, C., Reuer, J. J. and Battigalli, P. (2017) 'Cooperation across disciplines: A multilevel perspective on cooperative behavior in governing interfirm relations', *The Academy of Management annals*, 11(2), pp. 960–1004. doi: 10.5465/annals.2014.0001.

Schön, D. A. (1984) *The reflective practitioner: How professionals think in action*. Basic books.

Schön, D. A. (1987) *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions.* Jossey-Bass.

Silverman, R. E. (1971) *Psychology*. New York.

Skinner, B. F. (2019) *The behavior of organisms: An experimental analysis*. BF Skinner Foundation.

Vold, A. T. and Haave, H. M. (2020) 'Relevance of Adult Higher Education on Knowledge Management in the Healthcare Sector', in. Academic Conferences and Publishing International Limited.

Vroom, V. H. (1964) 'Work and motivation.'

Vygotsky, L. S. (1980) *Mind in society: The development of higher psychological processes*. Harvard university press.

Wenger, E. (2011) 'Communities of practice: A brief introduction'.

Wlodkowski, R. J. (1978) 'Motivation and teaching: A practical guide.'

On-line Learning for Addressing Challenges Associated to Business Models

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DOI: 10.34190/EEL.21.018

Abstract: Innovative business models are resources that support entrepreneurs in being more competitive on the market. Although there are different business models available to entrepreneurs, for many of them understanding their individual elements still poses a real problem. The findings from the research conducted in the European ERASMUS+ project — Understanding and Developing Business Models (ProBM2) — carried out between 2019 and 2021 in 7 countries (i.e. Poland, Italy, Malta, Portugal, Greece, Switzerland, and Romania) indicate that the implementation of business models is crucial for enterprises and the success and continuation of their operations, and thus in this article the author further discusses them, focusing in particular on the on-line educational and training platform supporting continuing education of entrepreneurs and helping them understand the importance of business models and their individual elements, developed and tested as part of the project in question. The insights provided are expected to be of value to both researchers and practitioners interested in the topic of business models.

Keywords*:* business models, on-line education, ERASMUS+, e-learning

1. Introduction

The development of knowledge-based economies is dictated by the intensification of globalisation processes and the development of information societies in which the demand for new technologies that help gain and maintain a competitive advantage on the domestic and international market alike is increasing significantly (Porter, 1990). According to the OECD (2001), creation of a knowledge-based economies requires the ability to transform knowledge into new products (knowledge transformation), but also the ability to transfer products to economic applications (technology transfer), which directly contributes to economic growth. Since the transfer of innovations in countries characterised by high R&D intensity and a high level of economic development follows applicable innovation support and development policies and often takes the form of a new tech company establishment or spin-off (Borges et al, 2013; Axelon et al, 2019). The concentration on business models and their importance therefore seems natural.

Although the interest in business models was already visible in the 1950s, the very concept of what a business model is and includes was first formulated in the 1990s in response to the sudden emergence and growing popularity of e-businesses (e.g.: Lewis, 1999; Afuah and Tucci, 2001; Magretta, 2002; Afuah, 2003; Zott, R. Amit and Massa, 2011; Rogoda, 2011; Onetti et al, 2012; Wirtz et al, 2016; Miller et al, 2020; Krishnamurthy, 2020; Hutasuhut, 2020). According to Bis (2013), in the period of the Internet boom, enterprises did not need strategies or special competences, and the only factor essential for building a competitive position was a business model enabling them to gain a competitive advantage and allowing them to predict and overcome barriers that could impede their growth. The birth and development of the Internet made the business model one of the key concepts in the theory of strategic management (Nurhadi et al, 2017; Kumar et al, 2019).

Based on the research results indicating the need to develop in seven partner countries (i.e.: Poland, Italy, Malta, Portugal, Greece, Switzerland, and Romania) a dedicated training course in business models, the author focuses on the use of digital content activities as learning resources (Magadan-Diaz, 2018; Suppatvech et al., 2019; Motohashi, 2021) to supplement an on-line learning platform developed in response to the educational need identified. As part of the research carried out in the Erasmus+ project, employees of enterprises were surveyed (n=55), and, based on the survey findings, eleven topics representing individual business model areas, i.e.: key partners; key activities; key resources; value propositions; customer relationships; channels; customer segments; cost structure; revenue streams; and citizenship and professional values, were identified and included in the on-line educational and training platform to encourage its users to reflect on, take practical exercises and assess their knowledge on the topic of business models. The paper discusses the design considerations and the findings from the verification of the on-line content conducted with the participation of adult educators (n=25), and students (n=69).

The background, methodology and analysis of the findings from the verification of the on-line educational and training platform and its content crucial for understanding business models is presented in the sections to follow.

2. Methodology

The development process followed a three-step methodology:

Step 1: Interviews. The interviewees (n=55) included directors, entrepreneurs, business owners, business managers, heads of business or heads of human resources involved in managing microenterprises and SMEs operating for at least 5 years (5-8 case studies in each partner country). In general (due to the COVID-19 pandemic) the survey took the electronic form (via e-mail, Skype, or Google Drive) but some one-to-one interviews were also conducted. The survey ran between March and April 2020.[1] The objective of the interview was to identify the areas which should be included in the business model for the company.

Step 2: Identification of on-line platform modules. Based on the research results, the following eleven modules were defined: introduction; key partners; key activities; key resources; value propositions; customer relationships; channels; customer segments; cost structure; revenue streams; and citizenship and professional values.

Step 3: On-line platform design and development. The third phase involved designing and developing an open on-line educational platform with access to educational resources dedicated to business models. The platform has so far been assessed by adult educators and students (n=94) from five countries.

3. Business model (ProBM2) open educational platform

3.1 Business models as a subject matter - the identified topics

Taking into consideration the above-mentioned data, it is necessary to strengthen the need to educate people through extending their knowledge on business models and improving their skills in their application. The author's initial research on business models and their elements was carried out as part of the "Understanding and developing business models" (ProBM) project and led to the development of a business models compendium (www.businessmodels.eu). The project came to end in 2018 but the target groups expressed interest in its continuation and in the development of a more comprehensive educational and training offer concerning business models. Since the ProBM project was mainly focused on the exchange of best practices, and not on the development of intellectual outputs, the author realised that the said compendium was just a starting point for further research in the area and for the development of a complete training programme for target groups and of a methodological guide for adult educators and training course providers, which could be successfully implemented in different types of adult training organisations, i.e., post-secondary schools, training institutions and partner organisations. The insights from the partner countries suggested that nowadays knowledge and skills in the area of business models are mainly acquired and developed at universities and other tertiary education institutions or contamination labs in the case of Italy. Currently available materials containing information about business models concern either entrepreneurship as such, or management topics. The partners did not identify any curriculum dedicated only to business models.

Therefore, it seemed to be reasonable to design a comprehensive and comprehensible training offer for adult educators and training providers, and for the adult learners (as beneficiaries). Moreover, it was necessary to design a professional methodological guide for educators with tips on how to effectively teach about business models (e.g.: focus on specific teaching methods and the assessment of knowledge and skills). In order to do that, the first step was to perform an interview with the use of a questionnaire on which elements are crucial for the training programme. The interviewees (n=55) included directors, entrepreneurs, business owners, business managers, heads of business or heads of human resources involved in managing microenterprises and SMEs operating for at least 5 (5-8 case studies in each partner country).

[1] The literature review and first interviews were performed in the "Understanding and Developing Business Models" project (2016–2018). An in-depth literature review was carried out to identify and understand the importance of business models in everyday business practice. It was done by four organisations participating in the project from Poland, Slovenia, Italy, Greece, and the Czech Republic. Moreover, interviews with managers of SMEs and individuals interested in the topic of business models on skills and knowledge needed to be more familiar with the topic of business models were performed (survey questionnaire, n = 145). This allowed for the development of the compendium with basic knowledge about business models that entrepreneurs can use in their everyday practice. The work initiated in this project was continued in the ProBM2 project discussed in this article.

The questionnaire was divided into 4 blocks[2]:

- Block 1: General knowledge and opinions on business models.
- Block 2: Business model in your company.
- Block 3: Elements of business models.
- Block 4: Company and interviewee profile.

In Block 1, the research results showed that companies from Poland, Malta, Greece, Portugal, Switzerland, Romania, and Italy have basic knowledge about what business models are (94.55% of interviewees answered that they know what a business model is), but only 43.64% of entrepreneurs have heard of Business Model Canvas before. Finally, when the participants were asked whether they agreed with the statement *"The use of a good business model improves the situation of an enterprise/organization on the market",* 43.64% of them totally agreed, and 52,73% of them agreed with the statement.

In Block 2 on the question *"Did you apply business models within your company"*, 50.91% of the respondents confirmed the use of business models, whereas 41.82% of them did not confirm it. While the participants seem to understand the importance of a Business Model, more than half of them do not use one. The very interesting question concerned the reasons of not using any business model in the company. The following reasons were mentioned, among others, early stage of business development and its specifics; lack of knowledge of the management about this topic; the focus of the company mainly on revenue streams, and not much emphasis on other elements of the business model, etc.

As for Block 3, according to the respondents, the most important element of the business models is Value Propositions (27.27%). 45.45% of the respondents stated that there is no least important element, however, 18.18% believe that Customer Segments is an element to which there is no need to attach greater importance. They see the different elements of a business model as mainly dependent (58.18%). Only 7.27% of the interviewees indicated that these elements are mainly independent.

The results showed that there is still little knowledge on business models, and especially on the importance of their application in companies. Therefore, synthesis of the findings led to the identification of eleven main topics that were considered for further work: introduction; key partners; key activities; key resources; value propositions; customer relationships; channels; customer segments; cost structure; revenue streams; and citizenship and professional values.

3.2 On-line educational platform

The content of each topic (11 topics divided into 11 separate modules) was developed by project partners in consultation with subject experts. With the aim to enable resources within each topic to be used as collective or stand-alone resources, the presentation of both content and activities is highly modular (see Figure 1). Educators and learners can pick and choose resources that are relevant to their teaching and learning. Specific resources, such as visually attractive Microsoft Power Point slides or videos can also be delivered to learners as required to allow access to small bites of learning contents and activities.

Each module is composed of the following elements:

- Introduction with a short presentation of the module.
- Theoretical background which provides students with theoretical overview of the analysed problem.
- Examples and good practices presenting real-life situations which are important for the development or application of business models.
- Exercises aiming at the verification of the acquired knowledge.
- Quizzes as additional elements of exercises.
- References based on which individual modules were developed.

[2] The whole comparative report is available on http://www.businessmodels.eu/02/images/report/Comparative_Report_O1_ProBM_2.pdf [access on 19.05.2021].

Source: Author.

Figure 1: The on-line platform (https://probm2.cti.ugal.ro/site/en/bm-canvas/) with educational resources

The on-line platform is innovative because it covers only the topic of business models. The language of educational materials available on the market is difficult and programmes contain theoretical aspects of business models only. The proposed on-line platform contains both theoretical and practical elements of business models and it constitutes a comprehensive training programme dedicated ONLY to business models.

4. Findings from on-line training course verification

This phase was the first test run of the proposed training course and it is focused on the training modules and training material produced within the ProBM 2 Project. The material was tested by adult educators, and by students from the Faculty of Strategic Management in the Organisation (Radom Academy of Economics, Poland). At the end of the evaluation, they filled in evaluation questionnaires (see Appendix 1).

Out of the 69 students from Radom Academy of Economics (Poland) who tested the resources of the on-line platform, 74% of them found the on-line training course to be highly engaging because the topic is extremely important especially business establishment. What the students liked the most was the simple and comprehensible language of the course. They also appreciated the modularisation of the training course as the linear form would be far too demanding and time-consuming. With the modular form, they can choose the topics they like and need the most at a specific time.

The on-line course was also tested by 25 adult educators from different countries: Poland, Italy, Greece, Portugal, Romania, Malta, and Switzerland. 75% of them stated that the course is a good material to be used as a part of adult and tertiary education. They paid attention to the simplicity of the material, similarly to the students mentioned above, and its user-friendly form. Moreover, the added value of the course is that it is translated into many European languages, so it can be easily adapted in several countries.

During the testing phase, all respondents indicated the top three most interesting modules in the proposed training (Table 1).

Table 1: Relative frequency of times the modules are ranked in top 3

Modules	Frequency (number of times)	Relative Frequency (%)
M1: Introduction	0	0
M2: Customer Segments	18	6
M3: Value Propositions	60	21
M4: Channels	27	10
M5: Customer Relationships	16	6
M6: Revenue Streams	46	16
M7: Key Resources	46	16
M8: Key Activities	12	4
M9: Key Partnerships	26	9

Modules	Frequency (number of times)	Relative Frequency (%)
M10: Cost Structure	23	8
M11: Citizenship and Professional Values	8	3

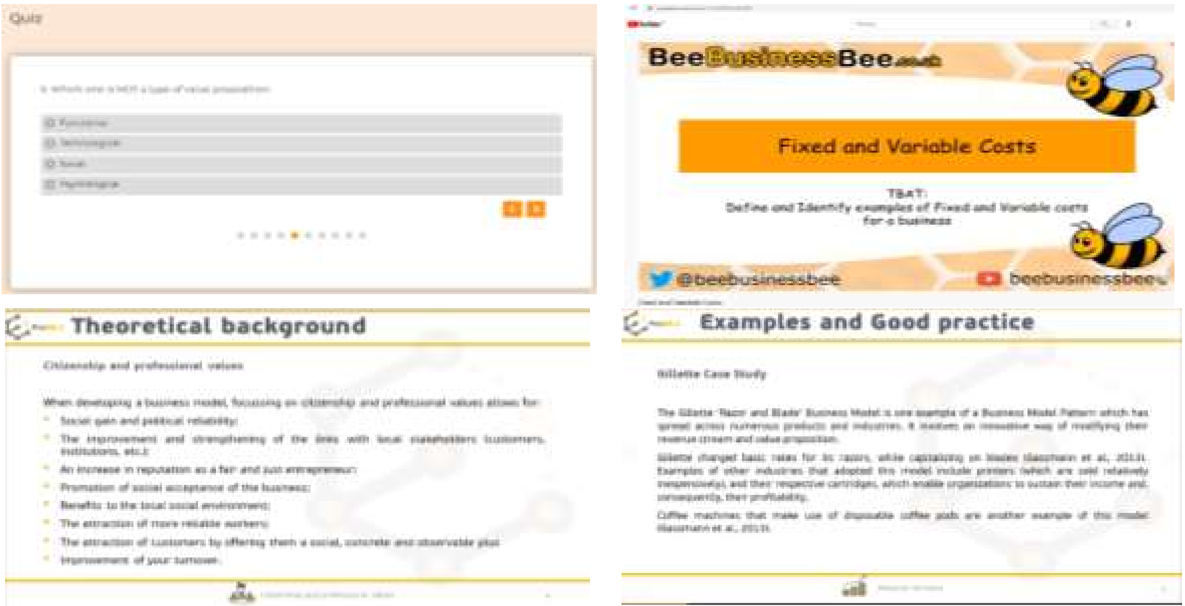
Source: Author.

The research shows that the Introduction is not interesting at all for the target groups as a separate module, but it can be understood due to the fact that the Introduction itself does not present any crucial content. This is just the opening to the whole course, and the respondents were more interested in the specific, topic-related modules. This hypothesis was confirmed during the testing phase.

The modules perceived as the most engaging were “Value Propositions” (21%), “Revenue Streams” and “Key Resources” (each 16%). The respondents admitted that the offer directed to potential clients is crucial for the successful existence of an enterprise.

As for “Revenue Streams” and “Key Resources” – they were mainly viewed through the prism of finances that are prerequisite for successful operations. Surely, when analysing “Key Resources”, the respondents also considered human and technical resources.

The *content of the on-line training course* was mostly rated as “excellent” with the exception of Modules 1, 6 and 10 that were perceived as “good”. The following suggestions were made: the inclusion of gamification for better transfer of the content; the contextualization of the “business design” and the “time variable” into the Business Model Canvas model. Generally, the material was assessed as clear, well-organised and engaging due to the inclusion of quizzes, video materials from available resources and simple presentation of the content (see Figure 2).



Source: Author.

Figure 2: The resources of the on-line training course

Apart from the content of each modules, the respondents also evaluated the usefulness of the on-line training course and completed a relevant questionnaire.

As for *the overall quality* of the proposed on-line training course, it was assessed as “good” or “excellent”. The respondents found the course plan and materials valuable in supporting the end user in gaining new knowledge and skills in the area of business model development; they also agreed or totally agreed that the materials meet adult educators’ needs as regards the development of an innovative educational offer. On the other hand, there were some suggestions for the improvement of the training course, among others, the insertion of an introduction on the general theory of “business design”, the definition of the “time variable” into the management of Business Model Canvas.”; or more focus on the integration of the business model parts.

The evaluation results show that the on-line learning platform was found appropriate to adult educators' needs (rated as good or excellent) and engaging for managers, employees, and students (rated as good or excellent). What is more, the developed training materials have been rated as useful and beneficial for the learning process.

From the research results it follows that the respondents agreed or totally agreed that the competences acquired through the ProBM 2 training course and the e-learning platform improve adult educators' awareness on business models and their skills in using on-line technologies for educational purposes.

5. Conclusions

The topic of business models is already well-established in literature and there have been a number of projects and research on entrepreneurship conducted at the transnational and national level. They mainly focused on:

- Statistical analysis concerning the activity and performance of start-up or spin-off companies.
- Statistical analysis concerning entrepreneurial ecosystems in different countries.
- Case study analyses concerning business models of main international market performers.
- Case studies of business models as applied by SMEs.
- Analyses on linkages between business models and company performance.
- Analyses of linkages between business models and technological innovation.

To support learners within a work-based environment, especially when related to professional development, or development of skills and aptitudes that would increase productivity and improve wellbeing, there was a need to enable quick and easy access to knowledge and contents that will support this development. The proposed on-line training course and on-line platform contain both theoretical and practical elements of business models and they constitute a comprehensive training programme dedicated ONLY to business models.

The on-line training course enables entrepreneurs, adult educators, and students not only to teach or learn about theoretical aspects, but also to show which kinds of business models are used in practice, which may help them to launch their own business activity in the future.

The proposed on-line training course and the platform have an impact on the following target groups:

- adult educators (possessing the necessary competences in the area of business models, improved awareness of the importance of teaching about business models as one of the elements of entrepreneurship);
- entrepreneurs, and students, who wish to extend their knowledge on business models, and other adults planning to establish own enterprise (broadening of horizons to see the bigger picture of the benefits from having and improving business models; having the necessary competences in well-planned establishment of an enterprise; increasing knowledge about the principles of the business market).

The use of the developed educational materials and knowledge on the issues linked with business models will enable the beneficiaries to avoid business failure, and consequently, increase the chances of its survival and success.

Appendix 1: Questionnaire for the testing of the on-line training course

Relevance of all training products at personal level					
	1 Very poor	**2** Poor	**3** Average	**4** Good	**5** Excellent
Please rate the overall quality of the proposed on-line training course					
	1 Not valuable at all	**2** Not very valuable	**3** Undecided	**4** Valuable	**5** Very valuable
The proposed on-line training course plan and material supports the end user in gaining new knowledge on and skills in business model development					

Relevance of all training products at personal level					
	1 Strongly disagree	**2** Disagree	**3** Neither agree nor disagree	**4** Agree	**5** Totally agree
The tested material meets the respondents' needs in the area of business models					
If the tested material does not meet your needs (1 or 2) please indicate WHY..					
Content of the training					
Please rate how satisfied you are with the content of modules of the proposed on-line training course:	**1** Very poor	**2** Poor	**3** Average	**4** Good	**5** Excellent
M1 – Introduction					
M2 - Customer Segments					
M3 - Value Proposition					
M4 – Channels					
M5 - Customer Relationship					
M6 - Revenue Streams					
M7 - Key Resources					
M8 - Key Activities					
M9 - Key Partnerships					
M10 - Cost Structure					
M11 - Citizenship and Professional Values					
Please state WHAT could be changed/improved in terms of content?					
Methodology adapted in this project					
	1 Very poor	**2** Poor	**3** Average	**4** Good	**5** Excellent
Methodology based on on-line learning is appropriate to respondents' needs					
Methodology enables the engagement of managers and employees in the training process					
Training material useful and beneficial for the learning process					
Please state WHAT could be changed/improved in terms of METHODOLOGY of training?					
Impact of the outcomes at individual and organisational level					
	1 Strongly disagree	**2** Disagree	**3** Neither agree nor disagree	**4** Agree	**5** Totally agree
The competences acquired improve respondents' awareness of business models					
The on-line tools (e-learning platform) improve respondents' skills in using on-line technologies for educational purposes					
The training course plan and on-line platform contribute to the enhancement of the resources available for the respondents' continuous professional development					
Sufficiency of the training materials and efficiency of the process					
	1 Very poor	**2** Poor	**3** Average	**4** Good	**5** Excellent
The quantity of information provided					
The language and layout of the materials					
The material is clear and easy to understand					
Adequacy of the provided educational material					
Support for the user (e-learning environment and tools)					
	1	**2**	**3**	**4**	**5**

Relevance of all training products at personal level					
	Very poor	Poor	Average	Good	Excellent
Navigation through and usability of the training material					
Overall graphic design					
Quality of the multimedia sources					
Form and organisation of the training materials					
NARRATIVE COMMENTS:					
What are the most positive aspects of the proposed on-line training material?					
What are the most negative aspects of the proposed on-line training material?					
Do you have any other comments?					

References

Afuah, A. (2003) Redefining firm boundaries in the face of the Internet: are firms really shrinking? *The Academy of Management Review*, Vol. 28 No. 1, pp 34–53.

Afuah, A. and Tucci, C.L. (2001) *Internet business models and strategies: Text and cases*, New York, McGraw-Hill.

Bis, J. (2013) Innowacyjny model biznesowy – sposób na zwiększenie przewagi konkurencyjnej, *Przedsiębiorczość i Zarządzanie*, Vol. XIV, No 13, part II, pp 53–63.

Cândido, B. and Louis, J.F. (2013) Spin-off Process and the Development of Academic Entrepreneur's Social Capital. *Journal of Technology Management & Innovation*, 8(1), pp 21–34.

Hutasuhut, S., Irwansyah, B., Rahmadsyah, A. and Aditia, R. (2020) Impact of business models canvas learning on improving learning achievement and entrepreneurial intention. *Cakrawala Pendidikan*, 39(1), pp 168–182.

Krishnamurthy, S. (2020) The future of business education: A commentary in the shadow of the Covid-19 pandemic. *Journal of Business Research*, 117, pp 1–5.

Kumar, P., Kumar, A., Palvia, S. and Verma, S. (2019) On-line business education research: Systematic analysis and a conceptual model. *The International Journal of Management Education*, 17(1), pp 26–35.

Lewis, M. (1999) *The New Thing: A Silicon Valley Story*, W.W. Norton, and Company.

Magadán-Díaz, M. and Rivas-García, J.I. (2018) Digitization and business models in the Spanish publishing industry. *Publishing Research Quarterly*, 34(3), pp 333–346.

Margretta, J. (2002) Why Business Model Matter, *Harvard Business Review,* 80(5), pp 86–92.

Mattias, A. and Bjurström, E. (2019) The Role of Timing in the Business Model Evolution of Spinoffs, *Research-Technology Management*, 62(4), pp 19–26.

Miller, K., McAdam, M., Spieth, P. and Brady, M. (2020) Business models big and small: Review of conceptualisations and constructs and future directions for SME business model research, *Journal of Business Research*, Vol. 131, pp 619–626.

Motohashi, K. (2021) *Progress of Digital Platforms and their Impact on Japan's Industrial Competitiveness*. Research Institute of Economy, Trade and Industry (RIETI).

Nurhadi, L., Borén, S., Ny, H. and Larsson, T. (2017) Competitiveness and sustainability effects of cars and their business models in Swedish small-town regions. *Journal of Cleaner Production*, 140, pp 333–348.

OECD (2001) *Science, Technology and Industry Scoreboard 2001 – Towards a knowledge-based economy*, Paris.

Onetti, A., Zuchella, A., Jones, M.V. and McDougall-Covin, P.P. (2012) Internationalization, innovation, and entrepreneurship: business models for new technology-based firms, *Journal of Management and Governance* 2012 (16), pp 337–368.

Porter, M.E. (1990) *The Competitive Advantage of Nations*, New York: Basic Books.

Rogoda, B. (2011) Modele biznesu małych i średnich przedsiębiorstw, *Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie*, 866/2011, pp 75–93.

Suppatvech, C., Godsell, J. and Day, S. (2019) The roles of internet of things technology in enabling servitized business models: A systematic literature review. *Industrial Marketing Management*, 82, pp 70–86.

Wirtz, B. W., Pistoia, A., Ullrich, S. and Göttel, V. (2016) Business models: Origin, development, and future research perspectives. *Long Range Planning*, 49(1), pp 36–54.

Zott, C., Amit, R. and Massa, L. (2011) The Business Model: Recent Developments and Future Research, *Journal of Management*, Vol. 37 No. 4, pp 1019–1042.

Effectively Communicating the Written Assignment Brief: Comprehensiveness and Conciseness

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Abstract: As a key aspect of higher education programmes, assessment is both unavoidable and complex. Students must be assessment literate to achieve high grades. This paper will discuss a key finding from a Ph.D. study that set out to explore how written assignment briefs affect students' understanding of the requirements of assessment, and students' potential to perform effectively. Before the COVID-19 pandemic, the written word was the dominant mode of communicating assessment and for distance education students, it was potentially the sole form of communication. For online programmes, reliance on the written assignment brief is significant. While the impact of COVID-19 on the future of higher education is unclear, higher education institutions may continue to offer an online option, or retain some online elements; thus signalling the continued prevalence of written briefs. With a dearth of research focusing on the design stage of the written assignment brief, this Ph.D. set out to determine how the assignment brief influences effective communication. Consisting of three phases, this mixed-methods study combined quantitative and qualitative data gathered across three semesters (spring 2016, autumn 2016, and spring 2017). Following the University's assignment regulations, Hughes' *Assessment Task Design* (2009) framework, and Gilbert and Maguire's *Assignment Brief Guidelines* (2014), the researcher worked with four academics (one from each of the four faculties in the University) to design their assignment briefs. The third phase involved conducting focus groups with students and interviews with academics to discuss their experiences of the effectiveness of these briefs. This paper will examine the impact of one of the key findings: the need for comprehensive yet concise assignment briefs, and its relevance to planning an assessment strategy. This paper will recommend a potential solution to balance the tension of providing detailed assignment briefs while maintaining conciseness. The findings will be valuable to academics and instructional designers involved in designing assessment documentation or planning an assessment strategy.

Keywords: assignment brief, programme level assessment strategy, assessment, communication

1. Introduction

The importance of assessment in higher education and its pedagogic potential are well documented. If students wish to achieve high academic grades, they cannot avoid assessment. Yet, the 2019 UK National Student Survey highlighted assessment (and feedback) as one of the weakest areas of higher education. Poor assessment can impact retention (National Forum, 2016), have a negative impact on teaching and learning (Hamdorf and Hall, 2001; Torrance, 1995), decrease students' confidence and self-esteem, and may cause students to abandon studying a particular subject (Boud, 1995b). Fortunately, Ramsden (2003, p.72) argues that "assessment need not be cast as [the] arch-villain in the saga of higher education" and advocates that assessment can improve teaching and learning, as long as it is "handled with infinite care".

Ensuring that assignment instructions are designed and developed appropriately is crucial if students are to have a positive experience of assessment (Brunton et al, 2016). Written communication is central, as this is a common format when communicating assignment briefs. For distance education students, the written brief "may be the only form of communication between students and teaching staff" (Morgan et al, 2004, p.74). Recent changes resulting in the rapid online delivery of university programmes, due to the COVID-19 pandemic, expanded this concern to programmes that were typically delivered on-campus. Even though accommodations can be made during the rapid shift to alternative assessments due to COVID-19, a fundamental aspect of assessment remains: "students need to be very clear about what you're really looking for in your assessment" (Brown and Sambell, 2020, p.4). Until recently, there was very little guidance on designing an effective assignment brief (see Gilbert and Maguire, 2014a). Gustafson-Pearce (2009, p.2584) identified the lack of "formal studies which considered the physical structure" of assignment instructions. Indeed, Gilbert (2012) identified the need for research focusing on the assignment brief in this quote,

> *Assignment brief design has perhaps been a neglected stage in the assignment process but given the call for innovative, authentic and diverse assignment tasks, coupled with the diverse student population and diverse study modes, it should be assigned more attention than it currently attracts.*

A lack of research surrounding the communicative effectiveness of the written brief and the barriers to effective communication, inspired this research study. The findings of this study, conducted at the University of Limerick, Ireland, may be of particular interest to students, academics, and E-Learning/Instructional Design professionals.

2. Methodology

This mixed methods study combined quantitative and qualitative data gathered across three semesters (spring 2016, autumn 2016, and spring 2017). The study aimed to explore how written assignment briefs affect students' understanding of the requirements of assessment, and students' potential to perform effectively. The study consisted of three phases. This paper focuses on the data collected during the final phase: interviews with academics and focus groups with students.

The participants involved a group of students and their lecturer and/or tutor from each of the four faculties (four groups in total) in the University of Limerick (UL): Faculty of Education and Health Science (EHS); Faculty of Arts, Humanities and Social Sciences (AHSS); Faculty of Science and Engineering (S&E); and Kemmy Business School (KBS). Having developed a written brief for each group (in accordance with University of Limerick regulations, Hughes' *Assessment Task Design* (2009) framework, and Gilbert and Maguire's *Assignment Brief Guidelines* (2014a)), the purpose of Phase 3 was to gain an in-depth understanding of the academics and students' experiences and opinions of this style of a brief. As the purpose was qualitative and exploratory in nature, a small sample size (5 academics and 17 students) was appropriate.

The student focus group questions were trialled with a representative group of students on February 15th, 2017. The questions for the academic interview (semi-structured) were evaluated through three pilot sessions on the following dates:

- 1. November 23rd, 2016
- 2. March 2nd, 2017
- 3. March 10th, 2017

Ethical approval was obtained from the Arts, Humanities and Social Sciences Research Ethics Committee. To ensure confidentiality and anonymity, participants were assigned a pseudonym during the transcription stage.

2.1 Data analysis

As the data were qualitative, thematic analysis provided a systematic approach to the generation of "codes and themes from qualitative data" (Clarke and Braun, 2017, p.297). Themes were identified using both a bottom-up (data-driven/derived from the data) and a top-down (researcher-driven/researcher explored concepts or theories) approach. While some themes emerged from the data, I also set out to explore specific aspects of the brief. Thematic analysis allows for this combination of bottom-up and top-down approaches (Braun and Clarke, 2013). Braun and Clarke's framework was used in analysing the data, as it is "a clear and usable framework for doing thematic analysis" (Maguire and Delahunt, 2017, p.3). The data were subjected to the five stages of Braun and Clarke's (2013) Thematic Analysis:

- Transcription and verification
- Reading and familiarisation
- Code creation
- Creating themes
- Writing up

3. Results and findings

The data were collected during the 2017 spring semester. This paper focuses specifically on a key aspect of this research: the nature and extensiveness of the information in the written assignment brief.

3.1 The preference for a comprehensive brief: Everything in one place

Both the student and academic participants supported the use of detailed and comprehensive briefs. Students felt that the comprehensive brief articulated what was expected of them.

Clodagh: So, yeah, this was probably the first time I have been given an assignment with that much detail. That we knew exactly what was expected of us and all that kind of thing.

Clara: And yeah I definitely agree as well.

The comprehensiveness of the brief was important to the S&E group as they felt that this level of detail was necessary to conduct the experiments and, therefore, the assignment.

Adam: Which is really good to have because now we know how to do them.

Sybil: Yeah. How to actually do them.

For the students, a comprehensive brief equated to increased clarity. "It was a lot clearer than previous ones that we had covered. It was quite detailed" (Evelyn) and "Yeah, in comparison to other assignments that we have, it's, it was much more clear" (Susan). This provided a sense of confidence. The students felt that they were not missing essential information and were more positive about their ability to do the task. They also felt more in control of the assignment, as they felt they were responsible for finding the information they needed; as all of the information they needed was provided.

Amy: Whereas, when it's all laid out for you, it's like, you can't go wrong. It's your own fault if you're going wrong because it's like, you're not reading your things properly. So, I definitely prefer these.

This was important because students need to feel in control and responsible for their learning (Keller, 2010). By including instructions about referencing, plagiarism, and submission requirements (including late submission policy), the brief removed the need for students to source this information and increased the time available to give to the task.

Students wanted all assignment-related information in one document or accessible from one location (e.g. in the virtual learning environment), as it made it easier to find the information. Reid (2010, p.6) found that even though students were given "precise and detailed instructions in the brief", they found it difficult to follow the instructions and that this difficulty may have arisen because the instructions were contained within several separate texts rather than within one document. Hepplestone et al (2016) also found that knowing where to find the relevant assignment information and being able to access it easily was important to students. For Amy, having all of the relevant information increased her confidence as "… it was all there. I didn't have to go looking in different places for all that stuff and I knew everything that I needed was here".

For the academic participants, a benefit of the detailed brief was the reduction in non-task-related queries. A reduction in the number of queries increases the amount of time available to concentrate on supporting students to develop an understanding of the assignment task. The focus of the majority of queries was on the content of the task, and not on the procedural aspects (e.g. submission format, submission deadline) of the assignment.

Although the participants favoured the comprehensive brief, an important issue highlighted by three of the academics was their concern around restricting creativity and the notion of 'spoon-feeding'. A comprehensive description, or even the sustained discussion of an assignment with students, can be viewed as the "dumbing down of standards, an increase in prescriptivism and the devaluation of […] originality and risk-taking" (Holland, 2002, para.7). Conversely, Gilbert and Maguire (2014b) counter this in their sixth principle for the effective communication of the brief:

A clear, explicit and accessible brief need not necessarily imply a restriction of student innovation and creativity in task performance or hinder development of independence.

Bell, Mladenovic, and Price (2013) equate the need for precise guidance with students' perception of the role of the academic. They described two opinions: expecting less direction from the academic was associated with a deeper approach to the task and expecting precise guidance was indicative of a surface approach. It is also possible to combine the students' desire for detailed briefs (e.g. instructions on how to get an A grade, how to structure their answers, what language and terminology to use, guidance on the level of detail required in different sections of an assignment, information around submission) with a brief that encourages active engagement. To allow students to be active learners, they need some level of guidance, so they are prepared, well equipped, and informed about their assessment (Laurillard, 2002). The brief can set out the requirements, standards, and expectations for the assignment, whilst serving as a foundation for discussion. A well-designed brief can engage students as co-creators, allow students to build on the work of others by providing templates, and provide the materials on which to discuss the task and criteria, so students and academics can develop a shared understanding. While the detailed brief can provide the guidance students require, it can also provide the freedom for creativity and ownership, and it can accommodate different approaches to the task, critical thinking, and problem-solving.

In deciding what to include in the brief, academics should consider the student's experience. Morgan et al (2004) say that academics should exercise their professional judgment in deciding how much information and support to provide. While there are concerns that increasing transparency nurtures instrumentalism (Torrance, 2007), Bloxham and Boyd (2007) recommend that all relevant information should be in the module handbook. Explicitly detailing assignment requirements increases the likelihood that students will achieve the requirements (Gilbert, 2012). While additional resources such as study-skills manuals include information on structure and writing style, these resources fail to guide on

> *the purpose and function of the wide range of academic activities demanded of students (in the name of assessment) in their various subjects of study.*
>
> *(Gillett and Hammond, 2009, p.122)*

Another reason to provide comprehensive briefs is that, on encountering a new type of assignment (more likely now as there has been an increase in types of assignments), students need additional support and detailed instructions. It is increasingly important that the requirements of a new type of assignment are made explicit to the students (Gibbs, 1992). Some academics assume that less instruction is required when they think students are familiar with the type of assignment, leading to surprise when some students do not know how to structure the assignment (Nesi and Gardner, 2006). Providing a detailed brief is essential when students first encounter any assignment. For example, for a poster-based assignment, Huntley-Moore and Lohan (2007, p.114) say that by,

> *providing detailed written assignment guidelines, including information on poster layout, content, structuring and referencing, […] most misconceptions can be addressed.*

Students were aware of the differing expectations of academics (around writing style for the same type of assignment) and that this could occur between different disciplines and within the same discipline. Reid (2010), referring to a report assignment, found that diversity can occur between disciplines, between modules, and even within the same disciple. Students need to be told about the differences in expectations between disciplines (Nesi and Gardner, 2006). My findings showed that students read the brief to determine the lecturer's expectations, and students viewed the comprehensive brief as necessary to communicate these expectations.

Less comprehensive briefs caused students to feel stressed. "You know, where are the specifics and all the extras that I need and that's where you get stressed" (Mairead). Two KBS students had a negative reaction to a previous assignment that lacked guidance on how to create and produce a video, as they felt they spent more time figuring out how to use the technology rather than focusing on the assignment task. "I spent more time trying to figure out how to put it onto a video than the actual content" (Shane). These students felt that providing instructions on how to create and produce a video would allow them to concentrate on the task because "if they gave a little bit more direction on how to do the video, people would get more out of the content side of things" (Shane).

The S&E group felt that less detailed briefs would prepare them for the reality of employment, work placement (most students in UL are required to go on a work placement as part of their studies, i.e. co-op), or for their Final Year Project (FYP) as "it's kind of what's expected of you when you go on co-op anyway. Or after college" (Tadhg).

It was interesting that the students felt that lecturers' expectations changed as students progressed through their programme, and students viewed the amount of detail in the brief as a reflection of these evolving standards and expectations. Morgan et al (2004, p.243) pointed out that at the beginning of their studies, students "are still trying to unravel the mysteries of what I [the academic] expected of them". This has an implication for assessment designers, as the level of detail within the brief should be tailored to suit the student's experience of a particular assignment. In addition, the comprehensiveness of the brief could be reduced as students progress through their programme.

Overall, knowing the needs of your students (including experience of the assignment and disciplinary expectations) informs the type and level of information one should include in the assignment brief. The level of detail within the brief should be based on what students need to *unpack* a particular assignment (Lea and Street, 1998). Providing comprehensive briefs is a key recommendation from this research.

3.2 All-Encompassing yet concise

Yet students felt that long documents were intimidating and overwhelming. "It's a bit daunting […]. Just being handed something like that." (Susan). Tummons (2010) also found that not only were some students discouraged by a lot of information in the brief, one tutor felt that students felt daunted by it. Morgan et al (2004) recommended that detailed information should accompany the task but cautioned against providing too much information, resulting in information overload.

Rochon and Knight (2015, p.2) claimed that a brief that is "bloated with excessive detail or sub-documents" could cause more confusion. In a long document, the EHS and S&E students found it difficult to find the relevant information.

> *Joel: If we ever do have to use the lab manual in the lab, we kinda get lost sometimes because we'd be…*
>
> *Sybil: There's too much, like, there's a load of words...*
>
> *Joel: Yeah.*
>
> *Sybil: …in it like.*

Students said that they sometimes missed important information if it was contained within a long document.

> *Megan: Everyone didn't know but it was embedded in the middle of all the course outline and stuff. So, we didn't exactly go and read it.*

The students would prefer a concise document containing the relevant assignment information rather than embedding this information within a larger module-level document (e.g. Module Outline). Students paid little attention to the Module Outline as they viewed it as a generic document, issued at the beginning of the semester, containing information that was irrelevant to their assignments. Having a document solely focusing on the assignment was preferable. When the assignment information was embedded within in a larger document, some students preferred to print the section containing the assignment information. They would disregard the remaining information).

> *Evelyn: So even having it separate because we did end up having to print it all out. You know, and making sure that because we couldn't just take a couple of pages in case we, we were afraid we'd miss something. So even if it is just a separate document that, it's just there in four pages and that's all you've to print out.*

Students felt less intimidated by shorter briefs, but the brief had to detail what the lecturer expected. "It's good because it shows you exactly what you need to do and what he expects of you" (Sybil).

Students were also concerned about the duplication of information. The AHSS group, in particular, felt that information applicable to all modules (e.g. information relating to referencing, plagiarism and academic integrity, submission, and late submission procedures) should be removed from the individual brief. They felt that this information should be contained within one document and shared across the School. Only information specific to the assignment task should be included in the brief. Gustafson-Pearce (2009) claimed that only necessary information should be included in a brief. Having examined examples (the number is not specified in the paper), Gustafson-Pearce (2009, p.2585) cautioned that while briefs tended to have extra data, this could lessen the effectiveness of the brief.

However, the students were unable to identify any redundant information. Yet, all groups (academics and students) expressed a preference for a more concise brief (the preference was for a maximum of two pages). The challenge was to consider how to retain all of the information without creating very long briefs.

3.3 A possible solution

One possible solution discussed with the participants was to replace common information (e.g. referencing, plagiarism, submission, regulations) with hyperlinks to documents within a repository. This would avoid repeating information in every assignment brief. Avoiding repetition is a characteristic of effective written communication (Agarwal, 2010). It would also reduce the length of the individual assignment brief while retaining access to a large amount of information; still keeping the sense that everything was available from one source. All participants felt that this was a potential solution to the conundrum of providing a large amount of information within a one- or two-page brief.

Reducing the content of the individual brief, by hyperlinking to a central repository, is dependent on a wider, programme-, or school-level assessment strategy. It requires programme/school-wide policy and procedures around referencing, plagiarism, late submission, extensions, and submission format and procedures. The students highlighted examples of duplicated information and a lack of consistency between markers in applying existing policy and procedures. Adopting an agreed approach would allow lecturers to refer to one source, encourage consistency, and remove duplicate information. This would result in a shorter brief without reducing access to all of the required information. Boud (1995a) says that we need to view assessment as the student views it, through the lens of the whole programme. This is important as effective communication involves considering our communication from the reader's point of view (Agarwal, 2010; Rai and Rai, 2009). Viewing assignments from the students' perspective can make academics aware of how complex these tasks are for students (Morgan et al, 2004). Creating resources at a higher level than the individual module allows resources to be shared across modules and programmes. This would reduce the workload for individual academics, potentially providing more time to work on the brief and/or supporting student learning.

4. Conclusion and recommendations

While the use of a written brief to communicate assessment instructions was common, COVID-19 transformed higher education in Ireland by moving most programmes online, thus increasing the need for effective written assignment briefs. The findings from this Ph.D. are of importance to any academic or instructional designer tasked with designing assessment instructions.

The main aim of this research was **to explore how written assignment briefs affect students' understanding of the requirements, and students' potential to perform effectively**. While the overall response to the style of brief adopted in this study from the student and academic participants was largely positive, this study highlighted a tension between providing comprehensive information whilst maintaining conciseness.

A benefit of the comprehensive brief was the reduction in queries from students about technical aspects (e.g. submission requirements, formatting, referencing, word count). This meant the academics had more time to discuss other aspects such as the specific assignment task, structure of the assignment, and evaluation criteria. The clarity provided by the comprehensive brief meant that students had more time to concentrate on the assignment task, and none of the participants (academics or students) could identify any redundant information. Yet, all of the participants wanted a shorter, more concise brief (maximum two pages).

A possible solution, albeit one dependent on adopting a school/programme-wide approach, was to include information specific to the assignment in the brief with links to generic school/programme-wide information, stored in a central repository. This would also reduce the duplication of information and increase consistency across modules. Based on the findings of this Ph.D., I extrapolated a list of core components and components that should be extracted to a central repository (see figure 1).

Providing links within the assignment brief to documents stored on a central repository, rather than including this information within the brief, ensures that students have access to all of the information they require without overloading the assignment brief. Reducing the amount of information in the brief makes it easier to find the task-specific assignment information and counteracts feelings of intimidation caused by longer documents. Linking to a central repository also makes it easier to control versions, update documentation, and ensures a certain level of consistency.

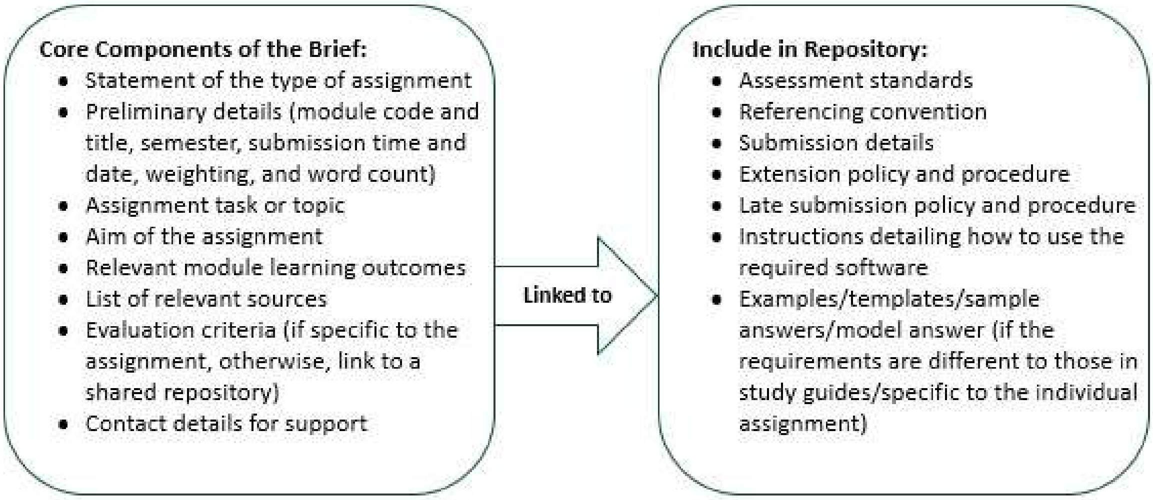

Figure 1: Model showing the core components of the brief and additional resources that should be stored within a central repository

Due to time constraints, it was not possible to conduct a longitudinal study. A consistent approach across a programme also suggests that as students encounter an assignment and internalise the assessment process (agreed and standardized at programme-level) as they progress through their programme, the level of detail in the brief could be reduced (facilitated by moving this information to a central repository). Further studies should explore the impact of adopting a programme-level approach and monitoring the development of students' assessment literacy over the duration of their studies, including their understanding of assessment feedback.

References

Agarwal, O.P. (2010) *Effective Communication-I*, 2nd ed., India: Himalaya Pub. House.

Bell, A., Mladenovic, R. and Price, M. (2013) "Students' perceptions of the usefulness of marking guides, grade descriptors and annotated exemplars", *Assessment & Evaluation in Higher Education*, Vol 38, No. 7, pp 769-788.

Bloxham, S. and Boyd, P. (2007) *Developing effective assessment in higher education: a practical guide*, England: McGraw-Hill Open University Press.

Boud, D. (1995a) "Assessment and learning: contradictory or complementary", in Knight, P., ed., *Assessment for learning in higher education*, London: Kogan Page, pp 35-48.

Boud, D. (1995b) *Enhancing learning through self assessment*, London: Kogan Page.

Braun, V. and Clarke, V. (2013) *Successful qualitative research: a practical guide for beginners*, California: Sage.

Brown, S. and Sambell, K. (2020) "Fifty tips for replacements for time-constrained, invigilated on-site exams", 2 April, available: https://sally-brown.net/kay-sambell-and-sally-brown-covid-19-assessment-collection/.

Brunton, J., Brown, M., Costello, E. and Walsh, E. (2016) "Designing and developing a programme-focused assessment strategy: a case study", *Open Learning*, Vol 31, No. 2, pp 176-187.

Clarke, V. and Braun, V. (2017) "Thematic analysis", *The Journal of Positive Psychology*, Vol 12, No. 3, pp 297-298.

Gibbs, G. (1992) *Improving the quality of student learning*, Bristol: Technical and Educational Services Ltd.

Gilbert, F. (2012) "Written assignment types in assessment: a varied and healthy diet?", *Brookes eJournal of Learning and Teaching: Promoting Good Practice in Learning, Teaching and Assessment in Higher Education*, Vol 4, No. 1, available: http://bejlt.brookes.ac.uk/paper/written_assignment_types_in_assessment_a_va ried_and_healthy_diet/ [accessed 28 November 2016].

Gilbert, F. and Maguire, G. (2014a) "Assignment brief design guidelines: developing academic communication to enhance the student experience in assessment", *Assignment Brief Design*, available: https://assignmentbriefdesign.weebly.com/index.html [accessed 28 November 2016].

Gilbert, F. and Maguire, G. (2014b) "Underlying principles", *Assignment Brief Design*, available: https://assignmentbriefdesign.weebly.com/underlying-principles.html [accessed 28 November 2016].

Gillett, A. and Hammond, A. (2009) "Mapping the maze of assessment: an investigation into practice", *Active Learning in Higher Education*, Vol 10, No. 2, pp 120- 137.

Gustafson-Pearce, O. (2009) "The assignment brief", *Procedia Social and Behavioral Sciences*, Vol 1, No. 1, pp 2584-2588.

Hamdorf, J.M. and Hall, J.C. (2001) "The development of undergraduate curricula in surgery: III. Assessment", *ANZ Journal of Surgery*, Vol 71, No. 3, pp 178-183.

Hepplestone, S., Glover, I., Irwin, B. and Parkin, H. (2016) "Setting out the role of feedback in the assessment process through both the student and tutor perspective", *Practitioner Research in Higher Education*, Vol 10, No. 1, pp 81-90.

Holland, S. (2002) “Communicating About Assessment”, version of paper presented at Exeter symposium on Assessment: Tradition and Innovation, 20th April 2002.

Hughes, C. (2009) “Assessment as text production: drawing on systemic functional linguistics to frame the design and analysis of assessment tasks”, *Assessment & Evaluation in Higher Education*, Vol 34, No. 5, pp 553-563.

Huntley-Moore, S. and Lohan, M. (2007) “Case 18: All for one and one for all or every student for themselves? Using group posters in the assessment of the sociology of health and illness”, in O’Neill, G., Huntley-Moore, S. and Race, P. eds., *Case studies of good practices in assessment of student learning in higher education*, Dublin: AISHE, pp 111-115.

Keller, J.M. (2010) *Motivational design for learning and performance*, New York: Springer.

Laurillard, D. (2002) *Re-thinking university teaching: a framework for the effective use of educational technology*, 2nd ed., New York, London, Publisher Routledge.

Lea, M.R. and Street, B.V. (1998) “Student writing in higher education: an academic literacies approach”, *Studies in Higher Education*, Vol 23, No. 2, pp 157-172.

Maguire, M. and Delahunt, B. (2017) “Doing a thematic analysis: a practical, step-by-step guide for learning and teaching scholars”, *All Ireland Journal of Teaching and Learning in Higher Education*, Vol 9, No. 3.

Morgan, C., Dunn, L., Parry, S. and O’Reilly, M. (2004) *The student assessment handbook: new directions in traditional and online assessment*, London: Routledge Falmer.

National Forum for the Enhancement of Teaching and Learning in Higher Education (National Forum) (2016) *Reaching out: why students leave*, Briefing Paper 1.

Nesi, H. and Gardner, S.F. (2006) “Variation in disciplinary culture: university tutors’ views on assessed writing tasks”, in Kiely, R., Clibbon, G.M., Rea-Dickins, P. and Woodfield, H., eds., *Language, culture and identity in applied linguistics*, London: Equinox Publishing, pp 99-117.

Rai, U. and Rai, S.M. (2009) *Effective communication*, 2nd ed., India: Himalaya Publishing House.

Ramsden, P. (2003) *Learning to teach in higher education*, 2nd ed., London: Routledge Falmer.

Reid, M. (2010) “More than just having the right headings: supporting students’ report writing”, *Journal of Learning Development in Higher Education*, Vol 0, No. 2.S

Rochon, R. and Knight, J. (2015) “The view from the fence: a dual perspective on assignment briefs”, *Journal of Educational Innovation, Partnership and Change*, Vol 1, No. 1, pp 1-3.

Torrance, H. (1995) *Evaluating authentic assessment: problems and possibilities in new approaches to assessment*, Buckingham, England: Open University Press.

Torrance, H. (2007) “Assessment as learning? How the use of explicit learning objectives, assessment criteria and feedback in post-secondary education and training can come to dominate learning”, *Assessment in Education: Principles, Policy & Practice*, Vol 14, No. 3, pp 281-294.

Tummons, J. (2010) “Institutional ethnography and actor-network theory: a framework for researching the assessment of trainee teachers”, *Ethnography and Education*, Vol 5, No. 3, pp 345-357.

Examining the Effectiveness Between Course Delivery Modes in a Teacher Training SPOC-Based Flipped Course

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DOI: 10.34190/EEL.21.059

Abstract: Purpose of the study. In response to the recent lockdown and social distancing, educators have been using the flipped learning approach (FCA) to transform their courses to maintain the quality of teaching and learning. While it is progressively adopted, scholars are interested in flexible learning strategies for accommodating the "New Normal" in the post-pandemic era. One of the elements to support FCA, is the Small Private Online Course (SPOC). It is a campus-based variation of a MOOC (Massive Open Online Course). In addition to standard course materials, it offers interactive courses with user forums discussions to enhance interactions among students and educators, as well as immediate feedback on short quizzes and assignments. This study aims to see how effective a SPOC-based flipped course can enable students to apply and reflect on their learning and teaching in different delivery modes. Using the experiential learning cycle (ELC), students learn how to apply the flipped classroom approach in their future instructional design and delivery by experiencing the flipped teaching and learning in the course. Course activities were mapped in the experiential learning model. **Methods.** A quasi-experimental mixed design was adopted. Variables such as course facilitators, and content were controlled. Participants were 130 research students from three semesters who were in face-to-face, online, or hybrid group. The impact of the different delivery modes on the course was assessed by students' course assessments and a feedback survey. **Results.** One-Way Welch's Analysis of Variance indicated statistically significant effects of delivery modes on students' participation and their reflective assignment. Students from each learning mode have relatively good performance in different assessments. No significant difference was found in students' total scores and teaching demonstration. Responses from the course feedback questionnaire showed positive attitudes specific to the learning modes they received. **Conclusions.** This study explored the flexibility of delivering a SPOC-based flipped course. Regardless of delivery mode, by integrating the FCA with the experiential learning framework, it was found to be effective for students' reflective learning. However, because students' learning performance in specific assessments may vary depending on delivery modes, the design of the SPOC and the assessments should be adjusted. This study demonstrated how to use FCA and ELC to establish curriculums that will benefit students as they navigate the world's recent challenging educational transformation.

Keywords: flipped classroom, online learning, hybrid learning, blended learning, experiential learning

1. Background

Due to the COVID-19 pandemic, higher education was confronted with the suspensions of physical classes. Despite the unfavourable circumstances, the concepts of flexible learning and virtual teaching methods have resurfaced to inspire educators to redesign their class content and delivery to maintain teaching and learning efficiency (Daniel, 2020; Huang *et al.*, 2020). Flexible learning encompasses the relationship between the organization, application, instruction, and technological aspects, in addition to time, content, entry requirements, instructional process, and delivery (Collis and Moonen, 2002). The Flipped Classroom approach (FCA) is perceived as one of the mainstream flexible learning approaches, focusing on how the versatility of learning spaces and course material can promote (Wanner and Palmer, 2015; Akçayır and Akçayır, 2018). FCA was first introduced by (Bergmann J., 2012) as a valuable approach to integrating course content prior to class, enabling instructors to make full use of the class time to direct students into more substantial learning through applying the course materials. Educators conducted FCA within a blended learning environment, expecting to help students learn not only efficiently but much more enjoyably (Birgili, Seggie and Oğuz, 2021).

1.1 Literature review

1.1.1 Practicing flipped classroom via different delivery modes

Since part of the learning in the FCA is expected to be completed out-of-class (Bergmann J., 2012), incorporating online elements such as web-based tutorials and SPOC into students' out-of-class activities has been shown to improve students' academic and affective outcomes (Hwang, Lai and Wang, 2015; Martínez-Muñoz and Pulido, 2015; He *et al.*, 2016; Chen *et al.*, 2018). According to the extent of integrating virtual delivery mode, the observed practices of FCA can be roughly divided into three sub-types, namely conventional face-to-face, online, and hybrid (flexible mix of both) (Birgili, Seggie and Oğuz, 2021). These modes aim to help instructional designers create positive teaching and learning activities for their students to achieve different learning gains (Franklin and Peat, 2001). Despite extant studies have verified the FCA in facilitating students' achieving a deeper understanding of certain topics, the specific mechanism of different delivery methods in realizing the effectiveness has not been examined (Mullen and Sullivan, 2015). Furthermore, a meta-analysis demonstrated that the influence of FCA is based on instructional designs such as face-to-face time rather than simply flipping before class and there is very little empirical evidence on how these designs contribute to successful FCA (van Alten *et al.*, 2019). Additionally, it is argued that students' agency in flipped learning, particularly the pre-class self-regulated learning and preparation, must be considered (Strelan, Osborn and Palmer, 2020). Students who perform unsatisfying self-regulated pre-class learning and preparation have the potential to reduce the impact of FCA on their short-term achievement of course learning outcomes and long-term lifelong learning (van Vliet, Winnips and Brouwer, 2015; Lai and Hwang, 2016; Hsiao *et al.*, 2019; Taranto and Buchanan, 2020).

1.1.2 Integrating experiential learning with flipped classroom

It is important to concentrate more on the problems and experiences of educators to make the flipped learning approach more successful (Birgili, Seggie and Oğuz, 2021). One of the ways to address the shortcomings of this approach is to map the Experiential Learning Cycle (ELC) to the FCA. Research has shown that incorporating the ELC into the FCA could increase satisfaction, learning performance (Zhai *et al.*, 2017), and, most importantly, the long-term effects of student learning (Zheng *et al.*, 2018). The experiential learning cycle (Kolb, 1984), suggests that to achieve the desired learning outcomes, a person must go through four stages. (1) concrete experience, in which a new event or circumstance is experienced, or a previous experience is reinterpreted; (2) reflective observation, in which any discrepancies in knowledge and perception are particularly important; (3) abstract conceptualization, in which reflection generates a new idea or modifies an existing abstract definition (the person has learned from their experience); and (4) active experimentation, in which the person reinterprets a new idea or modifies an existing abstract definition. Integrating the ELC into FCA is one of the ground-breaking ways of explaining the connection between out-of-class and in-class students' learning experiences (Teng, 2017; Prasetyo *et al.*, 2020; Tang *et al.*, 2020). It would be inspiring to see how the integration catalyses students' learning outcomes such as their knowledge, attitude and skills on a particular subject, which has rarely been studied empirically (Zheng *et al.*, 2018). Given the fact that this approach was suggested, the abrupt switching of delivery modes created additional unknowns in this integrated approach that needed to be investigated.

1.1.3 The experiential approach to flipped learning during the COVID-19

Because of the COVID-19, classes have been forced to switch into online or hybrid modes to continue students' learning (Moorhouse, 2020). These reforms had to be done in a short period (Daniel, 2020). Recent studies have shown that FCA could assist educators in surviving this momentous moment remotely across various disciplines (Chick *et al.*, 2020; Tang *et al.*, 2020; Fogg and Maki, 2021). However, studies comparing students' performance during the pre-pandemic and post-pandemic periods yielded mixed results, with some indicating improvement and others were not (Tang *et al.*, 2020; Yen, 2020; Lapitan *et al.*, 2021). Similarly, research on ELC suggested including online learning to deliver the adventure to facilitate the reflective process (Christian, McCarty and Brown, 2020). However, research on this new concept, ELC through online or hybrid delivery, is rare and requires further investigation (Zheng *et al.*, 2018). The pandemic proposes significant challenges to conventional practices of FCA and ELC. And the results of research conducted after the pandemic are either inconclusive or insufficient. Therefore, we suggested research on FCA and ELC as follows.

1.2 Purpose of the study

While past studies on students' learning in different course delivery modes pay less attention to their changes via accessing synchronous and asynchronous platforms (Baragash and Al-Samarraie, 2018) as well as the lack of existing evidence on mapping ELC to FCA during pandemic, it is necessary to focus on learners' unique response under different delivery modes. This study investigated the effects of delivery modes on students' knowledge, skills, and attitudes of university teaching at a Hong Kong university. It aimed to contribute to a better understanding of how and to what degree a flipped learning approach is advantageous to experiential learning design during this difficult time. The research questions are as follows:

- RQ1: Are there any differences in students' growth in the knowledge, skills, and attitudes between face-to-face, online, and hybrid modes?
- RQ2: What are the elements of the course design and delivery in three delivery modes contributing to students' growth?

2. Methods

2.1 Research design and participants

A between-subject quasi-experimental mixed design was used. Course facilitator, SPOC platform, Learning Management System and the content were controlled to diminish confounding issues. The same course instructor-led or co-led all the sessions. There are three groups from 3 academic years in this experiment for comparison, they are the face-to-face, Online, and Hybrid groups. The quantitative data from the grades of the course assessments and the qualitative data from the course feedback survey were combined in this study using a mixed approach. 130 students were enrolled in the courses from 3 semesters in the academic year of 2018/19, 2019/20, and 2020/21. The details breakdown of the participants in the study were depicted in Table 1. 36.9% of the students were from the Humanities disciplines. The majority of the participants (83.8%) are first-year research students. The university's Research Ethics Committee has given its approval to this study. Participants volunteered for the study and received informed consent at the first lesson.

Table 1*:* Demographic information of the participants

	2018/19 Face-to-face (N = 45)	2019/20 Online (N = 46)	2020/21 Hybrid (N = 39)
Year of study			
Year 1	42	43	24
Year 2	3	3	14
Year 3	0	0	1
Programme			
MPhil students	13	7	6
PhD students	32	39	33
Disciplines			
Business	5	8	6
Communication	1	9	8
Humanities	13	19	16
Health and Social Sciences	12	9	9
Sciences	14	1	0

2.2 Selected case: A teaching training course

The course, "Training on Teaching University Students" was chosen as a case study to answer the research questions. This 7-week course is for research students from diverse disciplines to teach undergraduates in the near future. It gives an overview of the basic theoretical knowledge and practical skills required to begin teaching at a university. It featured three flipped sessions in a SPOC, and the remaining sessions included case studies, discussions, guest speaker sessions, and lectures. There are five course intended learning outcomes (CILOs) and students are expected to achieve those outcomes after they complete the course. Figure 1 summarizes CILOs, corresponding teaching competencies, and assessments. The Knowledge-Skills and Attitude (KSA) framework was used to illustrate the teaching competencies in this study.

2.2.1 SPOC

In the first three sessions, learning theories and outcomes-based teaching and learning were introduced. These concepts were converted into three modules and incorporated into the SPOC platform, FutureLearn. It provided different learning aids for learners, including discussion forums, practice quizzes, and videos (See Figure 2).

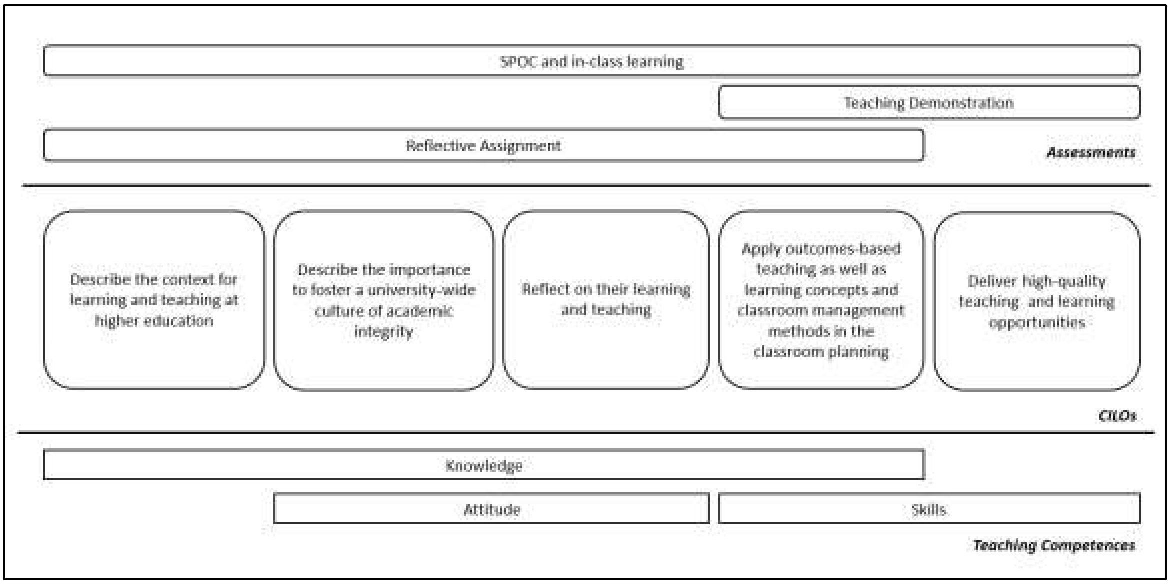

Figure 1*:* CILOs, teaching competences and assessments

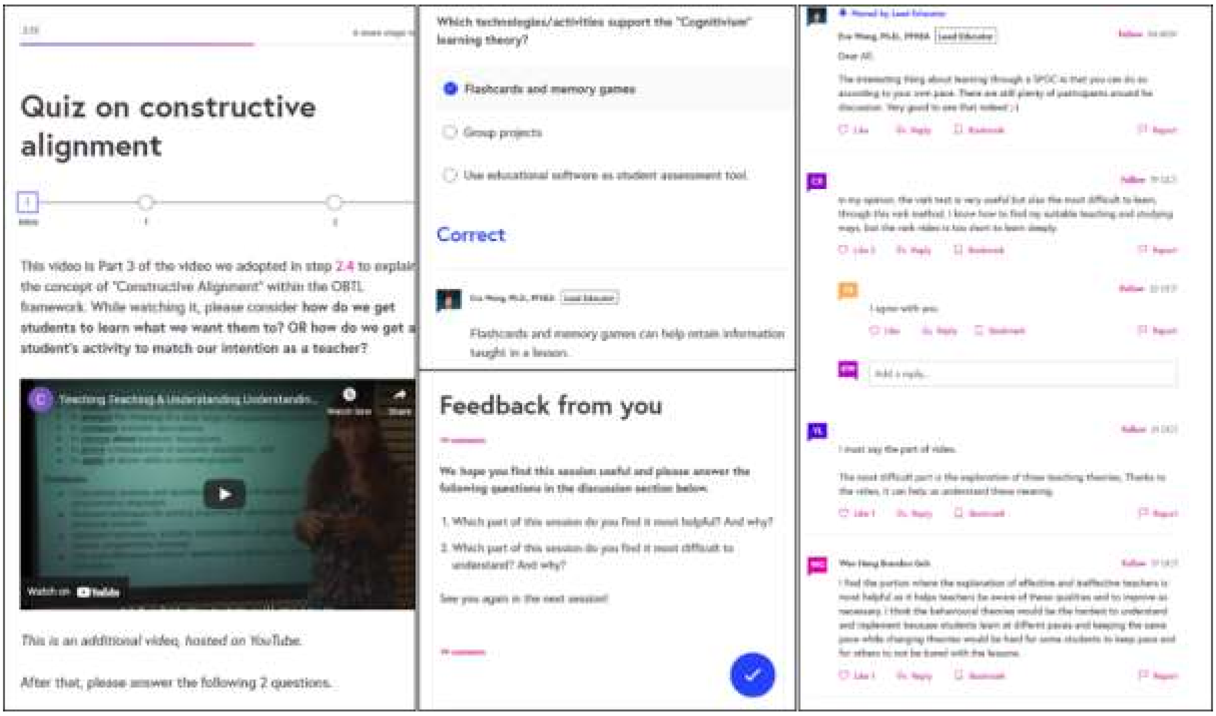

Figure 2: Learning in SPOC

2.2.2 Assessing the course learning outcomes

There are three assessments to evaluate students' achievement of CILOs, namely SPOC and in-class learning, Teaching Demonstration, and Reflective Assignment.

SPOC and in-class learning. SPOC learning was focused on data from learning analytics that represented their activities such as comments posted, module completion rate, and test scores. The teacher would grade their in-class learning by using rubrics that included their preparation for classes, attendances, and participation in class activities. For example, for designing the CILOs for a university course, ask the student to differentiate the meaning of the action verbs (e.g., elaborate what the words "understand" and "familiarize" mean to you.)

Teaching Demonstration. Students were asked to select a topic from their professions and apply the FCA in a 15-minute presentation. A group of students, for example, demonstrate the CILOs of an Alzheimer's disease course.

They used action verbs in the beginning of their demonstration to inform their classmates about the CILOs of learning that disease. Before the demonstration, they created pre-class videos that cover some basic disease information. The lecture was then delivered as a Teaching Demonstration using the FCA. After their demonstration, the teacher graded the students' work using a rubric that evaluated the content, structure, and presentation skills. Students were free to deliver any type of engaging activity during their presentation to pique the audience's interest in the subject. Instructors would grade the students' works and give comments after the 6^{th} session of the course.

Reflective Assignment. After students received the comments on their works, they had to write a short essay to reflect on what they have learned. Students were required to recognise areas for personal and professional growth as teachers, and realistic action items for moving these ideas forward. This assignment would serve as the foundation for their teaching philosophy and portfolio. This assignment was graded in three categories, (1) teaching goals, which focus on how their ideas, principles, and teaching goals merge well with their personal experiences with examples; (2) reflection on their own learning experience in this course, specifically how the course experience will help them design their future teaching practice using examples of constructively aligned results, Teaching & Learning Activities, and successful evaluation methods; and (3) the structure and language of this reflective journal are valued in demonstrating students' learning experience.

Course Feedback Survey. Students' feedback on the course would be gathered through the course feedback questionnaire, a survey circulated at the end of the session to elicit students' comments on the course designs in terms of 3 areas: (1) Describe the course's benefits; (2) Describe course aspects that could be improved; and (3) Comments on the teaching and learning environment.

2.3 Mapping the teaching and assessments into the ELC

In this flipped course, students had to go through ELC a few times (See Figure 3).

Learning in SPOC. Students reviewed the online materials and commented on the knowledge they learned in this course, such as learning theories in the SPOC forum. For instance, "Think of a learning experience that engaged you as a student; which learning theory (ies) did the teacher use to make the experience engaging?" Share this with the group in the comments below."

Learning in Class time. Students would participate in activities such as think-pair-share and student response systems during class time to build awareness and appraise their concepts. Students actively try out concepts they study and observe how the teacher conducts such activities and delivers lectures under the FCA.

Teaching Demonstration. Students have hands-on experience with FCA, and they begin planning their teaching demonstration assignment. They were allowed to design and discuss their learning materials in or out of class. They could discuss their ideas with their peers and the facilitator on this assignment. Students obtained feedback from the facilitator and reinterpreted the FCA of their implementation.

Reflect on Teaching Demonstration. Students review formative and summative feedback in the class. They then reflect on the differences in their experience and their interpretation of FCA and link to their educational philosophy. The ELC came to a halt at this stage, and students were encouraged to implement their new ideas in future lessons to continue their life-long learning.

2.4 Data analysis

The analyses were performed using the IBM SPSS 26 (IBM Corp. Released 2019, 2019). Preliminary analysis, the Kolmogorove-smirnov and Shapiro-Wilk tests indicated that significant values (p < .05). Levene's test also indicated that some of the assessments had significant values (p < .05) such as Pre-class self-related learning on SPOC, and reflective assignment. Therefore, the impact of the delivery modes on students' learning outcomes would be tested with the One-Way Welch's ANOVA. Students' comments on course-specific delivery mode would be extracted from the course feedback survey in each semester.

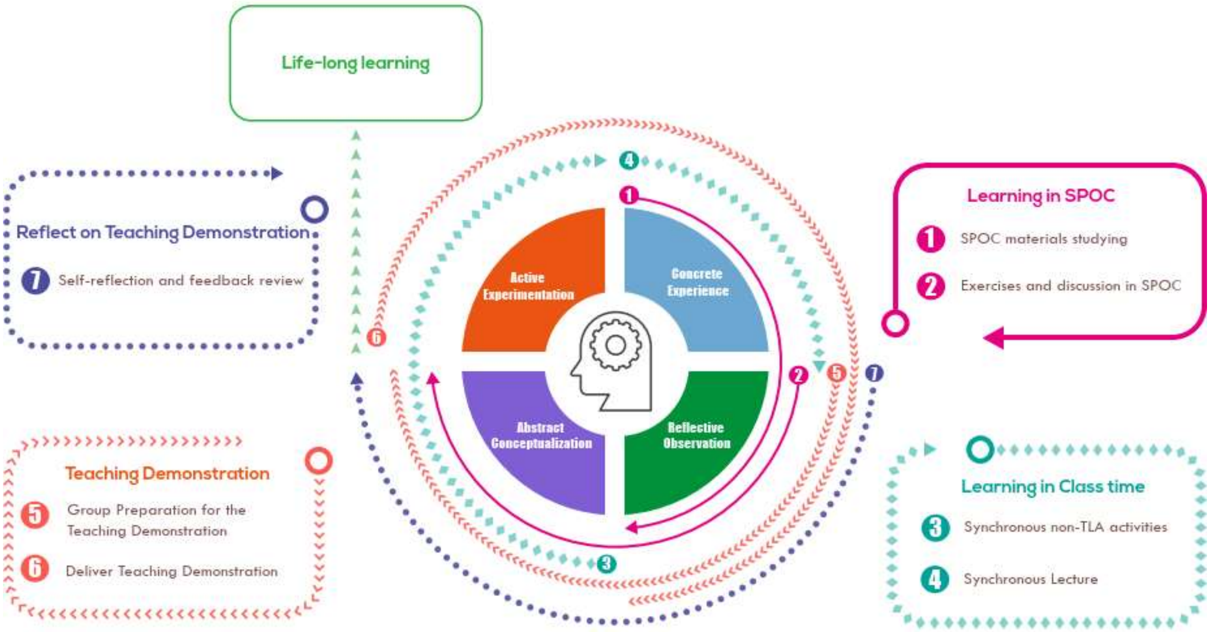

Figure 3: An experiential approach to flipped learning

3. Results

3.1 Effects of delivery modes on students' learning performance

For convenience report purpose, Face-to-Face, Online and Hybrid modes were named as Group A, B, and C, respectively. Results indicated statistically significant effect of delivery modes on SPOC Learning (F 2, 79.89 = 60.84, $p < .0001$), In-class learning (F 2, 84.41 = 36.57, $p < .0001$) and their Reflective Assignment (F 2, 84.46 = 11.26, $p < .0001$). There was no significant effect of delivery modes on Total scores (F 2, 127 = 2.15, $p = .12$) and Teaching Demonstration (F 2, 127 = .95, $p = .54$). The Games-Howell post-hoc test indicated that Group B students have relatively good performance in SPOC. Students from Face-to-face mode generally have higher endorsement in In-class learning and Reflective Assignment.

Table2: Students' learning performance across learning modes

	Group A Face-to-Face (N = 45)	**Group B Online** (N = 46)	**Group C Hybrid** (N = 39)	***df***	***F***	**Post-hoc Test**	**Teaching Competences**
SPOC Learning	2.84 (.57)	3.87 (.25)	3.74 (.23)	2 (79.89)	60.84***	B > C > A	Knowledge, Skills and Attitude
In-class learning	3.53 (.63)	2.48 (.57)	3.14 (.50)	2 (84.41)	36.57***	A > C > B	Knowledge, Skills and Attitude
Teaching Demonstration	2.94 (.41)	2.82 (.54)	2.83 (.49)	2 (127)	.95		Skills
Reflective Assignment	3.18 (.58)	2.67 (.68)	2.66 (.52)	2 (84.46)	11.26***	A > B;C	Knowledge, Attitude
Total scores	3.04 (.28)	2.90 (.38)	3.00 (.31)	2 (127)	2.15		Knowledge, Skills and Attitude

*** $p < 0.001$

3.2 Course design and delivery contributing to students' growth

3.2.1 Pre-class self-related learning on SPOC

Most students hold positive attitudes towards adopting SPOC for pre-class preparation. Although the online learning materials are generally the same across three semesters, distinctions can be observed in terms of instructors' positioning of SPOC in the flipped learning and students' expectations.

Group A demonstrated the lowest SPOC participation. Despite the SPOC at that time was initially introduced as a component of flipped learning, the learning habits developed under normal educational circumstances, they still heavily relied on face-to-face lecture. One student mentioned in the course survey, "*I can't learn very well by self-learning at SPOC…Probably some critical CILOs should be explained clearer in face-to-face classes.*"

Group B and C students demonstrated better SPOC learning. This can be partially explained by transforming into an online/hybrid mode due to the outbreak of the pandemic. At this stage, in addition to providing sufficient content for theoretical studies, SPOC was also used to engage students through online exercises. With the highest score in the SPOC participation, students from Group B particularly highlighted their exchange with "*an online crowd*." Precisely because of the social distancing, the online discussion forum became one of the few opportunities for students to exchange with their peers.

3.2.2 In-class learning

Most of the students affirm the course design and delivery in terms of its interactivity. Since Group A is delivered during a face-to-face situation, it makes sense it presents the highest score in terms of in-class participation. Students of Group A emphasized synchronous and in-person contact, which encouraged them to practice and try.

Differently, Group B was the first batch of students having classes entirely online. The focus of the course offered in 2019/20 was to keep students engaged. Students mentioned class activities (e.g., Kahoot!) are very responsive and interesting. Those diverse teaching activities were perceived as "extremely helpful in keeping *students focused while having online courses."* Nevertheless, it has to be admitted that neither teachers nor students have gotten used to the online teaching mode. A student gave an example of unsatisfactory adoption of technology in the class survey:

> *In some (online) discussion sessions, the teachers would put our ideas all into a word cloud. I sometimes lost track of the direction of our discussion by just seeing a word cloud. Rather than helping students concentrate, these kinds of technology-based activities seemed like a distraction.*

Besides, students also thought "*more agency should be given to students in class*" and "*the affective relationship between teacher and students*" should be paid more attention.

Group C is the second time to offer the FCA during social distancing. Considering the comments from Group B, instructors significantly revised the slides. The concern of student engagement has been well addressed. As they mentioned, they can "*subconsciously concentrated*" on each class. Besides, instructors set an excellent example of hybrid teaching as observed by the students that "*they (instructors) take good care of both online students and students in the classroom*." Students appreciated the complementarity between the theoretical studies online and practical content taught offline, particularly the content shared by the guest lecturer in the workshops.

3.2.3 Teaching demonstration

All groups mentioned the prompt and constructive feedback from the instructor teaching on students' teaching demonstration. Compared to Group A and Group C, Group B students were particularly demanding for instructors' feedback. This could be explained by the complete absence of face-to-face contact. Students mentioned they had no idea about their grading until the last lesson. They deemed that "formative assessments and feedback on grades should be used." This also makes more sense of students' low participation in in-class learning. Comparatively, Group C students appreciated the clear CILOs and assessment rubrics in terms of their role in guiding students to prepare their assignments.

3.2.4 Reflective assignment

Students conduct a retrospect on their own learning experience as students and plan their future teaching continuously during the entire course as well as in the course-end assignment. Since this is a teaching training course, the instructors' behaviors and performance in the course delivery are part of the experience. Students prevalently use the term enthusiastic, friendly, nice, well-prepared, experienced, professional, patient, humorous, supportive, etc., to describe their teaching team. Students also appreciate the teamwork by mentioning "they made good collaborations. It was exemplary for us all to see". Although students indicated that they view the instructors as role models for teaching, there is insufficient evidence from the survey to explain differences in reflective assignment performance.

4. Discussion

This study aims to examine whether different delivery methods in a teacher training course might yield different students' learning performance. The findings revealed that this course is adaptable during the outbreak of COVID-19 and post-pandemic time. This study echoed the findings of a recent experiment that showed that combining FCA with ELC improved students' academic performance (Zheng *et al.*, 2018). Our finding showed that FCA with ELC can ensure similar students' performance across delivery modes and the course assessments revealed some degree of impact of delivery modes on students' learning performance. Pedagogical implications for designing the FCA using the ELC were suggested below.

First, the educator should make the pre-learning part an indispensable component of the learning by adding interactive elements. Rather than standalone self-learning, students' application of relevant knowledge could start at this stage. Through the lens of ELC, it views students' digestion of knowledge and exports it for peer sharing to facilitate their simultaneous reflection and abstract conceptualization while experiencing something concrete. An online platform makes it easier for the exchange. Second, In-class interaction is vital in conceptualization and behaviour transformation. While the recommendation of a suitable in-class time in FCA for improving students' learning performance is still under debate (van Alten *et al.*, 2019), our finding contributed to the understanding that the linkage with and advancement of the pre-class content was crucial to designing an effective flipped classroom. The original FCA had suggested educators conduct "problem-solving or hand-on activities in-class" to correct students' misconceptions (Bergmann J., 2012, p. 15). Our findings further revealed that students reflect on the knowledge they gained after experiencing more application-oriented teaching and learning activities. Takin full play of students' agency is crucial to lead students to apply pre-study knowledge into reflective process. Finally, the feedback is significant in facilitating students' reflections and conceptualization. Using feedback to promote students' reflection in teaching is not a new but practical method (Quinton and Smallbone, 2010). This study also suggested the instructor should respond to students' inputs beginning with the pre-learning stage in FCA. The formative and summative feedback in the FCA could enhance interaction in classes and facilitate students to reflect and construct ideas based on the learning materials. In this study, students in online mode had a significantly lower performance during in-class time. As the qualitative findings suggested that students value the exchange opportunities with their peers and teachers in SPOC during online mode, it is suggested that more attention should be paid to the affective relationship. Students require to be seen, and clear, continuous, and formative feedback on application-oriented tasks is necessary. Despite the quantitative results are not surprising, the qualitative results in this study revealed that students' attitudes toward using SPOC for learning were different. It explained why face-to-face mode the highest in-class participation has, whereas online mode has adopted many e-tools, causing students to lose track of the discussion activity's direction.

4.1 Limitations and future studies

First, although most students responded positively to the survey, this study did not look at how students' acceptance of delivery modes could affect their performance in this course. Second, the survey data is inadequate to understand the discrepancy in reflective assignment performance. A deeper understanding of the stages on students' reflective observation and abstract conceptualization could be examined by document reviews such as written assignments. Finally, since the study's established framework emphasizes that students will accomplish life-long learning after completing the course, no follow-up measurements were taken. A longitudinal study is required to look at the long-term effects of this approach.

4.2 Conclusion

It is concluded that when integrating ECL with FCA, the delivery modes have little effect on students' competences in general, demonstrating that using an engaging pedagogical approach, especially giving feedback to students, providing in-class interaction would support students in a variety of learning modes for their reflections and conceptualization. This study revealed that FCA with ECL enables students to reflect and active experiment with their ideas. This study has taken a step in the direction of how to use FCA and ELC to design curriculums that could benefit learners whilst going through the recent challenging education transformation in the world.

References

Akçayır, G. and Akçayır, M. (2018) "The flipped classroom: A review of its advantages and challenges," Computers & Education, 126, pp. 334–345. doi:https://doi.org/10.1016/j.compedu.2018.07.021.

van Alten, D.C.D. et al. (2019) "Effects of flipping the classroom on learning outcomes and satisfaction: A meta-analysis," Educational Research Review, 28(June), p. 100281. doi:10.1016/j.edurev.2019.05.003.

Baragash, R.S. and Al-Samarraie, H. (2018) "Blended learning: Investigating the influence of engagement in multiple learning delivery modes on students' performance," Telematics and Informatics, 35(7), pp. 2082–2098. doi:10.1016/j.tele.2018.07.010.

Bergmann J., S.A. (2012) Flip Your Classroom: Reach Every Student in Every Class Every Day, International Society for Technology in Education.

Birgili, B., Seggie, F.N. and Oğuz, E. (2021) "The trends and outcomes of flipped learning research between 2012 and 2018: A descriptive content analysis," Journal of Computers in Education [Preprint], (4). doi:10.1007/s40692-021-00183-y.

Chen, K.-S. et al. (2018) "Academic outcomes of flipped classroom learning: a meta-analysis," Medical Education, 52(9), pp. 910–924. doi:10.1111/medu.13616.

Chick, R.C. et al. (2020) "Using Technology to Maintain the Education of Residents During the COVID-19 Pandemic," Journal of Surgical Education, 77(4), pp. 729–732. doi:10.1016/j.jsurg.2020.03.018.

Christian, D.D., McCarty, D.L. and Brown, C.L. (2020) "Experiential Education during the COVID-19 Pandemic: A Reflective Process," Journal of Constructivist Psychology, 0(0), pp. 1–14. doi:10.1080/10720537.2020.1813666.

Collis, B. and Moonen, J. (2002) "Flexible Learning in a Digital World," International Journal of Phytoremediation, 17(3), pp. 217–230. doi:10.1080/0268051022000048228.

Daniel, S.J. (2020) "Education and the COVID-19 pandemic," Prospects, 49(1–2), pp. 91–96. doi:10.1007/s11125-020-09464-3.

Fogg, K.C. and Maki, S.J. (2021) "A Remote Flipped Classroom Approach to Teaching Introductory Biomedical Engineering During COVID-19," Biomedical Engineering Education, 1(1), pp. 3–9. doi:10.1007/s43683-020-00001-4.

Franklin, S. and Peat, M. (2001) "Managing change: The use of mixed delivery modes to increase learning opportunities," Australasian Journal of Educational Technology, 17(1), pp. 37–49. doi:10.14742/ajet.1771.

He, W. et al. (2016) "The effects of flipped instruction on out-of-class study time, exam performance, and student perceptions," Learning and Instruction, 45, pp. 61–71. doi:10.1016/j.learninstruc.2016.07.001.

Hsiao, C.C. et al. (2019) "Exploring the effects of online learning behaviors on short-term and long-term learning outcomes in flipped classrooms," Interactive Learning Environments, 27(8), pp. 1160–1177. doi:10.1080/10494820.2018.1522651.

Huang, R.H. et al. (2020) Guidance on flexible learning during campus closures: Ensuring course quality of higher education in COVID-19 outbreak, Beijing: Smart Learning Institute of Beijing Normal University.

Hwang, G.-J., Lai, C.-L. and Wang, S.-Y. (2015) "Seamless flipped learning: a mobile technology-enhanced flipped classroom with effective learning strategies," Journal of Computers in Education, 2(4), pp. 449–473. doi:10.1007/s40692-015-0043-0.

IBM Corp. Released 2019 (2019) "IBM SPSS Statistics for Windows." Armonk: NY: IBM Corp.

Kolb, D.A. (1984) Experiential Learning: Experience as The Source of Learning and Development, Prentice Hall, Inc. doi:10.1016/B978-0-7506-7223-8.50017-4.

Lai, C.-L. and Hwang, G.-J. (2016) "A self-regulated flipped classroom approach to improving students' learning performance in a mathematics course," Computers & Education, 100, pp. 126–140. doi: https://doi.org/10.1016/j.compedu.2016.05.006.

Lapitan, L.D. et al. (2021) "An effective blended online teaching and learning strategy during the COVID-19 pandemic," Education for Chemical Engineers, 35(May 2020), pp. 116–131. doi:10.1016/j.ece.2021.01.012.

Martínez-Muñoz, G. and Pulido, E. (2015) "Using a SPOC to flip the classroom," IEEE Global Engineering Education Conference, EDUCON, 2015-April(March), pp. 431–436. doi:10.1109/EDUCON.2015.7096007.

Moorhouse, B.L. (2020) "Adaptations to a face-to-face initial teacher education course 'forced' online due to the COVID-19 pandemic," Journal of Education for Teaching, 00(00), pp. 1–3. doi:10.1080/02607476.2020.1755205.

Mullen, J.S. and Sullivan, J.M. (2015) "Student-perceived effectiveness of online content delivery modes," Proceedings - Frontiers in Education Conference, FIE, 2015, pp. 4–7. doi:10.1109/FIE.2015.7344335.

Prasetyo, A.H. et al. (2020) "A Review of Experiential Learning based on Flipped Classroom," International Journal of Research and Review, 7(12).

Quinton, S. and Smallbone, T. (2010) "Feeding forward: Using feedback to promote student reflection and learning - a teaching model," Innovations in Education and Teaching International, 47(1), pp. 125–135. doi:10.1080/14703290903525911.

Strelan, P., Osborn, A. and Palmer, E. (2020) "The flipped classroom: A meta-analysis of effects on student performance across disciplines and education levels," Educational Research Review, 30(November 2019), p. 100314. doi:10.1016/j.edurev.2020.100314.

Tang, T. et al. (2020) "Efficiency of flipped classroom with online-based teaching under COVID-19," Interactive Learning Environments, 0(0), pp. 1–12. doi:10.1080/10494820.2020.1817761.

Taranto, D. and Buchanan, M.T. (2020) "Sustaining Lifelong Learning: A Self-Regulated Learning (SRL) Approach," Discourse and Communication for Sustainable Education, 11(1), pp. 5–15. doi:10.2478/dcse-2020-0002.

Teng, M.F. (2017) "Flipping the Classroom and Tertiary Level EFL Students' Academic Performance and Satisfaction," The Journal of AsiaTEFL, 14(4), pp. 605–620. doi:10.18823/asiatefl.2017.14.4.2.605.

van Vliet, E.A., Winnips, J.C. and Brouwer, N. (2015) "Flipped-class pedagogy enhances student metacognition and collaborative-learning strategies in higher education but effect does not persist," CBE Life Sciences Education, 14(3), pp. 1–10. doi:10.1187/cbe.14-09-0141.

Wanner, T. and Palmer, E. (2015) "Personalising learning: Exploring student and teacher perceptions about flexible learning and assessment in a flipped university course," Computers and Education, 88, pp. 354–369. doi:10.1016/j.compedu.2015.07.008.

Yen, T.-F. (2020) "The Performance of Online Teaching for Flipped Classroom Based on COVID-19 Aspect," Asian Journal of Education and Social Studies, 8(3), pp. 57–64. doi:10.9734/AJESS/2020/v8i330229.

Zhai, X. et al. (2017) "An experiential learning perspective on students' satisfaction model in a flipped classroom context," Educational Technology and Society, 20(1), pp. 198–210.

Zheng, M. et al. (2018) "The mapping of on-line learning to flipped classroom: Small private online course," Sustainability (Switzerland), 10(3), pp. 1–14. doi:10.3390/su10030748.

Exploratory Study of a 360-Degree Model in Environmental Engineering Education

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DOI: 10.34190/EEL.21.121

Abstract: 360-degree models are a variant of virtual reality and are software-generated from multiple images of a space taken by 360-degree cameras. 360-degree models allow viewers virtually walking through them by jumping to the various viewpoints of the model. In addition, 360-degree models may be augmented with further media, such as text, graphics, or videos. Augmented as such, 360-degree models seem to be promising learning tools as their design incorporates multiple principles of multimedia learning, such as the contiguity principle, as well as 360-degree models support various approaches of learning, such as explorative learning. Evaluating the notion of 360-degree model as learning tools, this paper presents an exploratory study of the 360-degree model of an innovative wastewater treatment system named P-Bank. Methodologically, participants (N=17) were asked to explore the P-Bank 360-degree model for acquiring knowledge, which thereafter was assessed in a post-test. After the post-test, a questionnaire surveyed the participants' motivation and emotion on the one hand, and the usability of the model on the other hand. In addition, further aspects were determined qualitatively based on guided interviews conducted with each participant. In summary, the results are consistently promising: the usability of the 360-degree model was rated as good, motivation and emotion received excellent values and the learning outcomes were positive. The results of the interviews conducted provided information valid for further development of the 360-degree model. Overall, the study contributes to establishing 360-degee models as effective learning tools in environmental engineering education.

Keywords: 360-degree model, virtual field trip, virtual reality, higher education, engineering education

1. Introduction

360-degree models are software-generated 360-degree images of objects, for example spaces, which allow observers to view the objects almost from any direction. 360-degree models differ from 3D models generated by 3D scanners in lacking quantified depth information (Straub and Kerlin, 2014). As 360-degree models are a variation of virtual reality (VR), they are also known as 360VR. Compared to VR, 360-degree models require comparatively little effort in creating them. An important field of application of 360-degree models, which has been established for several years (Amory *et al.*, 2010), is virtual visits to real estate allowing prospective buyers or tenants to gain an impression of the property independent of time, location and people (Brenner, 2017; Felli *et al.*, 2018). Beyond the use for commercial purposes, learning is another application field of 360-degree models. For example, Pham *et al.*, (2018) describe a 360-degree model teaching safety on construction sites, Shi et al. (2021) use 360-degree models for Internet of Things education, and Ulrich *et al.* (2021) present application of 360-degree videos in healthcare education. Overall, 360-degree-based media is used in various variants, including 360-degree videos, virtual object augmentation (Barkatov *et al.*, 2020), or 360-degree models facilitating virtual field trips (VFTs). These various variants empower 360-degree-based media for serving a variety of didactic purposes: for example, named as "Spherical Videos", in peer-structured foreign language courses (Chien, Hwang and Jong, 2020) or also using an interactive variant for conveying knowledge in the field of cultural heritage (Argyriou, Economou and Bouki, 2017). Further, 360-degree models allow arranging virtual field trips (VFT) that provide students with practical experience while being motivating and encouraging learning. 360-degree model enabled VFTs exceed multimedia web site supported VFTs especially in providing immersion (Spicer and Stratford, 2001; Kundu, 2017; Seifan, Dada and Berenjian, 2020).

However, while a few years ago, complex technology was necessary to provide 360-degree-based media (See, Billinghurst and Cheok, 2015; Pham *et al.*, 2018), affordable consumer 360-degree cameras in conjunction with commercial 360-degree software platforms, such as Matterport (Matterport Inc, 2020) are now sufficient to create 360-degree-based media. The low level of effort required (Eiris, Gheisari and Esmaeili, 2018; Barkatov et al., 2020; Ulrich et al., 2021) in conjunction with guidelines available for creating educational 360-degree-based media (Violante, Vezzetti and Piazzolla, 2019) has led to low entry barriers in creating and deploying 360-degree-based media and thus seems to solve a current challenge in the educational use of 360-degree-based media: the high efforts required for creating learning resources (Merchant et al., 2014).

Among the shortcomings of 360-degree-based media in education are the comparatively few evaluations (Ulrich *et al.*, 2021) and the rather broad character of existing evaluations, such as the study of Eiris, Wen and Gheisari (2021), which compare the learning outcomes of a 360-degree variant to a paper-based variant. Cheng (2021) provides a first description of teachers' assessments of 360-degree-based media. Performing these kinds of qualitative analyses suggests an early stage of empirical evidence. Also, the study of Ulrich *et al.* (2021) from the field of health education shows rather mixed results of learning efficiency, what may be interpreted as a knowledge deficit of purposeful instructional design for 360-degree-based media.

The considerable potential for learning outcomes of 360-degree media in the presence of still limited empirical evidence has led to the creation of the 360-degree model presented in this article, which targets the education of environmental engineers. In environmental engineering education, field trips, e.g., to buildings in urban water management (Söbke *et al.*, 2019), are an established means of expanding theoretical knowledge with practical on-site impressions. For reasons of limited capacities - both in terms of time and money and of practical feasibility - extensive excursions, such as to construction sites in distant countries, can only be enabled in an unsatisfactory amount. Here, VFTs based on 360-degree technology, probably provided in subject-related libraries (Malinchi *et al.*, 2017) might help. Even though 360-degree models may not replace real impressions on site, they might come quite close to these impressions. Accordingly, VFTs have been realized with the help of 360-degree videos (Wehking *et al.*, 2019; Springer *et al.*, 2020). In urban water management, locations that can be depicted using 360-degree-based media include not only structures, but also laboratories and test facilities. Thus, the aim of the explorative pilot study is exploring the potential of 360-degree models as learning tools in environmental engineering. The 360-degree model of an innovative wastewater treatment system aiming at public awareness rising is assessed by environmental engineering students regarding usability, motivation, emotions and learning outcomes.

The paper is structured as follows: in section two the case study as well as the scope and the methodology of the study is depicted. Section three presents the results of the study, which are discussed in section four. Finally, conclusions are drawn in section 5.

2. Study

2.1 Technical background

P-Bank. Phosphorus is an essential resource, which means it is not substitutable by any other substance. The phosphorus deposits on earth are both geographically centred and finite (Cordell, Drangert and White, 2009). These facts are mostly unknown as it is also widely unknown that phosphorus can be recovered from human urine, thus conserving phosphorus reserves. To communicate these two facts to the public, the so called *P-Bank* (Figure 1), an information-providing technical installation including toilets capable of separate urine collection, has been designed aiming at presenting the phosphorus recovery cycle. The P-Bank entrance exhibits technical settings for transforming the urine collected into different forms of phosphorus fertilizer. Demonstrating the usefulness of the fertilizer produced planters containing vegetable surround the P-Bank. The appealingly designed technical installation of the P-Bank was accompanied by educational texts explaining the technical principles of phosphorus recovery techniques (Goldeimer gGmbH, 2020; Hörnlein, Mehling and Londong, 2021).

360-degree model. For creating a 360-degree model of the P-Bank the iOS application *Matterport Capture* (Matterport Inc, 2020) was employed. Based on Insta360 ONE X camera generated 360-degree pictures, a 360-degree model was rendered. The model might be explored by pointing devices, such as mouse and touchpad, or by using VR glasses in a first-person view by changing the viewpoints (Figure 1).

Figure 1: External view of the physical P-Bank (left) and dollhouse view of the 360-degree model (right)

Didactic augmentation: The information selected for augmenting the model didactically was guided by the intention of providing the public with information easy to comprehend. The selection was based on Bloom's taxonomy of educational objectives (Anderson *et al.*, 2000). Representing information, annotations were placed within the 360-degree model and linked to specific information. Annotations are color-coded regarding the learning objective. By clicking on the annotation, the information becomes visible. Information is presented in different forms, such as textual descriptions, images, graphs, and videos (Figure 2). While the textual descriptions communicate detailed information, the videos composed of interview sequences offer a wider contextual understanding. The placement of the annotations adhered to the spatial-contiguity-principle (Mayer, 2009). The software was able of rendering 360-degree models in closed rooms only. Thus, while the 360-degree pictures of the interior were assembled to a 360-degree model, the exterior view was represented by regular 360-degree pictures demonstrating the P-Bank's functional integration into the urban context.

Figure 2: Embedded annotations and an integrated video

2.2 Scope and methodology

The study was conducted in the course Urban Water Management in the winter semester 2019/2020. Of all the participants (N=17), the majority (N=12) were studying in the 5th semester of the three years Bachelor's program *Civil Engineering*. Five students were in their 2nd semester of the 2 years Master's program *Environmental Engineering*. The participants revealed different levels of knowledge about the P-Bank, which has been installed near the university in the preceding summer. Approximately 50 % of the participants had seen it from the outside, 30 % had visited it and nearly 25 % had read details about it. Only 18 % had not received any kind of information. None of the participants had taken part in designing, constructing, or maintaining the P-Bank. Participating in the study was introduced to the participants as an exploratory pilot study without any influence on the course's grading.

As mentioned, 360-degree models are a rather new medium, for whose didactic use little experience has been gained so far. Therefore, one of the objectives of this study was examining the general usability of the 360-degree model from the perspective of people who are not familiar with the medium beforehand. In addition, learning-relevant traits of the learners, such as motivation and emotion, were to be assessed. Finally, by means of semi-structured interviews, further key aspects of the 360-degree model that had not been considered in the design of the 360-degree model were to be identified. The information gathered aims at investigating the general appropriateness of 360-degree models as learning tools. The study comprised of four phases:

Exploration. At the beginning each participant was introduced verbally to the context and the design of the study, followed by ten minutes lasting exploration phase of the 360-degree model. Two different technical devices were used. Eight participants were asked to use a desktop computer, whereas nine participants explored the virtual model on a tablet. In both technical settings headphones were provided for enabling participants to listen to the acoustic information provided by the model integrated videos. For encouraging participants to explore the model purposefully, the participants were informed about the concluding post-test.

Questionnaire. Besides prior knowledge, demographics and a self-estimation of the learning outcomes, the questionnaire asked for usability, emotions, and motivation. Standardized measurements were used. User experience including joy of use was measured by the Questionnaire User Experience (QUX) (Müller, Heidig and Niegemann, 2012), motivational factors were measured by the Questionnaire on Current Motivation in Learning situations (QCM) (Rheinberg, Vollmeyer and Burns, 2001), and finally the Achievement Emotions Questionnaire (AEQ) measured emotions (Pekrun *et al.*, 2011).

Post-test. The post-test was conducted after completing the questionnaire and aimed at evaluating the knowledge gained from the exploration of the 360-degree model. The post-test comprised of five multiple choice questions for each participant.

Semi-structured interviews. To receive further feedback semi-structured interviews were conducted. The participants were individually interviewed after finishing the post-test. For each interview, a time duration of approximately 5 minutes was planned.

3. Results

3.1 Quantitative results

Learning outcomes. Learning outcomes were assessed firstly through self-assessment and secondly through a post-test. Regarding the self-assessment the participants were asked to indicate the extent of their achieved understanding of the concepts of the P-Bank. For that, a 10-point Likert scale, ranging from “I do not know anything” (1) to “I completely understand it” (10) was employed. The results show that all participants gained an understanding about the aim and the operational principles of the P-Bank. Overall, an average value of 7.8 was reached indicating that the participants believed in having gained a good understanding about the P-Bank’s concept. The pre-test comprised five questions randomly selected from a pool of altogether ten multiple choice questions. The participants answered 78.2 % of the questions correctly on average. Remarkable is the almost exact match of the two measures, whose significance could not be substantiated, but which nevertheless indicates sound learning outcomes.

User Experience. Arising from the interaction with a technical system (Norman, 1998), user experience may be understood as a crucial factor determining in how far users agree to continue to work with an application. Therefore, the user experience was analysed by focusing on the usability, the joy of use as well as a general rating. For measuring usability, participants were asked in how far they “disagree” (referring to value 1 on a 6-point Likert scale) or “agree” (value 6) to various statements. In general, a high level of satisfaction with the 360-degree model was observed (Figure 3). The participants indicated that the application was easy to operate (a: 4.9) and needed no additional manual (b: 4.6). Further, the software appeared being easy to operate (c: 4.6) and the offered navigational options met the requirements of exploration (e: 4.4/f: 4.2). Only finding purposefully embedded educational information appeared — with a value of 3.9 — to be challenging. Nevertheless, the participants were able to reach the goal without hesitation (d: 4.4). Deriving from the standard deviations, a few improvements might be required. In particular, the wide standard deviation of item ‘e’ indicates some participants experiencing difficulties in operating the software. This might correlate with the large standard deviation of item ‘h' implying the information appeared to be hard to find.

Emotional user reactions include general feelings that users experience while using an application (Müller, Heidig and Niegemann, 2012). For analysing three basic emotions by using the QUX, a 6-point Likert scale was used (1: “I disagree”, 6: “I agree”, Table 1). Amongst the three items, motivation (a) achieved the highest mean value of 4.4. It is to be valued positive that high motivation may be achieved, as high motivation might foster excellent learning outcomes. Further, the emotions of being glad (b) and of happiness (c) achieved slightly lower results. As the means as well as the standard deviation of these two emotions are similar, too, participants might not have been able to differentiate between the two items. The AEQ, also applied, measured learning-related emotions in eight items on a 7-point Likert scale (Table 1). Clearly, positive emotions such as enjoyment, hope and pride reach considerable positive values, while negative emotions are hardly present at all.

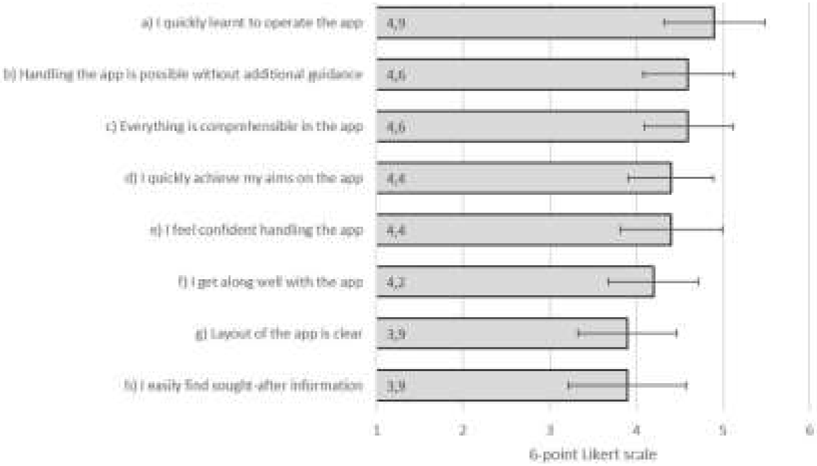

Figure 3: Usability

Table 1: Emotions

Questionnaire	Emotion	M	SD
QUX (6-point Likert)	I feel motivated	4.4	0.62
	I feel jolly	3.8	0.94
	Î feel happy	3.8	0.92
AEQ (7-point Likert)	Enjoyment	5.1	0.96
	Hope	5.4	0.91
	Pride	4.4	1.13
	Anger	2.3	1.13
	Anxiety	1.3	0.46
	Shame	1.6	0.69
	Hopelessness	1.0	0.00
	Boredom	1.2	0.38

Further, the joy of use is depicted by non-instrumental quality perceptions that comprise aesthetic symbolic aspects (Müller, Heidig and Niegemann, 2012). A scale ranged from 1 – 10 was used. The two values represent two opposite terms, whereas value 1 is mostly defined by negative and value 10 by positive impressions. By choosing a number between 1 and 10 participants had to state in how far they relate to each (Figure 4).

All items received high mean values. Analysing the results precisely, three groups showing similar mean values are to be identified. The first group having values from 8.7 - 8.8 indicates most of the participants having experienced a highly positive impression and found exploring the 360-degree model a thrilling activity (a/b). The second group (c-f) achieved slightly lower values (8.0 - 8.2), reflecting creative, enjoyable and stimulating 360-degree usage. Further, a high quality was approved, and the 360-degree model was evaluated as appealing and convenient (h-k). The standard deviations may be considered as low in general. However, the higher standard deviations of the items (a), (c) and (i) render the 360-degree model being not convincing to all participants. Thus, the 360-degree-model of the P-Bank might not address the needs of all learners. Further research needs to evaluate, whether changes of the 360-degree model might address these individual requirements or if participants not convinced require different learning tools.

Aiming to identify the acceptance of the system and usage behaviour (Müller, Heidig and Niegemann, 2012) participants had to provide a general feedback. Again, on the 6-point Likert scale, the value 1 referred to "disagree", value 6 was defined as "agree" (Figure 5). The 360-degree model received a throughout positive feedback. With a mean value of 4.6 participants would use the software again (a) and would highly recommend it (b) as well. This might be supported by the thoughtful appearance and excellent design of the 360-degree model (c/d).

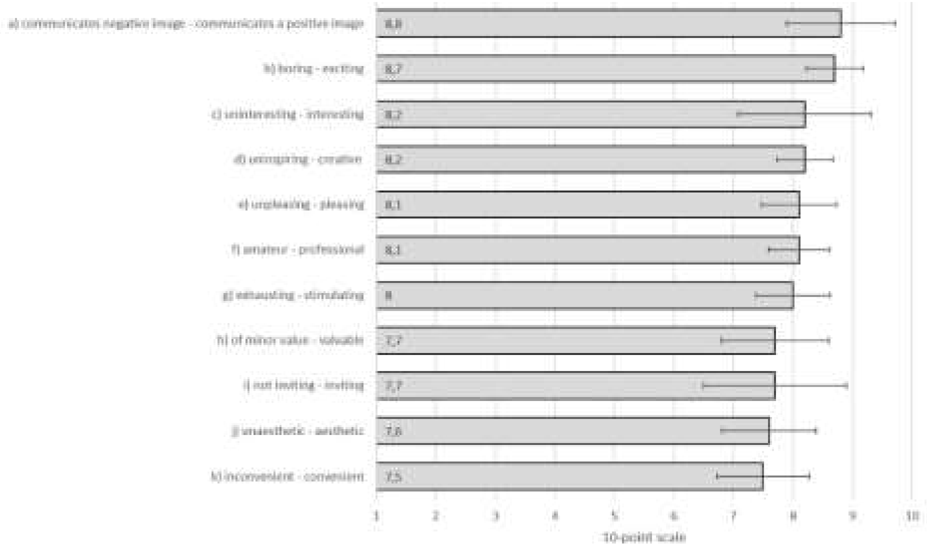

Figure 4: Joy of use – aesthetic and symbolic aspects

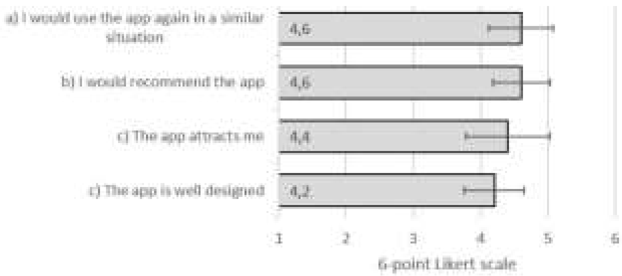

Figure 5: Overall judgement of intention to use

Motivation. Motivation is an essential factor for achieving learning outcomes. Thus, investigating motivations during learning is of great interest. The QCM measures based on a 7-point Likert scale the subscales Anxiety, Challenge, Interest and Probability of Success (Figure 6). The subscale Probability of Success (a) achieved the highest acceptance (5.4) indicating, that participants felt being capable of coping with operating the 360-degree model aimed at information collection. Showing a value of 4.9 the subscale Interest (b) received the second highest level of agreement possibly stating that participants appreciate such activities. Challenge (c) was experienced with a mean of 4.0 leaving the opportunity to embed more specific tasks and indicating differences between target group (general public) and assessment group (participants). The low value of Anxiety (d) complements the high value of Probability of Success (a) and depicts participants not feeling any pressure and not being concerned about failing. The measurements of motivation are to be considered as characterizing an almost optimal prerequisite of learning.

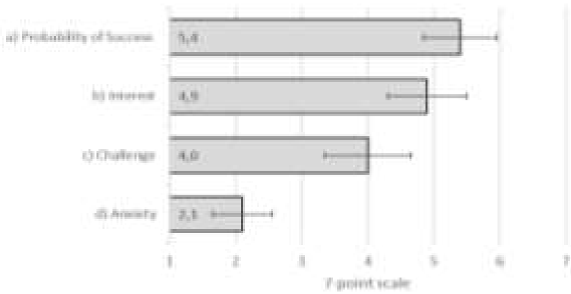

Figure 6: QCM: Subscales of motivations

3.2 Qualitative evaluation

In the final step of the study, a semi structured interview was conducted with each participant. The interviews were structured into three parts. First, participants were asked for a general feedback of the 360-degree model (a), then their perception of the 360-degree model as learning tool (b) was addressed and finally they were requested to share their experience about the technical setting (c). The average time of the interviews was 7.9 minutes, exceeding the duration of 5 minutes planned. The exceedance of the interview time planned was not least due to the participants, showing — based on great interest — their eagerness to contribute. For evaluating the interviews qualitative content analysis (QCA) (Gläser and Laudel, 2010) was conducted and the individual statements were coded and structured in 11 categories (Table 2). In total, 159 statements were analysed.

Table 2: Categorized statements (N=159)

	Category		f_i	Assignment Criteria
a)	C1	Positive	27	Participant comments positively on the 360-degree model
	C2	Negative	1	Participant comments negatively on the 360-degree model
	C3	Suggestion	15	Participant makes suggestions for improvements
b)	C4	Interesting activity	19	Participant describes the 360-degree model as an interesting learning activity
	C5	Learning potential	17	Participant emphasises the 360-degree model's potential for learning
	C6	Excursion	14	Participant mentions the application in context of excursions
	C7	Extend of content	12	Participant refers to the learning content
	C8	Structure of content	11	Participant mentions the structure of the learning content
	C9	Challenge	6	Participant points out difficulties regarding learning
c)	C10	Navigation	19	Participant describes navigational experiences
	C11	Time	18	Participant mentions the time frame as sufficient

In the first part (a), most statements (27 out of 43) were positive mentioning the concept and the design of the application as well as the variety of annotations (texts, figures, videos). Only one negative statement was given, expressing discomfort by looking at glass panes installed in the P-Bank and causing reflections. A high number of suggestions were given (C3), referring mostly to navigation, content or how the 360-degree model could be integrated in lectures. In part two (b) the evaluation revealed that many statements (36 out of 73) perceived the application as interesting activity that may be frequently used as an educational tool. Further, the 360-degree model's potential for learning was mentioned. The comments of the category C6 understood the 360-degree model mostly as suitable approach to document field trips, while two statements envisioned it as a substitution of field trips. Focusing on the extend of the content (C7), most of the statements (10 out of 12) expressed satisfaction with the amount of information supplied, whereas two statements demanded declining the amount of information. All 11 statements in category C11 pointed to a deficient structure of the content, stating that finding the relevant information was rather difficult, while some statements considered learning detailed information using the 360-degree model difficult (C9). Focusing on the navigation (C10), nearly half of the statements (8) emphasized the 360-degree model intuitive navigation, while the others experienced difficulties. The time to explore the 360-degree model of the P-bank was found to be sufficient (C11).

As part of the interview, participants were asked to compare the 360-degree model as a tool for learning with books and homepages. The most named advantages and disadvantages of the application are presented below (Table 3).

Table 3: Advantages and disadvantages of the 360-degree model

Advantages	Disadvantages
Provides holistic overview over topic Information is highly understandable and memorable Useful support to create mental models Opportunity to present new projects quickly High motivation of usage	Uncertainty about kind and extent of information Deficient structure of information Complex approach to learn detailed information Specific information searched are hard to find

4. Discussion

First, it may be noted that in all quantitative measurements (usability, emotion, motivation) of the 360-degree model received high values. Looking at the figures separately, the results of the motivational subscales reveal participants being highly motivated to explore the 360-degree model. This finding is supported by the qualitative evaluation revealing the 360-degree model's potential as learning tool and the participants' interest in exploring the 360-degree model. Although the participants encountered a decent user experience, focusing on the figures separately, a correlation between the items having received lower values may be inferred (Figure 3,4,5). All the items may be linked to the learning content in general and its structure in particular (Figure 3,4,5). That the current structure of the learning content (colour-coding of annotations) would be mentioned "as not being ideal" was predictable, but could not be avoided due to technical limitations: better approaches of structuring by embedding a contend-based order of the annotations through numbers or letters is technically not implementable yet.

Further, it needs to be pointed out, that the potential difference between the two technical settings (desktop computer and tablet) were not considered in the presented results. The intention of this notion of the study design was achieving a qualitative preference of one of the two settings. However, no major differences were observed. At least, the study provided some indication that participants operating the 360-degree model with their preferred technical setting experienced less technical challenges. However, participants, who mentioned their low technical affinity, point to the potential of the 360-degree model as well.

To evaluate the potential of 360-degree models as learning tools in environmental engineering precisely, the learning effectiveness needs to be analysed as well. The post-test conducted was primary used as a motivation encouraging participants to explore the model purposefully for achieving more detailed results regarding usability, motivation and emotions. For a detailed evaluation of the learning effectiveness the 360-model should be improved beforehand, as the results indicate. Further, a larger number of participants is required. For achieving mostly unadulterated results, participants might be allowed to choose their preferred technical setting including head mounted displays.

In earlier studies, VFTs - realized as multimedia installations - were seen as interesting, but by no means as a substitute for real field trips (Spicer and Stratford, 2001). In further work there is the need of assessing in detail possible differences induced by the subject domain and the medium. Further, it needs to be examined whether the higher level of detail of 360-degree models compared to modeling software created virtual reality models may possibly lead to lower learning successes of 360-degree models (Eiris, Gheisari and Esmaeili, 2020).

5. Conclusion

360-degree models are algorithmically assembled 360-degree images of objects, for example spaces, which allow observers to view the objects almost from almost any viewpoint. The explorative pilot study revealed a high educational potential of a 360-degree models having been created with low technical effort in the field of environmental engineering. The evaluation indicated promising results referring to user experience, emotion, and motivation, however at the same time, the results showed participants searching for guidance for exploration. Overall, the study contributes to establishing 360-degee models as effective learning tools in environmental engineering education. Among further work are the evaluation of the 360-degree models' detailed learning effectiveness and the transfer of educational 360-degree models to further disciplines.

Acknowledgements

The authors gratefully acknowledge the financial support provided by the German Federal Ministry of Education and Research (BMBF) through grant FKZ 16DHB2131 provided for the "AuCity 2" project and the German Federal

Environmental Foundation (DBU) through grant 35076/01. Any opinions, findings, conclusions, or recommendations expressed in this paper are those of the authors and do not necessarily reflect the views of institutions mentioned above.

References

Amory, D. *et al.* (2010) "Patent App Publication System and method for capturing, combining and displaying 360-degree 'panoramic' or 'spherical' digital pictures, images and/or videos, along with traditional directional digital images and videos of a site, including a site audit, ."

Anderson, L. W. *et al.* (2000) *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives, Abridged Edition*, *Theory Into Practice*. Edited by L. W. Anderson and D. R. Krathwohl. Allyn & Bacon. doi: 10.1207/s15430421tip4104_2.

Argyriou, L., Economou, D. and Bouki, V. (2017) "360-Degree Interactive Video Application for Cultural Heritage Education," *Online Proceedings from the Third Immersive Learning Research Network Conference*, pp. 297–304. doi: 10.3217/978-3-85125-530-0-44.

Barkatov, I. V *et al.* (2020) "New effective aid for teaching technology subjects: 3D spherical panoramas joined with virtual reality," in *Proceedings of the 3rd International Workshop on Augmented Reality in Education (AREdu 2020), Kryvyi Rih, Ukraine*.

Brenner, A. J. (2017) *Scholarship @ Claremont Virtual Reality: The Game Changer for Residential Real Estate Staging through Increased Presence Recommended Citation*. Claremont McKenna College. Available at: http://scholarship.claremont.edu/cmc_theses/1471.

Cheng, K.-H. (2021) "Teachers' perceptions of exploiting immersive virtual field trips for learning in primary education," *Journal of Research on Technology in Education*. Routledge, pp. 1–18. doi: 10.1080/15391523.2021.1876576.

Chien, S. Y., Hwang, G. J. and Jong, M. S. Y. (2020) "Effects of peer assessment within the context of spherical video-based virtual reality on EFL students' English-Speaking performance and learning perceptions," *Computers and Education*. Elsevier Ltd, 146, p. 103751. doi: 10.1016/j.compedu.2019.103751.

Cordell, D., Drangert, J.-O. and White, S. (2009) "The Story of Phosphorus: Global Food Security and Food for Thought," *Global Environmental Change*. Tempe, USA: Elsevier Ltd., 19(2), pp. 292–305. doi: 10.1016/j.gloenvcha.2008.10.009.

Eiris, R., Gheisari, M. and Esmaeili, B. (2020) "Desktop-based safety training using 360-degree panorama and static virtual reality techniques: A comparative experimental study," *Automation in Construction*. Elsevier, 109(September 2019), p. 102969. doi: 10.1016/j.autcon.2019.102969.

Eiris, R., Wen, J. and Gheisari, M. (2021) "iVisit – Practicing problem-solving in 360-degree panoramic site visits led by virtual humans," *Automation in Construction*, 128, p. 103754. doi: https://doi.org/10.1016/j.autcon.2021.103754.

Felli, F. *et al.* (2018) "Implementation of 360 videos and mobile laser measurement technologies for immersive visualisation of real estate & properties," *Education Building Professionals for the Future in the Globalised World*, 2(November), pp. 294–305.

Gläser, J. and Laudel, G. (2010) "Einführung," *Experteninterviews und qualitative Inhaltsanalyse*, pp. 11–22. doi: 10.1007/978-3-531-91538-8_1.

Goldeimer gGmbH (2020) *P-Bank - ein zukunftsweisendes Projekt der Bauhaus-Universität Weimar*. Available at: https://www.goldeimer.de/p-bank/ (Accessed: March 10, 2021).

Hörnlein, S., Mehling, S. and Londong, J. (2021) "COMMUNICATING SOURCE SEPARATION OF URINE," *Detritus*. CISA Publisher, (14), pp. 37–47. doi: https://doi.org/10.31025/2611-4135/2021.14061.

Kundu, S. N. (2017) "Designing an effective Virtual Field trip for e-Learning," *Proceedings of 2016 IEEE International Conference on Teaching, Assessment and Learning for Engineering, TALE 2016*, (December), pp. 9–13. doi: 10.1109/TALE.2016.7851762.

Malinchi, C. *et al.* (2017) "A Mobile Exploration Solution for Virtual Libraries in Higher Education," *Proceedings - IEEE 17th International Conference on Advanced Learning Technologies, ICALT 2017*, pp. 490–492. doi: 10.1109/ICALT.2017.39.

Matterport Inc (2020) *Matterport: 3D Camera, Capture & Virtual Tour Platform | Matterport*. Available at: https://www.matterport.com/ (Accessed: February 13, 2020).

Mayer, R. E. (2009) *Multimedia Learning*. 2nd Editio. New York: Cambridge University Press.

Müller, J., Heidig, S. and Niegemann, H. M. (2012) "Evoking Emotional Dimensions in HCI – Development of the Questionnaire User Experience (QUX)," in *Paper presented at the Annual Meeting of The American Educational Research Association (AERA), April 13th - 17th, Vancouver, Canada.* Vancouver, Canada.

Norman, D. A. (1998) *The invisible computer: why good products can fail, the personal computer is so complex, and information appliances are the solution*. MIT press.

Pekrun, R. *et al.* (2011) "Measuring emotions in students' learning and performance: The Achievement Emotions Questionnaire (AEQ)," *Contemporary Educational Psychology*, 36(1), pp. 36–48. doi: 10.1016/j.cedpsych.2010.10.002.

Pham, H. C. A. I. C. *et al.* (2018) "Virtual field trip for mobile construction safety education using 360-degree panoramic virtual reality," *International Journal of Engineering Education*, 34(4), pp. 1174–1191.

Rheinberg, F., Vollmeyer, R. and Burns, B. D. (2001) "QCM : A questionnaire to assess current motivation in learning situations," *Diagnostica*, 47, pp. 57–66. doi: 10.1026//0012-1924.47.2.57.

See, Z. S., Billinghurst, M. and Cheok, A. D. (2015) "Augmented reality using high fidelity spherical panorama with HDRI," *SIGGRAPH Asia 2015 Mobile Graphics and Interactive Applications, SA 2015*, p. 2014. doi: 10.1145/2818427.2818445.

Seifan, M., Dada, O. D. and Berenjian, A. (2020) "The effect of real and virtual construction field trips on students' perception and career aspiration," *Sustainability*, 12(3), pp. 1–14. doi: 10.3390/su12031200.

Shi, W., Haga, A. and Okada, Y. (2021) " Web-Based 3D and 360 ∘ VR Materials for IoT Security Education and Test Supporting Learning Analytics ," *Internet of Things*. Elsevier B.V., p. 100424. doi: 10.1016/j.iot.2021.100424.

Söbke, H. *et al.* (2019) "Using a Location-based AR Game in Environmental Engineering," in Spek, E. van der et al. (eds.) *Entertainment Computing and Serious Games - ICEC -JCSG 2019 LNCS 11863*. Springer, pp. 7–10. doi: 10.1007/978-3-030-34644-7_47.

Spicer, J. I. and Stratford, J. (2001) "Student perceptions of a virtual field trip to replace a real field trip," *Journal of Computer Assisted Learning*, 17(4), pp. 345–354. doi: 10.1046/j.0266-4909.2001.00191.x.

Springer, C. *et al.* (2020) "Virtualization of Virtual Field Trips: A Case Study from Higher Education in Environmental Engineering," in Söbke, H. et al. (eds.) *Proceedings of DELbA 2020 - Workshop on Designing and Facilitating Educational Location-based Applications co-located with the Fifteenth European Conference on Technology Enhanced Learning (EC-TEL 2020) Heidelberg, Germany, Online, September 15, 2020*. CEUR Workshop Proceedings. Available at: http://ceur-ws.org/Vol-2685/paper6.pdf.

Straub, J. and Kerlin, S. (2014) "Development of a Large, Low-Cost, Instant 3D Scanner," *Technologies*, 2(2), pp. 76–95. doi: 10.3390/technologies2020076.

Ulrich, F. *et al.* (2021) "Learning effectiveness of 360° video: experiences from a controlled experiment in healthcare education," *Interactive Learning Environments*. Taylor & Francis, 29(1), pp. 98–111. doi: 10.1080/10494820.2019.1579234.

Violante, M. G., Vezzetti, E. and Piazzolla, P. (2019) "Interactive virtual technologies in engineering education: Why not 360° videos?," *International Journal on Interactive Design and Manufacturing*. DIGEP-Department of Management and Production Engineering, Politecnico di Torino, Corso Duca degli Abruzzi, 24, Turin, 10129, Italy: Springer-Verlag France, 13(2), pp. 729–742. doi: 10.1007/s12008-019-00553-y.

Wehking, F. *et al.* (2019) "How to Record 360-degree Videos of Field Trips for Education in Civil Engineering," in Schulze, S. (ed.) *Proceedings of DELFI Workshops 2019*. Bonn: Gesellschaft für Informatik e.V.z, pp. 177–188. doi: 10.18420/delfi2019-ws-120.

PhD Research Papers

Improving Student Engagement and Satisfaction Using Universal Design for Learning and Storytelling

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Abstract: The purpose of this research is to examine the effect of a mobile education application that uses Universal Design for Learning (UDL) and digital storytelling on student engagement and satisfaction while they learn how to read in the Arabic curriculum. For the purpose of this research, an interactive mobile learning application has been developed based on the idea of targeting learners' individual needs where students will progress from reading single words to sentences and creating their own stories and share them to a website which is developed for the purpose of this research. The participants of this study were second-year primary school children, their parents, and their Arabic language female teachers in the first semester from three different primary school classes in Saudi Arabia. Due to the closure of the schools in Saudi Arabia as a result of the novel pandemic (Covid-19), this study was conducted online. This study employed both qualitative and quantitative approaches to measure the effectiveness of the interactive tool for enhancing student engagement and satisfaction while reading in Arabic and to obtain general knowledge about students' background of using technology. The qualitative approach is based on online semi-structured interviews for the teachers and online observations of students while they interact with the novel mobile application. The quantitative approach is based on online questionnaires for both the students and their parents. The student survey obtains opinions about the system, while the parent survey examines the students' prior knowledge of using technology and home literacy environment. The aim of this research is to prove that such a proposed novel mobile learning application will increase and enhance student engagement. The results indicate that students show increased engagement and expressed satisfaction with the system. Therefore, a system based on UDL and digital storytelling can increase and improve students' engagement and satisfaction.

Keywords: e-learning, m-learning, mobile learning, digital storytelling, universal design for learning, student engagement

1. Introduction

Technological advancements and the popularity of mobile devices has increased significantly in the educational setting. This in turn has created the Mobile learning paradigm aimed at supporting anytime, anywhere learning (Leligou et al, 2017). There are many mobile learning applications used for students learning in different curriculum such as science (Umer et al,2017), art and humanities (Chao,2011), literacy (Gu et al,2014), mathematics (Riconscente,2013). In the area of language learning, mobile learning applications have been used extensively such as speaking and listening (Hwang & Chen, 2013), vocabulary (Hao et al, 2019), writing (Eubanks et al,2018) and reading (Moser et al,2017).

The traditional oral or paper-based storytelling has progressed to digital storytelling with technological advancements (Garzotto , 2014) which help in making the students more engaged with the learning materials and more active learning (Robin, 2016). Although the wide variety of students in their communication, interaction and understanding information in the classroom can enrich the classroom, this can cause problems where one-size-fits-all curriculums is not the best approach for educating learners with different abilities (Rao and Meo,2016). Universal Design for Learning (UDL) is aimed at targeting different student's needs to make learning accessible for a diverse populations of students (Katz and Sokal,2016). Based on The Center for Applied Special Technology (CAST), UDL has three principles; Multiple means of representations, meaning representing knowledge in multiple ways in the learning process; Multiple means of action and expression, meaning the students can express their knowledge and actions in different ways; Multiple means of engagement, meaning engaging and motivating students in different ways.

The purpose of this research is to examine the effect of a mobile education application that uses Universal Design for Learning (UDL) and digital storytelling on student engagement and satisfaction while they learn how to read in the Arabic curriculum, thus supporting effective and interactive learning within the classroom. The study was conducted online due to the novel pandemic (Covid-19) which caused the closure of the schools.

2. System overview

The system is designed by combining Universal design for learning (UDL) principles and digital storytelling for enhancing student engagement and satisfaction when reading in Arabic. The structure of the system is shown in Figure 1.

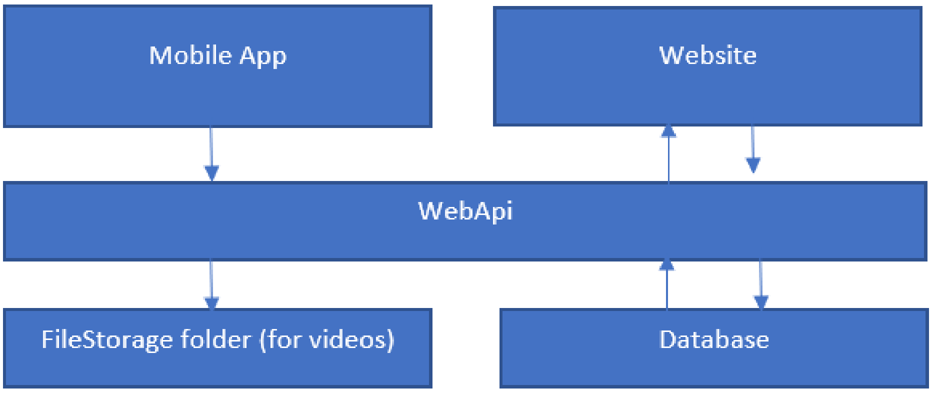

Figure 1: System architecture

The application's content is based on the general teaching materials covered in the formal second grade book (iEN National Education Portal, 2019). The application contains two parts: preparation and story creation as follows:

- 1. The preparation part prepares students to read before starting to create a story. This part contains words and sentences sections. Each section contains multiple pages that contain sets of words or sentences which will be displayed along with descriptive pictures and a read-aloud help feature.
- 2. The story creation part will be on two levels of difficulty: Novice and Expert to help students to progress when creating a story from simple to more complex level as follows:
- **The novice level:** this shows a predefined list of pictures and some questions to help the students to create a story by answering the questions via dragging items from the predefined lists and dropping them in the draggable area for each question in order to answer it. If the student drags and drops the wrong item when answering any question, immediate feedback is displayed. Students are able to delete any dropped item if needed and after answering all questions, a short story with its descriptive pictures and a read aloud feature will be displayed based on students' answers.
- **The expert level:** this is similar to the novice level but more advanced and contains no questions, thus inviting students to use their imagination to create the story. Moreover, here, students will be able to share their own story to a website which will help them to share stories with their classmates. The shared stories are available on the following website: http://www.readingthestory.com/webapp .

All students can attempt the novice level while students require more reading competency to be able to create a story at the expert level. However, the final story created by the students will appear in two versions in both levels. The first version will be presented in separate pages for each element in the story. The second version of the story will be displayed as a full version of the story in one page along with congratulatory feedback and supportive picture which indicates that the student has successfully completed the level. For more information about the developed system please see (Alharbi and Newbury, 2020).

3. Methodology

The study uses both qualitative and quantitative approaches to answer the research questions. The qualitative approach is based on online semi-structured interviews for the teachers and online observations of students while they interact with the application. The quantitative approach is based on online questionnaires for both the students and their parents. The student survey obtains opinion about the system and how students feel about it while the parent survey examines the students' prior knowledge of using technology and home literacy environment. This study was conducted during the autumn term 2020 and completed in October 2020. This study has 2 experiments organized in 2 schools, with 3 classes, within a period of 6 weeks and with 40 students. The first experiment was in public primary school for girls only while the second experiment was in public school that applies The Early Childhood Schools Project in Makkah, Saudi Arabia. The Early Childhood Schools Project, aimed at ensuring that every child has an equitable and inclusive quality education by assigning boys at early school levels to female teachers (Early Childhood Care and Education, 2019). This project started in the first term in September 2019 and has applied in 55 public schools in Makkah region (WAS Saudi Press Agency, 2019).

4. Participants

Random sampling of the participants was used with a general invitation distributed by the teachers to the parents. The main participants are 40 second year primary school children (with parental consent) aged 7-9 years old (F=27, M=13), (Experimental group= 25 and control group=15). Parents of the selected students and three Arabic language teachers also participated in the study which took place in the autumn semester 2020 from two different primary schools in Makkah city in Saudi Arabia. The control group was mainly used for a separate quantitative study not covered in this paper, however, the control group parents participated in the parent survey.

5. Procedure

All students receive the same base learning material, but different methods of learning. For the practical sessions, the control group receive no intervention (i.e. learn with their teacher in virtual classes provided by the ministry of education) while the experimental group receive the intervention (i.e. application on a provided tablet delivered by the researcher). Each student in the experimental group attends three sessions distributed over 3 days (i.e. one session per day), each session lasts approximately 45 minutes which is equal to the class time. In each session, each child works individually with system on a provided tablet. Following the practical sessions, the researcher reads the student questionnaire for each student to obtain their perspective on the system usability, their satisfaction and their opinion about the use of the system. The Arabic language teachers were also interviewed online through Microsoft Teams in an appropriate time selected by the teachers. The main aim of teachers interviewing is to explore the use of technology in the classroom, type of strategies they use for educating the students, the Arabic language curriculum and the use of storytelling. Additionally the system was discussed from the teacher's point of view to check that the system is in-line with the curricula and that it is effective for the students. The parent questionnaire is an online survey through Qualtrics, which is used to examine the use of technology at the children's home and home literacy environment.

6. Findings

6.1 Parent surveys

The survey includes questions on learning ability and disability, the technology available at home and preferences and time spent on such technology. The survey also has questions about the home literacy environment such as who is responsible for educating the child at home, is the child read to and how often, along with book ownership and the use of technology when reading. Additionally, parents opinion is canvased with regard to using technology, in the children's classrooms for learning Arabic.

Based on the parents answers, only 10% of the students have a diagnosed learning disability and the majority of the students are fluent with only 32.5% regarded as not fluent. All of the students have good level of experience with technological devices. The vast majority of the children can use smartphones and tablets independently although the least popular activity polled was reading (17.5%) while unsurprisingly playing games was most popular (92.5%). Eighty percent of the children can operate mobile/tablet applications independently and 60% own their own device. Interestingly 72.50% of the children use these devices for both entertaining and learning, with only 17.50% stating entertainment only.

For the home literacy environment, mothers are the person most responsible for teaching the child at home with 62.50% reading with their children. The majority of children are read to by their parents. Most of the parents prefer reading to their children from books (80%) while 20% prefer to read from the smartphones/tablets. The stated reasons for reading from books were as follows; because it is the original method and parents want to show the importance of books, to make their child love reading from books, better and easier to read from with easy access to pictures. Those who prefer reading from smartphones or tablets do so because there are more options for available stories and they can access stories anywhere and anytime.

When parents were asked about their children's preference of reading stories from books or from smartphones/tablets, 75% they said that their children prefer stories read from books while 25% said their children prefer smartphones/tablets. They mentioned the reason of choosing books because; the children are used to reading from books, their children choose the stories by themselves, because of the pictures, because the mothers prefer the books, to avoid disruptive light from screens and to protect their children's eyes. A few parents said that they do not know the reason. On the other hand, some parents said that their children prefer smartphones/tablets because; there are many stories to choose and it is faster to choose the stories that their children want to read.

When parents were asked about what their children's preference when reading by themselves, 65% said books while 35% said smartphone/tablet. The reason why their children prefer books are because they are used to them, to mimic their parents, books are clearer and have pictures. The parents of those that preferred to use smartphone/tablet to read by themselves stated that it was because, children can read and listen at the same time, learn fast and play.

The majority of parents' opinion with regard to technology in the classroom for teaching and learning reading was that it was a positive step.

In general, these findings show that the children have a good experience of using mobile devices and enjoy using them. Parents seem to be happy with children using these devices, and the majority of them are also happy for them to use them in the classroom for learning.

6.2 Students survey

The survey was used to assess system usability and evaluate student satisfaction with the system. The questionnaire consisted of 31 Likert scale close ended questions and 2 open-ended questions. The researcher read the questions to the students and captured their reply.

The experimental students were questioned about describing various features of the developed system, which included their feeling, attitudes and behaviours towards using the system. Each characteristic was measured by statements that used a 5-point Likert scale ('Strongly agree', 'Agree', 'Neutral', 'Disagree' and 'Strongly disagree').

The System Usability factor was measured using fifteen items in the student questionnaire. The collected data was about student perception of system usability. The majority of responses were agree or strongly agree with only one negative response for the question "reading from the screen is easy" (discussed below).

User satisfaction (US) is another factor used to measure sixteen items related to the mobile learning application. This showed that all students were satisfied using the system.

The experimental group students were asked open-ended questions regarding the ease and difficulty of the system. When they were asked about the easy parts of the system, most of them stated everything was easy to use. Some students mentioned specifically some features such as: Picture, texts, words, creating stories and reading them, the use of the sounds. The following student comment is typical of the responses received "*When I created the stories on both levels, you heard the stories that you shared. I learned reading while I playing, creating the stories by dragging pictures", "I can hear the words and I repeat after it. Reading the story. The pictures because when I see them, It will help me to read. Sharing my stories because I can hear my friends' stories and they can her my stories*."

When they were asked about the difficult parts of the system, most of the student said nothing is difficult. However as mentioned above a few students stated that the sentences in the story were quite long, *"Reading stories is quite difficult because it is quite long*". Also, a few mentioned that creating stories with no questions is quite difficult as this relies on the student designing their own story.

6.3 Observations

The researcher observed 25 students using the system (6 boys and 19 girls) via Microsoft Teams video link. Mothers were sitting next to their children to move the camera as the researcher requested. The researcher explained via Microsoft teams how the application worked. During the three sessions, the researcher observed that the students became more independent using the application, they used it more easily and moved between pages with no problems. One mother was surprised at her daughter's ability, as she did not have a tablet yet interacted with the application independently and easily.

In observations the application was consistently seen to be easy to use, without any difficulties. Students liked it, enjoyed using it and played with it in a very independent manner. With the help of the pictures and the read aloud feature students progressed very well and read observably faster and more accurately than the previous sessions. They were also excited and engaged while playing and interacting with the application and did so without asking any questions. Some students talked to themselves while playing, whilst some of them thought aloud when selecting the elements for their stories. They read the text loudly and showed confidence when they read the texts.

All students were focused while using the application. A mother of a boy student said *"I feel my boy is focusing and excited although he always escape and crying from the language subject (Arabic language) because he does not like reading"*. There was a student who her sister is on the third year of school was sitting next to her and both were completely focused and quiet.

The students were smiling when they read the words, the sentences, when they moved from word level to the sentences, when they were creating their stories especially when choosing the preferred background, character, activity and feeling, changing their selected pictures and then selecting new elements for their stories. Students enjoyed their created story appearing and when they were reading their stories.

The students overwhelmingly enjoyed interacting and using the application with a few students saying "*Yes*", "*Yay*" or "*congratulation*" when they saw the feedback page on finishing the word and sentences levels. One student said "*I like reading from this application*". A student when he finished the words and sentences level said "*Now, I will create my own story*".

Almost all students were trying their best to read correctly especially when they read their stories although they were spelling and decoding words.

Students who were able to share their stories were excited when they knew that their friends, families and their teachers would see and listen to their stories. Although some students tended to read quietly, when they knew that their reading will be recorded they tried to raise the voices to a good level.

By the end of the third session all students had finished the word and sentence levels with only one student unable to create a story as they ran out of time. Twenty four students were be able to create their own stories on the novice level, but five of them did not read the full story. Eleven students were be able to create and share their own stories on the expert level.

6.4 Teachers interviews

This study used NVivo version 12 to analyse the interviews' transcripts and identify and interpret the descriptive themes of the interviews.

6.4.1 The use of technology in the classroom

During online learning the teachers use virtual classes called Madrasty (my school) platform through Microsoft Teams, PowerPoint presentations created by the teacher, educational YouTube channels, Ein educational channels and educational games. Teachers use screen sharing to present videos, presentations and worksheets in the lesson. However, in the normal classes in schools the technology that been used in the classroom were computers, laptops, document cameras, smart boards and projectors. Technology has become inseparable from education and they considered it as necessity in the classroom. It helps in entertaining students and changes the classroom's atmosphere bringing fun to the class. Technology is an aid for the standard book-based learning, engaging students and increasing their interaction while bringing excitement. It also helps to simplify and explain the difficult information from the book, deliver information to students quickly as well as making it more memorable. Even though the school closure and moving to the online learning and virtual classes has helped teachers and students in using technology, there are still some barriers that teachers mention that prevent them from using technology in the classroom such as the lack of internet and smartboards in some classes.

6.4.2 Arabic language teaching

Teachers believe that the curriculum is rich, helps students to learn, is age appropriate and meets students' needs. However, they mentioned some limitations of the curriculum from the teachers perspective such as lack of pictures and exercises. Teacher 3 stated that in the formal book *"There are intensive exercises but the texts are few"* also suggesting the curriculum should be gradual and the topics connected *"some lessons can change and be related to his environment and the reality that the child is going through".*

The teachers use various strategies for teaching the Arabic language curriculum such as the round table, the train of reading, peer learning and changing tone when reading stories with multiple characters. Students like these strategies and interaction is improved, however, it is difficult to use these strategies during the online learning as there is less control of the students and direct physical interaction is reduced.

When the teachers introduce new vocabulary they use many ways to simplify the meaning for their students. Putting words in a sentence from the surrounding environments and asking their peers to explain the meaning for the students. Analysing the text by extracting the linguistic phenomena is another way that teachers introduce new vocabulary and help students to learn. Explaining the meaning of the new words and then finding the antonyms of the new word. If the student find difficulties in pronouncing or reading a word, the teacher helps him to divide the word into small parts.

6.4.3 The use of storytelling in the class

All the teachers used storytelling in class and also played stories from videos on the smartboard screen. Sometimes the teachers read stories with changing the tones of their voices based on the characters and actions in the story and then asked their students questions from the stories. Additionally storytelling can teach good behaviour and calm down students as the students enjoy listening to stories.

6.4.4 The use of the application

Teachers liked the application, and believed it age appropriate and that it takes into considerations the individual differences of students on their learning styles by containing pictures, sounds and texts. Its gradual approach was commented on, starting with words, then multiple words, sentences and then creating stories and this was seen as an essential feature for the early education students. Teacher 2 *"The gradual feature is beautiful, necessary, and essential especially for this age".*

It was commented that it will support the curriculum in an interactive way and help students in their learning process because it contains words with linguistic and grammatical phenomena and makes the learning process more enjoyable, leading to students using it in their free time.

Teacher's saw many benefits of using the application; It helps the students who are unable to read by using sounds which the student tries to mimic; it helps the teacher to strengthen the non-fluent students; the pictures and read aloud feature in the application help the student to become independent and provide for students who do not have support at home. Additionally the read aloud feature helps to correct pronunciation of the text especially for students who do not like receiving corrections from their classmates. Teacher 1 "*some students do not like to hear a correction of his mistake from another student, but this method helps the student to hear the word several times".*

Creating stories and the flexibility to change pictures increases the vocabulary that the students are able to read and understand as every time they create a new story they will have different words to read. Teacher 2 *"… the student innovates every time she tries a new story. whenever she change the pictures in the four fields, the story will change".*

Voice recording, sharing stories and viewing the shared stories were also seen as key functionality, Teacher 1 *"After the student hears himself, he will be motivated by the fact that next time his reading will be better and give the motive to learn and give more"*.

Commenting on each other on the website can enhance students writing. Teacher 1 "*As for the students' comments on each other on the website, this helps them to write and encourage them to express their opinion* *freely and develop the skill of criticism"*. Moreover, it helps the students to feel accomplishment when they progress in the application.

All teachers emphasised that they will download it if it is available in the Apple store or Google play store. Teacher 1 "*As a teacher, if the application is found in the store, I will ask mothers to download it, and I, as a mother, will download it to my son*".

6.4.5 Most positive aspects of the application

The application is a small, light, fun application for students. It has clear pictures and uncomplicated words therefore it is appropriate and suitable for the students' age. It guides student reading progressively from simple words to sentences and then creating stories and reading the short stories. One of the key positive aspects of using the application is the drag and drop features. These helps students to create their own stories without writing any words, benefiting students who might normally disengage with the Arabic class because of the writing. Teacher 1" *the application does not contain writing because some children do not like writing, so they get bored of Arabic language class, while the application has drag and drop pictures".*

Moreover, the navigation restrictions prevent students from going to sentence level before ending the words level is a nice feature.

6.4.6 Most negative aspects of the application

The need for an Internet connection in order to use the read aloud features and sharing the story is one of the negative aspects of the application. Additionally, creating stories could possibly be challenging for some students. Teacher 1 expected that most of the students can read the words and not all of them are able to create stories. Finally, shy and/ or non-fluent students may face difficulties in voice recording in the sharing story part because they are unconfident and their speech may be quiet when reading.

By the end of the interviews, the teachers were asked to rate the features in encouraging students to read and enhance their ability to read through the use of storytelling, pictures, read aloud feature and sharing stories. All teachers rated all features as 10 out of 10.

7. Conclusion

This paper discussed the effect of implementing of the mobile learning application which combined UDL and digital storytelling on students engagement and satisfaction when reading in Arabic. The study was run mainly to test the system effectiveness in enhancing students engagement and satisfaction. The results indicate that students show increased engagement and expressed satisfaction with the system. The students enjoyed using the system and their teachers were very positive in their analysis of the system and whether it met the stated goals. This suggests that a system based on UDL and digital storytelling can increase student engagement and satisfaction and that there is significant potential for this to lead to increased attainment and understanding. Although the sample size in this study was small due to the pandemic, we feel that the overall results are strongly indicative of a clear positive impact of the developed system.

References

Alharbi, S., & Newbury, P. (2020). Designing a Mobile Learning Application by Integrating Universal Design for Learning Principles and Digital Storytelling: Pilot Study. In *European Conference on e-Learning* (pp. 547-XII). Academic Conferences International Limited.

CAST. [Online] Available from: http://www.cast.org/ [Accessed 25 May 2021].

Chao, J., Lu, Y. H., Tzeng, Y. D., & Liu, C. H. (2011). The study of integrating PDA mobile learning device into the arts and Humanities Learning Curriculum for elementary schools—Mobile digital learning space. In *2011 International Conference on Multimedia Technology* (pp. 6119-6124). IEEE.

Early Childhood Care and Education (2019) [Online] Available from: https://www.moe.gov.sa/en/PublicEducation/EducationDepartments/Pages/Early-Ch-dev-care-2.aspx [Accessed 03 May 2021].

Eubanks, J.F., Yeh, H.T. and Tseng, H., 2018. Learning Chinese through a twenty-first century writing workshop with the integration of mobile technology in a language immersion elementary school. *Computer Assisted Language Learning*, *31*(4), pp.346-366.

Garzotto, F. (2014). Interactive storytelling for children: a survey. *International Journal of Arts and Technology*, *7*(1), 5-16.

Gu, E., Tzou, M.H. and Hoda, R., 2014, April. Fill that blank! An iOS-based literacy application. In *2014 23rd Australian Software Engineering Conference* (pp. 80-83). IEEE.

Hao, Y., Lee, K.S., Chen, S.T. and Sim, S.C., 2019. An evaluative study of a mobile application for middle school students struggling with English vocabulary learning. *Computers in Human Behavior*, *95*, pp.208-216.

Hwang, W-Y. and Chen, H. (2013) Users' familiar situational contexts facilitate the practice of EFL in elementary schools with mobile devices. Computer Assisted Language Learning, 26(2): 101–125

iEN National Education Portal (2019) [Online] Available from: https://ien.edu.sa/#/courses/309 [Accessed 05 May 2021].

Katz, J., and L. Sokal. 2016. "Universal Design for Learning as a Bridge to Inclusion: A Qualitative Report of Student Voices." International Journal of Whole Schooling 12 (2): 37–63

Leligou, H. C., Zacharioudakis, E., Bouta, L., & Niokos, E. (2017). 5G technologies boosting efficient mobile learning. In *MATEC Web of Conferences* (Vol. 125, p. 03004). EDP Sciences.

Moser, G.P., Morrison, T.G. and Wilcox, B., 2017. Supporting fourth-grade students' word identification using application software. *Reading Psychology*, *38*(4), pp.349-368.

Rao, K., & Meo, G. (2016). Using Universal Design for Learning to Design Standards-Based Lessons. *SAGE Open,6*(4), 1-12. doi:10.1177/2158244016680688

Riconscente, M.M., 2013. Results from a controlled study of the iPad fractions game Motion Math. *Games and Culture*, *8*(4), pp.186-214.

Robin, Bernard R. (2016). The Power of Digital Storytelling to Support Teaching and Learning. *Digital Education Review,* (30), 17-29.

Umer, M., Nasir, B., Khan, J.A., Ali, S. and Ahmed, S., 2017, April. MAPILS: Mobile augmented reality plant inquiry learning system. In *2017 IEEE Global Engineering Education Conference (EDUCON)* (pp. 1443-1449). IEEE.

WAS Saudi Press Agency (2019) [Online] Available from: https://www.spa.gov.sa/1960179 [Accessed 15 April 2021].

Playful Online Learning Environments Promote Student Teachers' Renegotiation of Their Learner Role

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DOI: 10.34190/EEL.21.030

Abstract: As part of a PhD project examining the integration of playful learning approaches and student teachers' use of digital artefacts and physical activity, this study investigated how student teachers approach playful learning in an online environment. A pilot test revealed some reservations that arose when student teachers were encouraged to make a Rube Goldberg machine as an alternative approach to curricula. The present study considered these reservations and focused on facilitating a space for exploring playful approaches. Insights from Gudiksen and Skovbjerg (2020) showed that feeling safe is prerequisite for being playful, and therefore creating a safe space is necessary. A design-based research approach was used to plan and conduct two parallel teaching modules in an online environment. The modules were developed to investigate the students' reservations, the reservations' connection to specific situations and the occurrence of new modes of playful approaches to learning. The theoretical framework drew on insights from Whitton and Moseley (2019), who argued that playfulness among students is often a state of mind and they must be willing to embrace the playful activity so that learning can emerge through an iterative process—one with no guarantee of success or a clear endpoint. Furthermore, Goffman's (1959) theory of front-, back- and off-stage, as well as Meyrowitz's (1986) work, contributed to understanding how students engage in playful activities in an online environment. A situational analysis of video recordings was used to understand how the students navigated in a learning environment that was open-ended and unfamiliar. This analysis determined any patterns in the students' positioning when engaged in playful activities in these online situations. The study confirmed that learning designs featuring a safe space facilitate students' playful approach. Furthermore, it showed that when moving from an educational setting with predetermined teacher and student positions and learning agenda towards open-ended learning situation, the majority of students developed failing, experimenting and hacking skills.

Keywords: learning design, online education, playful approach to learning, stage positioning, teacher education, hacking learning designs

1. Introduction

Danish educational institutions are increasingly interested in shifting from pre-determined learning agendas and the notion that the teacher knows everything to new methods of learning. If this shift is to occur in primary school, upgrading the student teacher´s competencies, skills and knowledge by letting students could be one way to start, for instance by experiencing playful approaches to learning in a teacher education setting.

In 2019, the Danish project Playful Learning was initiated and funded by the LEGO Foundation. The project aims at creating a program for both teacher and social education with focus on playfulness. A partnership between the LEGO Foundation, Kolding Design School and six University Colleges was established to create a research base. The project aims to gain new insights into teaching practices and encourage students to search for meaning beyond their existing understanding of learning (Gudiksen and Skovbjerg, 2020). The goal of the project was that students would *experience excellent teaching that supports experimental and playful learning* (Playful Learning, 2021a). The long-term goal was *to educate excellent teachers who are capable of creating playful learning environments in Danish primary schools*.

The findings given in this paper spring from a PhD project that is part of the Playful Learning Research Extension programme that include up to 11 other PhD projects. The aim of the PhD project is to investigate how playful learning approaches integrate digital artefacts and physical activity among student teachers in a higher educational setting (Playful Learning, 2021b). The present paper focuses on how student teachers positioned themselves in an online learning environment framed by a playful learning approach.

Playful approaches to teaching and learning are not new. Several physiological, psychological and social studies have linked playful learning to children's learning and development (e.g., Broström, 2018; Johansson and Samuelsson, 2007; Kangas, 2010; Paes and Eberhart, 2019; Zosh et al, 2017). Play in an educational context with adults has been less investigated, particularly in online environments (Nørgård et al, 2017; Walsh, 2018; Whitton, 2018). Play is often understood as an activity amongst children (Carden, 2018; Fesseha and Pyle, 2016).

This understanding of play as a childish activity may give rise to resistance and concern among both educators and adult students (Gudiksen and Skovbjerg, 2020; Whitton and Moseley, 2019) in curriculum-based teaching.

It seems that the satisfactory of the playful learning environment among the students may be influenced by the pedagogical and emotional engagement of the teachers. Specially, the teachers' commitment, motivation, interest and competencies for developing their practice was critical (Kangas et al, 2017). Moreover, a qualitative case study (Barber, 2020) showed that the pedagogical strategy increased students' participation and developed their sense of belonging to the learning community, encouraging them to engage in collaborative processes. Sharoff (2019) highlighted the need for an innovative, creative educator with an impactful online presence to keep students engaged and motivated to learn the course content. The need for a safe, non-judgmental environment in which views, perspectives and personal and professional experiences were encouraged was also emphasised. The present study incorporated these findings into the research design, combining them with an investigation of how students act in online environments when given an assignment with playful elements to promote technology comprehension.

2. Research design

The present study was conducted in a new module, "Technology Comprehension and Digital Building", at University College Copenhagen a mandatory module for the teacher education curriculum (Københavns Professionshøjskole, 2021). The module addressed design thinking, computational thinking and problem-solving. Student teachers were taught technology comprehension through design activities and theoretical discussions based on the modules' learning objectives (Rehder et al, 2019).

In the module, the students were given the assignment of constructing a Rube Goldberg machine. This hands-on, experimental activity aimed to develop the students' technology comprehension skills and knowledge according to the concept of computational thinking (i.e., predicting and analysing the situation logically, working with algorithms and determining whether a Rube Goldberg machine is an abstraction for solving a simple problem). Furthermore, it aimed to provide the students with computational thinking approaches, such as tinkering, creating, debugging, persevering and collaborating. The students were introduced to design thinking to increase their competency in identifying, investigating and designing solutions to complex problems with both digital and analogue technologies (Rehder et al, 2019). Building a Rube Goldberg machine was assigned to engage students in a playful activity and to determine the extent to which the activity would stimulate creativity, curiosity and playfulness.

The research drew on design-based research (e.g., Barab and Squire, 2004; Brown, 1992; Collins, 1990) and a pilot project conducted in fall 2020. The pilot project tested three design principles of the playful learning project: 1) imagining together, 2) daring to go for unpredictability and 3) insisting on meaningfulness (Playful Learning, 2020). The test was organised in a PlayLab, a physical environment located on the University College campus that contained facilities to invite, inspire and stimulate a playful learning approach. The students were asked to build a Rube Goldberg machine with both digital and analogue materials. An analysis of the activity uncovered some student reservations about this playful environment. These students verbally and nonverbally expressed their insecurity about the learning process and design and/or their lack of understanding about how this approach would prepare them for the upcoming examination. These reservations were analysed according to the Gudiksen and Skovbjerg (2020) model of play space boundaries, which explains how situational constraints influence the establishment of boundaries. The analysis showed that the constraints were related to the following categories: relationship, role, regulations, culture, structure and time (Gudiksen and Skovbjerg, 2020).

The learning design was then refined for the first iteration, which took place in spring 2021. Due to the Covid-19 pandemic, which moved all teaching to online formats, this iteration was conducted online. This added extra complexity to the activities and participation of both teachers and students. The iteration was conducted in one session (4.5 hours) containing both plenary sessions and group work. Two parallel teaching modules focused on if, how and when the students' reservations emerged and whether they were connected to specific situations. The two parallel teaching modules were used to provide multiple opportunities for studying the students' engagement in the learning process. Two groups of 23 and 27 student teachers, respectively, were enrolled in the modules. Of the first group, 17 participated, while 25 in the second group participated.

In this study, the practitioner was also the researcher. Thus, the researcher both taught and tested the learning designs (Drake and Heath, 2011; Thing and Ottesen, 2015; Winther, 2015). This double role may have produced blind spots in interpretation of the students' reactions and coherence of the design. However, hermeneutic phenomenological analysis (Manen, 1990) was applied to relate critically to the role of practitioner and researcher. Furthermore, the sessions were recorded to create an analytical distance from the experienced observations. Although the students and teacher did not have previous relationship with or knowledge of each other, both parties still had preconceptions from being in an educational setting.

Additional situational analysis of the video recordings (Clarke et al, 2015) enabled dynamic and holistic interpretation of the teaching sessions. This analysis was used to understand each student's behaviours. Clarke et al's (2017) concepts for 'messy' situational maps were constructed early in the project and were revised throughout the research process to understand the complexities of the students' behaviour in each situation. Three types of situational maps (situational maps, arena maps and positional maps) were created to engage fully with the sessions. Each situational map contained several maps.

3. Theoretical framework

The theoretical framework drew on three conceptual approaches to developing the learning design and understanding the student teachers' and educator's actions. First, the framework drew on the notion of situational constraints that influence the establishment of a play space's boundaries (Skovbjerg and Gudiksen, 2020). These constraints are relationship (historic, power and background), role (positions, characters, preferences), regulations (formal goals, curriculum, security), culture (languages, rituals, habits), structure (objects, sequences, conditions) and time (priorities, accessibility, focus). Within these constraints, the play space must establish safety, encourage curiosity, explore surprises and create the opportunity to shift perspective. Furthermore, Gudiksen (2020) argued that a progression-based and behavioural-oriented play design can be useful for situations in which routines change and participants must break out of habitual thinking.

Second, Whitton and Moseley (2019) argued that play is open-ended and free-formed and that participation in play must be voluntary. They argued that play is driven by enjoyment of the activity, which often does not have a clear goal or endpoint. Lastly, they argued that play creates a safe space for experimentation, failure and learning from mistakes; it allows learning through active exploration and problem-solving, and it can create engaging, immersive, motivational learning environments (Whitton and Mosely, 2019). Regarding adult play, Whitton and Moseley emphasised that it is a conscious choice. Thus, playfulness is a state of mind in which the adult is willing to accept and embrace the constraints of a play activity, try something new and attempt something difficult, without the guarantee of success. Playful learning approaches embrace whimsy, creativity, humour, surprise and imagination.

Third, theories by Goffman (1959) and Meyrowitz (1986) informed the analysis that aimed to identify students' modes of positioning. Goffman (1959) introduced the socio-cultural concepts of frontstage and backstage. Regarding frontstage, individuals seek to acquire information about the person they meet when entering that person's presence; this helps define the situation and enables the individuals to know what can be expected of the situation. In an educational setting, the reason for acquiring this information is often practical (e.g., knowing the teacher's competence for being an educator). Furthermore, the person who presents her/himself in front of others has behaviour characterized by politeness and careful attention to the situation (Goffman, 1959). Practical jokes and social games are sometimes used as a source of humour, a catharsis for anxieties and a sanction for inducing individuals to be modest in their claims and reasonable in their projected expectations (ibid.). Furthermore, traditions also have an impact on the situation. An educator is traditionally expected to deliver subject-specific knowledge to the class, and the students expect this knowledge.

Opposed and often proximal to frontstage is backstage, a venue where *suppressed facts can make an appearance* and where the impressions created in the frontstage are contradicted, often purposefully (Goffman, 1959). The backstage is hidden from the frontstage audience to a greater or lesser extent and is where three primary practices occur: rehearsals for frontstage performances, training and prop-gathering for competent frontstage performances and catharsis/relaxation.

Goffman's front stage–backstage approach is complicated by the online format because performing actions may occur simultaneously. For instance, a study group may take the frontstage by writing a chat message to all participants, even though the educator by definition has the frontstage. However, Goffman's approach could identify how students use several strategies to cope with both the online format and the learning approach. Furthermore, this context could provide new insights and categories for the frontstage–backstage theory.

Whereas Goffman's study focused only on face-to-face interactions, Meyrowitz (1986) argued that self-staging should be more fluidly described as middle- and side-stage behaviour in a digital world. Middle-stage allows an individual to access both the backstage and frontstage performance without an active confrontation (Meyrowitz, 1986). This notion is, to an extent, applicable to an online learning session but should be expanded to include off-stage, where a student no longer participates in the online learning setting.

4. Empirical data

The empirical data contained video recordings of the two parallel online sessions; 13 hours of video footage were analysed—five hours from the main teaching session and eight hours from the students' group work. From the first session, 3 (out of 4) groups shared their videos for research, while 2 (out of 4) groups from the second session shared their videos.

The camera is already implemented as part of the online teaching format. One of the advantages of using video recordings is that they capture both verbal and nonverbal expressions, but video recordings is a reduction of a complex field. For the practitioner-researcher, video recordings enabled an objective perspective Interpretation of videos can be done in many ways (Fink-Jensen, 2003); this study utilised situational analysis (Clarke et al, 2017) to identify patterns in the students' actions throughout the learning process.

5. Analysis and findings

The analysis provided two maps. The first confirmed the pilot test findings about the importance of a safe and non-judgmental online learning environment and showed how students navigated in a learning environment that was open-ended. The second showed how some students hacked the learning design and were brave enough to fail during the learning process.

Overall, 17 (out of 23) students participated in the first part of the teaching session. At the end of the teaching session, 14 students remained. In the parallel teaching session, 25 (out of 27) students participated, and 21 participated until the end. The students who left the session went offline after the PowerPoint presentation when they were asked to participate in group work and discuss the theoretical aspects from the text they should have read to prepare for the session.

5.1 Navigating in a learning environment that is open-ended

The video recordings revealed how the students navigated in a learning environment that were open-ended according to Goffman's (1959) frontstage-backstage theory. The students' navigation was analysed from a safe space perspective (Skovbjerg & Gudiksen, 2020). Different initiatives were established to create a safe space for the students to overcome situational constraints. After a short icebreaker, the educator gave a 25-minute PowerPoint presentation including both curriculum-based knowledge and visual elements that showed the educator's desire to step back from the predetermined teacher position and learning agendas, aim for unpredictability and be brave enough to fail a given task.

The educator introduced the notion of 'fail-ability' (being brave enough to fail and make mistakes) as an experimental learning approach, and the students watched a music video of "This Too Shall Pass" by the rock band OK Go that showed how a large-scale Rube Goldberg Machine could be successfully constructed. Then, the educator explained the PlayLab members' attempts to operate under 'fail-ability' when building a Rube Goldberg machine. A video of their numerous mistakes regarding a Rube Goldberg machine was shown. In these instances, the machine failed to work or needed to be set in motion repeatedly, which created space for several iterative processes that required design thinking and computational thinking.

The educator used this visual media to inspire the students to imagine themselves in a playful space. While the video occupied the frontstage, the students could either join in, viewing the video and thus occupying middle-stage, or they could choose to position themselves backstage. The online format made it possible for the students to move into the middle-stage and gave the educator the opportunity to take another position.

Throughout the first part of the teaching session, the educator occupied the frontstage, and the students were pushed to the middle- or backstage. This situation was accepted by both the educator and students because it was similar to the teaching culture they had experienced in both online and offline settings. However, while the educator was sharing the screen, determining whether the students were in the middle-, back- or off-stage was impossible, as the students could easily engage in other online activities. Data from both groups showed similar patterns of behaviour: no one turned their camera on or off, and they remained positioned at their starting point (e.g., at their desk, sofa or bed).

A learning space sets social expectations (Goffman, 1986). In an online setting, these expectations could be that the frontstage will always be occupied either by the educator or student(s) sharing a subject-specific topic. These spaces can, of course, be framed for more collaboration between the students and educator (Walsh, 2018; Whitton and Moseley, 2019). When the educator stepped back from the predetermined role, both the educator and students had to renegotiate their expectations and agree upon how the online session should proceed. The setting made an agreement difficult because of the physical and sometimes visual distance and the students' inability to make nonverbal utterances to interact with the educator. The students could go offline or off-stage or disrupt the presentation if they had reservations towards the learning process. According to Goffman (1959), a frontstage disruption would be unlikely, as the students would risk being impolite and feeling embarrassed.

The second part of the session involved group work, for which most students in both groups remained online. During this time, the educator visited the groups only if they asked for help. This was part of the pedagogical principles set for this session; the students needed to experience a learning process in which no right answers, guarantee of success or clear endpoint were given and an opportunity for unpredictability was provided. However, this made it difficult for the educator to control the situation and determine whether the students were in the learning zone. Nevertheless, several students expressed that this open-ended environment was pleasant.

In this situation, the performance of the student was backstage from the educator's point of view. According to Goffman, the students prepared themselves to perform frontstage later. The groups also created their own frontstages, where they agreed upon what they would present in the plenum session. They also needed to agree upon at least two of them participating in the frontstage to prevent the discussion from collapsing. The video recording revealed that the students all turned on their cameras, took seats at a desk and engaged in the work for this part of the session.

5.2 Experimenting, failing and hacking

The third session revolved around the students' construction of their Rube Goldberg machines. First, the students were introduced to the task. The educator demonstrated how different analogue materials could be placed on a domino line and how materials could travel between digital screens. For instance, a pencil was the last part of a Rube Goldberg machine on one screen and the first to show up on the next screen, creating a visual illusion of the machine's continuation. The first task was to set up the camera so that everyone's computer display was aligned. The first group of 4 students decided to place themselves in the same order on the screen. After some trial and error, a student suggested that they simply share the screen. One student asked the others if this was cheating. After further trial and error, the students discovered that they could not share the online communication platform. After a while, a student claimed, "I feel like we can use 45 minutes just doing this activity", and the rest of the group laughed. The students were challenged by the default setting in the communication platform that changed the perceived orientation of each of their screens. One of the students put a filter on, and the rest of the group followed her example, forgetting everything else. This went on for several minutes, with everyone laughing at each other's filters and facial expressions. Suddenly, one student urged them to resume the task of building the machine: "She 100% asks what we have done, and we need to have something ready".

In this situation, the students all simultaneously occupied the frontstage. All students experimented with the functionality the platform provided, and the entire group contributed to the development of the learning environment. The students performed with politeness and careful attention and used practical jokes and social games as humour to cope with the situation (Goffman, 1959). This use of social games could be interpreted in the following ways: 1) an escape from the learning process, 2) a way for the students to accept the playful learning approach and occupy a playful mindset and safe space, or 3) the creation of a new play situation in which the learning design could be hacked. Student feedback from the day elucidated the reason for these social games:

> *I think it was nice to have the opportunity to be silly and get student credit for failing the task. But we tried to build the machine a couple of times and succeeded in getting a Rube Goldberg-like machine to actually work. But then it got a little lame because we couldn't move on. So, the feeling of this is actually working and how amazing it could be was not really present. It was impossible to make this kind of machine online but also very funny to try. And even though it was meaningful, I ended up thinking about summer, drinks and being outside in the sun (translated by author).*

The main goal of a Rube Goldberg machine is to solve one simple task with connected materials, but this group, like several others, chose to create a verbal machine and used the materials to solve several problems. Thus, they took ownership of the learning process by hacking the design. Although the students did not manage to build a traditional Rube Goldberg machine, they agreed that they had gained valuable knowledge about learning and that the activities were still meaningful and thereby met the subject-specific goal.

6. Conclusion

This paper provided some initial findings concerning an online learning environment in which adult student teachers and the educator shifting from pre-determined learning agendas towards a more participant-driven and experiential learning approach. First, the research confirmed that learning designs that facilitate a safe space enable some students to be playful; playfulness occurred when the students connected with each other while constructing the Rube Goldberg machine. By hacking the learning design through experimentation with virtual modes to connect physical artefacts, the students were imaginative, experimental, and fail-able.

Second, the study showed that new energy emerged when the students were working on an unsolvable task away from the plenary room, when the educator stepped back from the frontstage as a pedagogical strategy. The online format enhanced this strategy, creating situations in which both the educator and the students could easily be moved into different positions, i.e. from back-stage to front-stage or vice versa.

Third, the analysis showed that when students were asked to take action in group work, the back-, middle- and frontstage were rearranged, allowing multiple frontstages to emerge. Some students entered the frontstage and accepted ownership of the learning process, thus engaging in the playful environment. Others left the session before it started. The online format made it easier for these students to withdraw; however, the group work encouraged the participating students to turn on their cameras, engage in the learning activities and dare to fail.

The study indicates that the playful online learning environment promotes student teachers' renegotiation of their own stage positioning and learner role. These findings will be taken into consideration for the next iteration.

Acknowledgements

The student teachers were obliged to participate in the teaching session due to institutional regulations, but all participants signed a letter of consent. Thanks to all the students who gave their consent, and thanks for a playful afternoon.

References

Barab, S. A. and Squire, K. (2004) "Design-Based Research: Putting a Stake in the Ground", *Journal of the Learning Sciences,* Vol 13, No. 1, pp. 1-14. DOI: 10.1207/s15327809jls1301_1

Barber, W. (2020) "Building Creative Critical Online Learning Communities through Digital Moments", *Electronic Journal of E-Learning*, Vol 18, No. 5, pp. 387-396. DOI: 10.34190/JEL.18.5.002

Broström, S. (2018) "Fri leg og lærerig leg i skolen", In H. H. Møller, I. H. Andersen and K. B. Kristensen (Eds.), *Leg i skolen en antologi,* Forlaget UP: Unge Pædagoger, København Ø, pp. 31-49.

Brown, A. L. (1992) "Design Experiments: Theoretical and Methodological Challenges in Creating Complex Interventions in Classroom Settings", *The Journal of the Learning Sciences*, Vol 2, No. 2, pp. 141-178. DOI: 10.1207/s15327809jls0202_2

Carden, C. (2018) *Primary Teaching: Learning & Teaching in Primary Schools Today,* SAGE, London.

Clarke, A. E., Friese, C. and Washburh, R. S. (2017) *Situational Analysis: Grounded Theory After the Interpretive Turn,* SAGE, Los Angeles. DOI: 10.7146/kkf.v27i1.106342

Clarke, A. E., Friese, C. and Washburn, R. (2015) *Situational Analysis in Practice: Mapping Research with Grounded Theory,* Walnut Creek, California, Left Coast Press. DOI 10.4324/9781315420134

Collins, A. (1990) "Toward a Design Science of Education", In Scanlon E., O'Shea T. (eds) *New Directions in Educational Technology. NATO ASI Series (Series F: Computer and Systems Sciences*, Springer, Berlin. DOI: 10.1007/978-3-642-77750-9_2

Drake, P. and Heath, L. (2011) *Practitioner Research at Doctoral Level: Developing Coherent Research Methodologies,* Routledge, London and New York.

Fesseha, E. and Pyle, A. (2016) "Conceptualising Play-Based Learning from Kindergarten Teachers' Perspectives", *International Journal of Early Years Education,* Vol 24, No. 3, pp. 361-377. DOI: 10.1080/09669760.2016.1174105

Fink-Jensen, K. (2003) "Den forskende lærer i et fænomenologisk perpektiv", In Rønholt, H. et al. *Video i pædagogisk forskning: Krop og udtryk i bevægelse,* Forlaget Hovedland, Institut for Idræt, Københavns Universitet.

Goffman, E. (1959) *The Presentation of Self in Everyday Life,* Anchor Books, New York. DOI: 10.1215/08992363-8090145

Goffman, E. (1986) *Frame Analysis: An Essay on the organization of Experience,* Northeastern University Press. DOI: 10.2307/2106908

Gudiksen, S. (2020) "Play Design Insight 10: Play Design Methods in Organisational Development", In Gudiksen, S. and Skovbjerg, H. M. *Framing Play Design: A Hands-on Guide for Designers, Learners and Innovators,* BIS Publishers, Amsterdam, pp. 163-182.

Gudiksen, S. and Skovbjerg, H. M. (2020) "Prologue: Uncovering the Qualities of Play Design", In Gudiksen, S. and Skovbjerg, H. M. *Framing Play Design: A Hands-on Guide for Designers, Learners and Innovators,* BIS Publishers, Amsterdam. pp. 15-36.

Johansson, E. and Samuelsson, I. P. (2007) *Att lära är nästan som at leka: Lek och lärande i förskolan och skola,* Liber, Häftad.

Kangas, M. (2010) "Creative and Playful Learning: Learning Through Game Co-Creation and Games in a Playful Learning Environment", *Thinking Skills and Creativity*, Vol 5, No. 1, pp. 1-15. DOI: 10.1016/j.tsc.2009.11.001

Kangas, M., Siklander, P., Randolph, J. and Ruokamo, H. (2017) "Teachers' Engagement and Students' Satisfaction with a Playful Learning Environment", *Teaching and Teacher Education*, Vol 63, pp. 274-284. DOI: 10.1016/j.tate.2016.12.018

Københavns Professionshøjskole (2021) "*Studieordning 2020-2021: Modul- og kursusbeskrivelser, del 3",* [online], www.kp.dk/wp-content/uploads/2021/01/studieordning-lu-kp-del-3-modul-og-kursusbeskrivelser-2020-2021.pdf?x39333

Manen, M. V. (1990) *Researching Lived Experience: Human Science for an Action Sensitive Pedagogy,* The Althouse Press, *,* London. DOI: 10.4324/9781315421056

Meyrowitz, J. (1986) *No Sense of Place: The Impact of Electronic Media on Social Behavior,* Oxford University Press, New York. DOI: 10.1016/0277-9536(87)90322-4

Nørgård, R. T., Toft-Nielsen, C. and Whitton, N. (2017) "Playful Learning in Higher Education: Developing a Signature Pedagogy", *International Journal of Play*, Vol. 6, No 3, pp. 272-282. DOI: 10.1080/21594937.2017.1382997

Paes, T. and Eberhart, J. (2019) "*Developing Life Skills Through Play–Part of the Cambridge Papers in ELT Series",* Cambridge University Press, Cambridge.

Playful Learning (2020) "*Playbook 1",* [online], https://playful-learning.dk/programaktiviteter/udgivelse-af-playbook-1/

Playful learning (2021a) "*Et nationalt udviklingsprogram",* [online], https://playful-learning.dk/

Playful Learning (2021b) "*Forskningsudvidelse",* [online], https://playful-learning.dk/om-playful-learning/forskningsudvidelse/

Sharoff, L. (2019) "Creative and Innovative Online Teaching Strategies: Facilitation for Active Participation", *Journal of Educators Online*, Vol 16, No. 2, pp. 121-129.

Thing, L. F. and Ottesen, L. S. (2015) "Indledning: Om metode i idrætsvidenskab", In L.F. Thing and L.S. Ottesen (Eds.), *Metoder i idræts: og fysioterapiforskning,* Munksgaard, København. pp. 13-21

Walsh, A. (2018) "Giving Permission to Play in Higher Education", *4th International Conference on Higher Education Advances (HEAd'18), June 20- June 22, Spain, Valencia*. DOI:10.4995/HEAD18.2018.7988

Whitton, N. (2018) "Playful Learning: Tools, Techniques, and Tactics", *Research in Learning Technology*, 260. DOI:10.25304/rlt.v26.2035

Whitton, N. and Moseley, A. (2019) "Play and Learning in Adulthood", In Whitton, N. and Mosely, A. *Playful Learning: Events and Activities to Engage Adults,* Routledge, New York and London. pp. 11-24.

Winther, H. (2015) "Praktikerforskning", In Thing, L. F. and Ottesen, L. S. *metoder i idræts- og fysioterapiforskning,* Munksgaard, København. pp. 172-189

Zosh, J. M. et al. (2017) "*Learning Through Play: A Review of the Evidence (White Paper)",* The Lego Foundation, Denmark.

The use of Programming Tools in Teaching and Learning Material by K-12 Teachers

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Abstract: The integration of programming in K-12 education (kindergarten to grade 12) can be viewed worldwide. Expected outcomes of the integration is that students will develop skills in problem solving, creativity, logical thinking, reasoning, and computational thinking. Previous research has identified several challenges for the integration of programming, such as lack of guidance, motivation, time and competence. The aim of this study is to examine the use of programming tools in teaching and learning material by K-12 teachers. The teaching and learning material analysed in this study were collected from a website (Lektion.se) where K-12 teachers can share their teaching and learning material with each other. A document review process, inspired by a systematic literature review process, was used to select the teaching and learning material to be included in the study. The selected teaching and learning material were later analysed through content analysis with deductive and inductive coding. In the study, four types of programming tools can be found in the analysed teaching and learning material: textual programming tools, block programming tools, tangible programming tools, and unplugged programming. The findings of the study indicate potential relationships between the use of different programming tools and school subjects and student grades. These findings can be drawn upon by teachers and other stakeholders in the decision on what programming tools to integrate in classroom practice and how they are to be used.

Keywords: programming tool, programming, K-12, teaching material, learning material

1. Introduction

A worldwide trend in K-12 education (kindergarten - grade 12) is the integration of computer science and programming in the school practise and curriculum (Balanskat & Engelhardt, 2015; Rubio et al., 2015; Lindberg, Laine & Haaranen, 2019). Two frequently mentioned reasons for this integration are the future shortage of computing and informatics professionals; and that coding skills could help students understand the digitalised society (Balanskat & Engelhardt, 2015; Enders et al., 2019; Lindberg, Laine & Haaranen, 2019).

The integration, and learning, of programming is expected to help students develop useful skills, such as computational thinking, logical thinking, problem solving and creativity (Balanskat & Engelhardt, 2015; Zhang & Nouri, 2019). Previous research has pointed out challenges for the integration, such as lack of technical resources, motivation, time, guidance, competence and high-quality professional development courses for teachers (Yadav et al., 2016; Falkner, Vivian & Williams, 2018; Humble, Mozelius & Sällvin, 2020).

Sweden is one of the countries that are in the process of integrating programming in K-12 education. A new curriculum was presented by the Swedish government in 2017, which contained mentions of programming and relating concepts, both as interdisciplinary traits and in the subjects of mathematics and technology (Heintz et al., 2017). The aim of this study is to examine the use of programming tools in teaching and learning material by K-12 teachers. This work has been guided by the following research questions:

- RQ1) Which programming tools are used in the teaching and learning material?
- RQ2) How are the programming tools used in the teaching and learning material?
- RQ3) What relationship can be found between the programming tools in the teaching and learning material and school subjects and student grades?

2. Theoretical background

In a literature review study by Garneli, Giannakos and Chorianopoulos (2015), the results show that there are mainly three types of programming tools used in K-12 setting: textual programming, block (or visual) programming, and tangible programming. These three types of programming tools can also be found in a study by Wyffels, Martens and Lemmens (2014), together with a fourth programming approach that uses no computer. The activity of programming without a computer is mentioned in other studies (Heintz et al., 2017; Aranda & Ferguson, 2018) under the name of unplugged programming. The four types of programming tools are well established in previous research and will be presented in separate sub-headings below.

2.1 Textual programming

Textual programming can be described as an authentic programming technology due to its long connection to professional software design (Erwig & Meyer, 1995; Garneli, Giannakos & Chorianopoulos, 2015). Textual programming tools are characterised by the use of text editors to write and modify the code (Chen et al., 2019). Although textual programming tools are mainly used in professional context and with older students, there are examples with younger students. In a study by Tsukamoto et al. (2015), textual programming is introduced to primary school students with the motivation that 1) it is more practical to use programming tools that are similar to those used for real application development, 2) textual programming tools could be easier for primary school students than initially thought, and 3) there are existing tools for textual programming that are both easy and attractive.

Some of the textual programming tools mentioned in previous research are: Cobol, FORTRAN, Python, Java, Action Script, Arduino Integrated Development Environments, and Processing (Erwig & Meyer, 1995; Garneli, Giannakos & Chorianopoulos, 2015; Tsukamoto et al., 2015; Lindberg, Laine & Haaranen, 2019). The strong position of textual programming tools in professional contexts does not necessarily depend on it being a better approach than other alternatives. There are strong economic and personal reasons in software design to stay in the well-established, since a lot of investments have been put into it. (Erwig & Meyer, 1995) A challenge with textual programming tools is that they can be both hard to learn and difficult to teach, even with well-chosen teaching and learning materials, since many struggles with the syntax of textual programming (Garneli, Giannakos & Chorianopoulos, 2015; Yukselturk & Altiok, 2017; Lindberg, Laine & Haaranen, 2019).

An opportunity with using textual programming tools, especially with older and more advanced students, is that the professional and authentic experience could be inspiring (Garneli, Giannakos & Chorianopoulos, 2015; Lindberg, Laine & Haaranen, 2019). It is suggested in previous research that if students want to further develop their programming skills, they sooner or later need to shift to a textual programming tool (Tsukamoto et al., 2015). Another opportunity with textual programming tools mentioned in previous research, is that younger students, in primary school, can understand and use textual programming if effort is put into making the interaction fun and engaging (Tsukamoto et al., 2015).

2.2 Block programming

Block programming tools often uses representations of the code, such as graphical icons or blocks, to build programs in a similar way that LEGO bricks are used (Brennan & Resnick, 2012; Costa & Miranda, 2017). Some of the block programming tools mentioned in previous research are: Alice, Blocky, Code.org, Dwengo blocks, Greenfoot IDE, Modkit, Scratch, Squeak Etoys, S4A, and Viscuit (Wyffels, Martens & Lemmens, 2014; Garneli, Giannakos & Chorianopoulos, 2015; Wohl, Porter & Clinch, 2015; Tsukamoto et al., 2015; Costa & Miranda, 2017; Yukselturk & Altiok, 2017; Lindberg, Laine & Haaranen, 2019; Durak, 2020).

A challenge with block programming tools is that they could require more time to learn and use in educational setting, since teachers have to learn both technical and pedagogical aspects of the tools (Meerbaum-Salant, Armoni & Ben-Ari, 2013; Garneli, Giannakos & Chorianopoulos, 2015). A potential challenge is that block programming tools can produce a greater focus on the tools, rather than the programming (Wohl, Porter & Clinch, 2015). The use of block programming tools might therefore require a carefully planned and explained approach (Garneli, Giannakos & Chorianopoulos, 2015). Another challenge with block programming tools is that they might not provide advanced students with enough opportunity to develop their programming skills (Tsukamoto et al., 2015). Since block programming tools are not widely used in professional context and it is not certain that students' knowledge in block programming will transfer to textual programming tools, this could provide yet another challenge (Tsukamoto et al., 2015; Weintrop & Wilensky, 2019).

An opportunity with block programming tools is that they could provide an engaging introduction to computing since many students find the tools absorbing (Garneli, Giannakos & Chorianopoulos, 2015; Sáez-López, Román-González, & Vázquez-Cano, 2016; Durak, 2020). This could potentially support a broader appeal towards programming among students and not only the boys (Kong, Chiu & Lai, 2018). Previous research also mentions that some of the strengths with one of the more popular block programming tools, Scratch, is that it combines programming with other fields, such as music, art, games and storytelling (Maloney et al., 2010; Topalli & Cagiltay, 2018). This, together with its use of computer devices (such as a mouse), enables block programming tools for a broad participation among students with, and without, behavioural or learning disabilities (Maloney et al., 2010; Garneli, Giannakos & Chorianopoulos, 2015); and could support the view of programming as something more than lines of code (Topalli & Cagiltay, 2018).

2.3 Unplugged programming

Unplugged programming is programming without the use of a computer (Heintz et al., 2017; Aranda & Ferguson, 2018). In the study by Wyffels, Martens and Lemmens (2014), the students give their teacher instructions to perform different tasks, and by doing so, learn basic concepts in programming. Wohl, Porter and Clinch (2015) describe it as an activity where the algorithms are enacted by the students themselves. Unplugged programming is also exemplified in previous research as boardgames and instructions to control another human (Tsarava, Moeller & Ninaus, 2018; Aranda & Ferguson, 2018).

There have been some sceptical voices raised in previous research, stated that more research is needed to determine to what extent unplugged programming can be used before the effectiveness decreases and computing devices need to be introduced (AlAmer et al., 2015; Brackmann et al., 2017). In a study by Feaster et al. (2011) the results indicate that the unplugged approach had no effect on high school students' attitudes towards computer science or perceived understanding of the concepts taught. In a study by Bell and Vahrenhold (2018) it is concluded that the unplugged approach should not be used isolated in education, but linked to current technology.

Although there are challenges associated with unplugged programming, previous research also suggests that it can serve as an engaging introduction to the field of computer science and programming, especially for younger students (Brackmann et al., 2017; Bell & Vahrenhold, 2018). Studies suggest that unplugged programming serve as a good approach to generate high understanding of the basic concept of logical predictions, algorithms and debugging (Wohl, Porter & Clinch, 2015). Perhaps the most important opportunity of unplugged programming is its easy access and low threshold for getting started, since it requires no computing devices; which could be especially important for schools and regions with a lack of technical resources (Brackmann et al., 2017).

2.4 Tangible programming

Tangible programming can be described as an activity where tangible objects are manipulated directly, for example through building or controlling physical objects (Horn, Crouser & Bers, 2012; Garneli, Giannakos & Chorianopoulos, 2015; Manches & Plowman, 2017). Tangible programming tools are often similar to other kinds of programming tools, such as textual and block programming, but incorporates physical objects to represent the programming instead of words and pictures (Horn & Jacob, 2007). Tangible programming is often developed to resemble stacking of blocks or building with LEGO (Wohl, Porter & Clinch, 2015; Hamilton et al., 2020). Some of the tools mentioned in previous research are: Arduino, Bee-Bot, Blue-Bot, LEGO-Mindstorms, Robo-blocks, Tern, and Quetzal (Horn & Jacob, 2007; Garneli, Giannakos & Chorianopoulos, 2015; Hamilton et al., 2020).

Previous research suggest that younger students can find tangible programming both engaging and easy to use (Horn, Crouser & Bers, 2012; Garneli, Giannakos & Chorianopoulos, 2015; Wohl, Porter & Clinch, 2015). However, previous research has also suggested that a challenge with tangible programming tools is that some of the older, and the more curious younger, students might prefer a graphical interface (Horn, Crouser & Bers, 2012; Garneli, Giannakos & Chorianopoulos, 2015). Researchers have therefore explored a hybrid interface between a tangible and graphical approach and found that younger students seem to be able to move fluidly between the two (Horn, Crouser & Bers, 2012).

An opportunity with tangible programming tools is that they could make programming attractive and enjoyable, especially among girls, by the promotion of collaboration, interaction, active learning, exploration, and artistic creation with light, sound and motion (Rusk et al., 2008; Horn, Crouser & Bers, 2012; Garneli, Giannakos & Chorianopoulos, 2015; Rubio et al., 2015). This could also make tangible programming appropriate for activities and discussions in the whole-class (Horn, Crouser & Bers, 2012). Another opportunity with tangible programming tools is that they could be more engaging for the students, this is suggested by previous research where tangible programming have been compared to block and unplugged programming (Wohl, Porter & Clinch, 2015).

3. Method

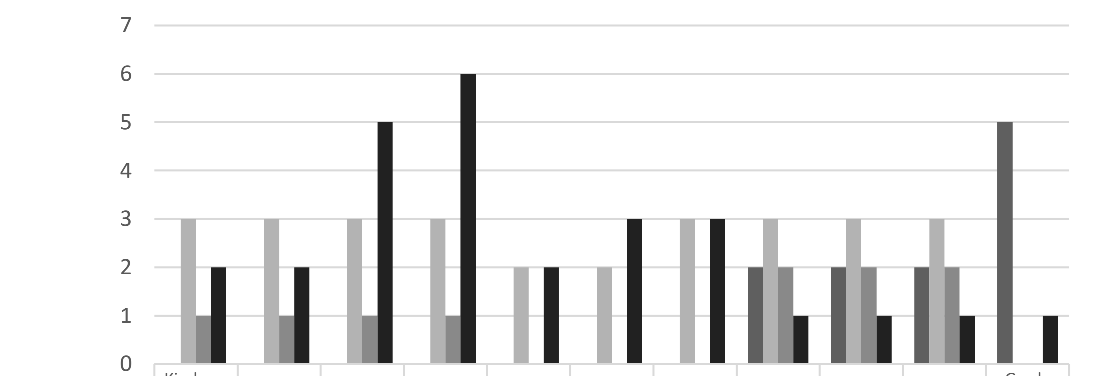
This study has been conducted as a document review with teaching and learning material as the data source. Bowen (2009) describes the document review as a method for identifying relevant and meaningful passages in a text. In this study it has been used to identify the use of programming tools in teaching and learning materials by K-12 teachers. The data in this study consists of written teaching and learning material from a Swedish website for K-12 teachers (Lektion.se), collected during late 2019. At the website, users can share their teaching and learning material to a database by creating an account and posting it. Other users can see the post, but to download and comment on the material they also need to create an account.

The selection process in this study was inspired by Tondeur et al. (2017) systematic literature review. In the first step, potentially relevant teaching and learning material was identified by conducting a database search on the following keywords in Swedish and English: programming, program, code, coding, script. This produced a list of 332 unique and potentially relevant teaching and learning material. The second step consisted of screening the title and summary of each teaching and learning material to judge the relevance for the study. This decreased the list of potentially relevant teaching and learning materials to 62. The third and final step consisted of thoroughly analysing each post as a whole (title, summary and the attached teaching and learning material) to determine the relevance for the study. This decreased the list of teaching and learning materials to 26, published between 2008 and 2019, which were chosen to be included in the study.

The selected teaching and learning materials have been analysed through content analysis. According to Bryman (2016) "[content analysis] seeks to quantify content in terms of predetermined categories and in a systematic and replicable manner" (2016, p. 283). A mixture of deductive and inductive coding has been used in the process of analysis. Deductive coding was used to structure the findings in the categories described in *2 Theoretical background*, and to connect the use of the tools to school subjects and student grades. Inductive coding was used to identify themes of use for the programming tools in the analysed material.

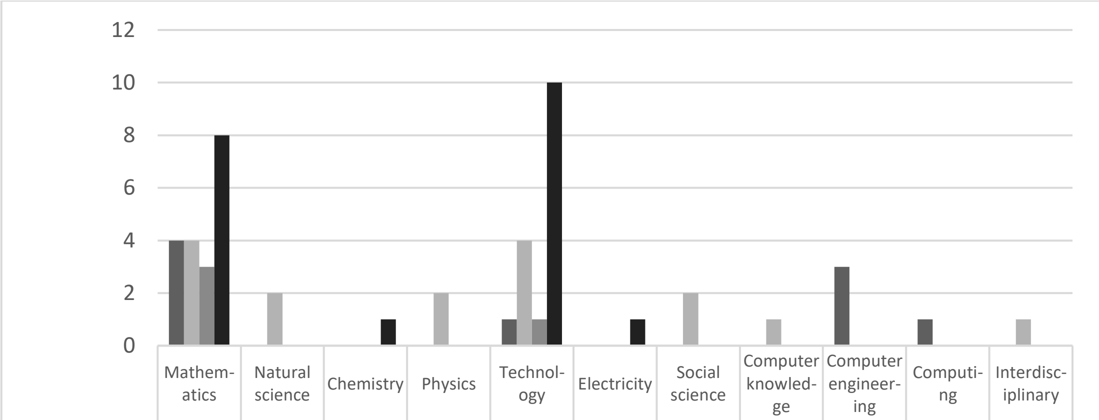
4. Results

The results of which programming tools are used in the material, which student grades (Figure 1) and school subjects (Figure 2) they relate to, and how they are being used, are presented in sub-headings according to the four types of programming tools outlined in *2 Theoretical background*.



	Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10-12
Textual	0	0	0	0	0	0	0	2	2	2	5
Block	3	3	3	3	2	2	3	3	3	3	0
Unplugged	1	1	1	1	0	0	0	2	2	2	0
Tangible	2	2	5	6	2	3	3	1	1	1	1

Figure 1: Distribution of tool usage over student grades



	Mathem-atics	Natural science	Chemistry	Physics	Technol-ogy	Electricity	Social science	Computer knowled-ge	Computer engineer-ing	Computi-ng	Interdisc-iplinary
Textual	4	0	0	0	1	0	0	0	3	1	0
Block	4	2	0	2	4	0	2	1	0	0	1
Unplugged	3	0	0	0	1	0	0	0	0	0	0
Tangible	8	0	1	0	10	1	0	0	0	0	0

Figure 2: Distribution of tool usage over school subjects

4.1 Textual programming

Textual programming tools can be found in 7 of the 26 selected materials. The programming tools mentioned in the material are (parenthesis for the number): Java (2), Python (2), Kojo (1), Excel (1), Octave (1) and Visual Basic (1). The most common student grades for the tools to be used in are Grade 10-12 (Figure 1) and the most common school subject is mathematics (Figure 2).

There are two main usage of textual programming tools in the material: as a tool for other subjects (mathematics and technology), and to learn programming. As a tool, the material give examples of how textual programming can be used to more efficiently solve complex calculations (Example 1), and visualise geometry and steering of objects (Example 2).

> *"This lesson has the aim to show how Python programming can be used to check if a random integer is a prime or not. The assignment should be solved with a loop that checks all the integers up to the chosen integer or an appropriate span of integers."*
>
> ***Example 1**. Check prime with programming.*
>
> *"Use programming to draw an equilateral triangle. With the help of the Turtle module write code that draws an equilateral triangle. Write the code in three different ways to achieve the same result."*
>
> ***Example 2**. Programming in geometry.*

The material give examples of how textual programming tools can be used to learn the fundamentals of programming (Example 3). Some programming concepts referred to in the material are: algorithms, classes, comparisons, compilation, conversions, data types, functions, graphical user interface, methods, modules, objects, procedures, pseudo code, and variables.

> *"There are eight data types built into Java: byte, short, int, long, float, double, Boolean, and char. Everything else are classes."*
>
> ***Example 3**. Data types in programming.*

4.2 Block programming

Block programming tools can be found in 7 of the 26 selected materials. The programming tools mentioned in the material are (parenthesis for the number): Scratch (3), Code.org (2), RoboLogic LE (1), and Scratch Jr (1). The use of block programming tools is evenly spread out over the grades, with the exception of Grade 10-12 that have no usage (Figure 1). The most common subjects are mathematics and technology (Figure 2). All of the described uses in the material are centred around controlling objects in a virtual environment (Example 4). The most obvious relation to a school subject is therefore technology.

"Download the application 'RobotLogic LE' in AppStore. When you open RoboLogic LE, you will get the assignment to create a program that controls the robot. You use the visual commands to program your robot to execute different movements; move forward, turn left/right, jump."

***Example 4**. Steering and technology.*

The material also touches upon concepts such as pair programming and coordinates, and is often set in a context to visualise another subject or field, such as natural science or social science. In that sense, the tools are used in an interdisciplinary way (Example 5). Some of the material relates to basic concepts in programming, such as: commands, events, functions, iteration, and variables.

"Program a lake [with Scratch] where one or more fishes swim back and forth. How does your lake look beneath the surface? Maybe there is an object floating on the surface."

***Example 5**. Water and density.*

4.3 Unplugged programming

Unplugged programming can be found in 3 of the 26 selected materials. Pen and paper are used in all the material. The materials are aimed to the youngest and some of the older students (Figure 1) and mainly towards the subject of mathematics (Figure 2). The material does not explicit touch upon any concepts in programming but is centred on the practise of giving instructions, either oral or via drawings. In the material, unplugged programming is combined with either geometry or steering imagined objects in a game-like way (Example 6).

"Santa Claus wants to reach his sleigh. He has to collect all the Christmas gifts on the way but he does not want to walk into a Christmas tree. Draw your own Christmas gifts and trees [on the playfield]. Ask a friend to draw arrows in the column on the side."

***Example 6**. Christmas programming.*

In one of the posts, unplugged programming is used as an introduction to textual programming (Example 7). This material is directed to students in grade 7, 8 and 9 and the subject of mathematics.

"The task: 1- Draw an equilateral triangle and a square with the help of a ruler, protractor, paper and a pen. 2- Use programming to draw the same geometric figures [...]. 3- Compare the two methods, what advantages and disadvantages do they have?"

***Example 7**. Drawing geometry with and without a computer.*

4.4 Tangible programming

Tangible programming tools can be found in 11 of the 26 selected materials, which makes it the most common tool. The programming tools mentioned in the material are (parenthesis for the number): Blue-Bot (7), Bee-Bot (1), Arduino (1), programmable logic controller (1), and 1 unclear (defined only as 'the robot'). The tools are most commonly used in grade 3 (Figure 1) and the subjects of technology and mathematics (Figure 2).

Most of the use in the materials are centred around controlling physical objects, which make the subject of technology the most obvious relationship. However, much of the material directed towards the lower grades relates the controlling of objects to mathematics (Example 8).

"Your assignment is to program the bot [robot] to walk on the numbers in order of size. Order the numbers by size by doing the calculation tasks below. Then program the bot to walk on the answers in order of size and to pause on each answer before moving on to the next. Good Luck!"

***Example 8**. Robots and mathematics.*

A common use is to get a robot to move over a printed carpet and stop on mathematical symbols and numbers. Most of the material does not explicit touch upon programming concepts, with some exceptions in the materials directed toward older students (Example 9). Some programming concepts that the materials relate to are: error handling, functions, iteration, and selection.

"important parts of a program: [...] curly brackets. [...] for. [...] if. […] case. [...] Comments. [...] Function. [...] random(). [...]"

***Example 9**. Robot programming.*

5. Discussion

Concerning which programming tools are used in the analysed material, all categories mentioned in *2 Theoretical background* can be found. The most common are tangible programming tools, which were mentioned in 11 of the 26 analysed materials. Followed by textual and block programming tools, which were mentioned in 7 of the 26 analysed materials each. Lastly, unplugged programming was mentioned in 3 of the 26 analysed materials. The reason for tangible programming tools being the most common in the material could be the approach to programming as part of the outside world. As stated in previous research, the connection to collaboration, active learning, exploration, creation, sound and motion in tangible programming could provide an engaging and attractive entrance to programming for students (Rusk et al., 2008; Horn, Crouser & Bers, 2012; Garneli, Giannakos & Chorianopoulos, 2015; Rubio et al., 2015).

Textual and block programming tools have a greater focus on being used as tools for other subjects in the materials, which differentiates them from unplugged and tangible programming tools. Textual programming tools are primarily centred around performing complex calculations and learning programming with older students, while a more versatile and interdisciplinary use can be found in the materials on block programming tools. The difference could be explained by the programming tools history and development, where textual programming tools often are described as authentic and professional tools (Erwig & Meyer, 1995; Garneli, Giannakos & Chorianopoulos, 2015). Block programming tools does not have the same relationship to professional development, but are primarily used in educational settings. This can explain the more versatile use of block programming tools in the materials, which is also noted as one of the strengths with block programming in previous research (Maloney et al., 2010; Brennan & Resnick, 2012; Topalli & Cagiltay, 2018).

Regarding the programming tools relation to school subjects and student grade, the most common relationships are to mathematics (17 of 26) and technology (15 of 26); and the second (9 of 26) and third (10 of 26) grade. The relationship to school subjects, this is in line with the integration in Swedish K-12 education where the curriculum has specific mentions of programming in the subjects of mathematics and technology (Heintz et al., 2017). The clearest relationship to student grades can be found between textual programming tools and the upper grades, while the other programming tools have a more scattered distribution. This might not be that surprising since previous research has stated that textual programming tools' high threshold and connection to professional development could make them more suitable for older students (Erwig & Meyer, 1995; Garneli, Giannakos & Chorianopoulos, 2015; Lindberg, Laine & Haaranen, 2019).

6. Conclusion

This study has shown that there is a possibility for a variety of programming tools to be used in K-12 education; and that there are potential relationships between different types of programming tools, student grades and school subjects. This can be drawn upon by teachers and other stakeholders in the decision on what programming tools to be integrated in classroom practice, and how they are to be used. The study indicates that block programming tools and tangible programming tools are appropriate to use in activities and school subjects, in most student grades, where emphasis is put on controlling an object. For example, the subject of technology, or visualising an aspect of a school subject through the controlling of an object, for example storytelling and mathematics.

The results of the study further indicate that textual programming tools are the most specialised among the four types of programming tools, in regard to use, student grades and school subjects. This makes the textual programming tools appropriate for activities that are centred on the programming practice, for example programming visualisations of geometry or conducting mathematical calculations. Since textual programming tools have well established higher threshold for novice programmers, it could also be appropriate to use these tools with students and in settings where these difficulties can be addressed. The high threshold of textual programming tools could also, potentially, be reduced by combining the tools with an unplugged programming introduction. Since unplugged programming have a focus on giving clear instructions (without the use of a computer), this could make the students better prepared for the more complex textual programming tools.

7. Limitations and future research

Although a structured design was used in this study, there are limitations. The main limitation is the number of included teaching and learning materials in the study. This is especially obvious in the category of unplugged programming. Future research should focus on widen and deepen the analysis of which programming tools are used and how they are used in K-12 education. This could be done through an aggregated use of multiple sources for gathering teaching and learning materials. It could also be done by combining the research with other methods for data collection, such as interviews and classroom observations.

References

AlAmer, R. A., Al-Doweesh, W. A., Al-Khalifa, H. S., & Al-Razgan, M. S. (2015, October). Programming unplugged: bridging CS unplugged activities gap for learning key programming concepts. In *2015 Fifth International Conference on e-Learning (econf)* (pp. 97-103). IEEE.

Aranda, G., & Ferguson, J. P. (2018). Unplugged Programming: The future of teaching computational thinking. *Pedagogika*, *68*(3), 279-292.

Balanskat, A., & Engelhardt, K. (2015). Computing our future: Computer programming and coding. *Priorities, school curricula and initiatives across Europe: European Schoolnet (EUN Partnership AIBSL), Brussels, Belgium*.

Bell, T., & Vahrenhold, J. (2018). CS Unplugged—How Is It Used, and Does It Work?. In *Adventures Between Lower Bounds and Higher Altitudes* (pp. 497-521). Springer, Cham.

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative research journal*, *9*(2), 27.

Brackmann, C. P., Román-González, M., Robles, G., Moreno-León, J., Casali, A., & Barone, D. (2017, November). Development of computational thinking skills through unplugged activities in primary school. In *Proceedings of the 12th Workshop on Primary and Secondary Computing Education* (pp. 65-72).

Brennan, K., & Resnick, M. (2012, April). New frameworks for studying and assessing the development of computational thinking. In *Proceedings of the 2012 annual meeting of the American educational research association, Vancouver, Canada* (Vol. 1, p. 25).

Bryman, A. (2016). *Social research methods*. Oxford university press.

Chen, C., Haduong, P., Brennan, K., Sonnert, G., & Sadler, P. (2019). The effects of first programming language on college students' computing attitude and achievement: a comparison of graphical and textual languages. *Computer Science Education*, *29*(1), 23-48.

Costa, J. M., & Miranda, G. L. (2017). Relation between Alice software and programming learning: A systematic review of the literature and meta-analysis. *British Journal of Educational Technology*, *48*(6), 1464-1474.

Durak, H. Y. (2020). The effects of using different tools in programming teaching of secondary school students on engagement, computational thinking and reflective thinking skills for problem solving. *Technology, Knowledge and Learning*, *25*(1), 179-195.

Enders, T., Hediger, V., Hieronimus, S., Kirchherr, J. W., Klier, J., Schubert, J., & Winde, M. (2019). Future Skills: Six Approaches to Close the Skill Gap. *World Government Summit*.

Erwig, M., & Meyer, B. (1995, September). Heterogeneous visual languages-integrating visual and textual programming. In *Proceedings of Symposium on Visual Languages* (pp. 318-325). IEEE.

Falkner, K., Vivian, R., & Williams, S. A. (2018). An ecosystem approach to teacher professional development within computer science. *Computer Science Education*, *28*(4), 303-344.

Feaster, Y., Segars, L., Wahba, S. K., & Hallstrom, J. O. (2011, June). Teaching CS unplugged in the high school (with limited success). In *Proceedings of the 16th annual joint conference on Innovation and technology in computer science education* (pp. 248-252).

Garneli, V., Giannakos, M. N., & Chorianopoulos, K. (2015, March). Computing education in K-12 schools: A review of the literature. In *2015 IEEE Global Engineering Education Conference (EDUCON)* (pp. 543-551). IEEE.

Hamilton, M., Clarke-Midura, J., Shumway, J. F., & Lee, V. R. (2020). An Emerging Technology Report on Computational Toys in Early Childhood. *Technology, Knowledge and Learning*, *25*(1), 213-224.

Heintz, F., Mannila, L., Nordén, L. Å., Parnes, P., & Regnell, B. (2017, November). Introducing programming and digital competence in Swedish K-9 education. In *International Conference on Informatics in Schools: Situation, Evolution, and Perspectives* (pp. 117-128). Springer, Cham.

Horn, M. S., & Jacob, R. J. (2007, February). Designing tangible programming languages for classroom use. In *Proceedings of the 1st international conference on Tangible and embedded interaction* (pp. 159-162).

Horn, M. S., Crouser, R. J., & Bers, M. U. (2012). Tangible interaction and learning: the case for a hybrid approach. *Personal and Ubiquitous Computing*, *16*(4), 379-389.

Humble, N., Mozelius, P., & Sällvin, L. (2020). Remaking and reinforcing mathematics and technology with programming–teacher perceptions of challenges, opportunities and tools in K-12 settings. *The International Journal of Information and Learning Technology*.

Kong, S. C., Chiu, M. M., & Lai, M. (2018). A study of primary school students' interest, collaboration attitude, and programming empowerment in computational thinking education. *Computers & Education*, *127*, 178-189.

Lindberg, R. S., Laine, T. H., & Haaranen, L. (2019). Gamifying programming education in K-12: A review of programming curricula in seven countries and programming games. *British Journal of Educational Technology*, *50*(4), 1979-1995.

Maloney, J., Resnick, M., Rusk, N., Silverman, B., & Eastmond, E. (2010). The scratch programming language and environment. *ACM Transactions on Computing Education (TOCE)*, *10*(4), 1-15.

Manches, A., & Plowman, L. (2017). Computing education in children's early years: A call for debate. *British Journal of Educational Technology*, *48*(1), 191-201.

Meerbaum-Salant, O., Armoni, M., & Ben-Ari, M. (2013). Learning computer science concepts with scratch. *Computer Science Education*, *23*(3), 239-264.

Rubio, M. A., Romero-Zaliz, R., Mañoso, C., & Angel, P. (2015). Closing the gender gap in an introductory programming course. *Computers & Education*, *82*, 409-420.

Rusk, N., Resnick, M., Berg, R., & Pezalla-Granlund, M. (2008). New pathways into robotics: Strategies for broadening participation. *Journal of Science Education and Technology*, *17*(1), 59-69.

Sáez-López, J. M., Román-González, M., & Vázquez-Cano, E. (2016). Visual programming languages integrated across the curriculum in elementary school: A two year case study using "Scratch" in five schools. *Computers & Education*, *97*, 129-141.

Tondeur, J., Van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: a systematic review of qualitative evidence. *Educational Technology Research and Development*, *65*(3), 555-575.

Topalli, D., & Cagiltay, N. E. (2018). Improving programming skills in engineering education through problem-based game projects with Scratch. *Computers & Education*, *120*, 64-74.

Tsarava, K., Moeller, K., & Ninaus, M. (2018). Training computational thinking through board games: The case of Crabs & Turtles. *International Journal of Serious Games*, *5*(2), 25-44.

Tsukamoto, H., Takemura, Y., Nagumo, H., Ikeda, I., Monden, A., & Matsumoto, K. I. (2015, October). Programming education for primary school children using a textual programming language. In *2015 IEEE Frontiers in Education Conference (FIE)* (pp. 1-7). IEEE.

Weintrop, D., & Wilensky, U. (2019). Transitioning from introductory block-based and text-based environments to professional programming languages in high school computer science classrooms. *Computers & Education*, *142*, 103646.

Wohl, B., Porter, B., & Clinch, S. (2015, November). Teaching Computer Science to 5-7 year-olds: An initial study with Scratch, Cubelets and unplugged computing. In *Proceedings of the Workshop in Primary and Secondary Computing Education* (pp. 55-60).

Wyffels, F., Martens, B., & Lemmens, S. (2014, November). Starting from scratch: Experimenting with computer science in flemish secondary education. In *Proceedings of the 9th Workshop in Primary and Secondary Computing Education* (pp. 12-15).

Yadav, A., Gretter, S., Hambrusch, S., & Sands, P. (2016). Expanding computer science education in schools: understanding teacher experiences and challenges. *Computer Science Education*, *26*(4), 235-254.

Yukselturk, E., & Altiok, S. (2017). An investigation of the effects of programming with Scratch on the preservice IT teachers' self-efficacy perceptions and attitudes towards computer programming. *British Journal of Educational Technology*, *48*(3), 789-801.

Zhang, L., & Nouri, J. (2019). A systematic review of learning computational thinking through Scratch in K-9. *Computers & Education*, *141*, 103607.

Utilization of Remote Access and Distance Control Technology for the Management of Virtual Classrooms, During the Covid-19 Pandemic, in Vocational Education and Training (VET) Specialties' Laboratories

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DOI: 10.34190/EEL.21.072

Abstract: Teaching in an electronics computer lab in a Vocational Education and Training (VET) environment, regardless of the subject matter, is a very demanding task, since it includes in addition to teaching, the individual support of each student or group of students per computer, the proper monitoring of the learning process, and the necessary demonstration of techniques or procedures to perform a task. The new reality of distance education during the covid-19 pandemic period, in addition to the above, requires a lot of changes in the structure, form, and content of teaching. On the one hand, the direct control of the course flow and on the other hand, the control of the virtual classroom in all phases of teaching, including the assessment process of the students. In this article, we focus on the use of Remote Access Technology (RAT) for the management of virtual laboratories in the context of distance education for the laboratories of the courses of Informatics and Electronics. The use of RAT in distance education enables teachers to a) directly manage the virtual classroom, b) provide immediate support for their distance learning students, c) have real-time instant feedback from the virtual classroom, d) receive the necessary snapshots of their virtual classroom in real-time, e) be able to supervise their progress exams, and f) to perform their educational work with relative completeness. To test the capabilities of RAT, we integrated a remote-control tool into the imposed due to Covid-19 Distance Learning circumstances and organized instructional scenarios for its implementation. Through virtual classrooms, we utilized the tool of remote support of teaching in distance learning circumstances for vocational specialties. A key direction of the research was to determine whether the process of remote control of virtual classrooms through Distance Learning provides opportunities for self-regulated learning and motivates students for effective Learning. The effectiveness of this technology was investigated through the observation of virtual classrooms, through the correction processes of the original design and retrieval of control, and finally, using weighted questionnaires. Through the graded questionnaires of the intermediate and final evaluation, we tested the efficiency, usability, and pedagogical usefulness of the method in a distance laboratory. The additional benefits for students are related to cognitive and metacognitive skills from the use of advanced teaching methods.

Keywords: distance education, virtual classroom management, remote access technology

1. Introduction

The problem of educational support has been prevalent in the field of open and distance education in the last years, as it has become clear that its successful integration into the educational landscape of the 21st century depends to a large extent on how educational institutions recognize and support the special needs of the heterogeneous groups of students they are asked to serve (Fletcher 2018). Since the beginning of the last decade, the issue of quality student support, especially in an age of highly sophisticated technical skills, has preoccupied leading theorists in the field of distance education. In these studies, we can look for data related to the definition of support in the earlier stages of the development of open and distance education, especially in Europe, and the transformations that the idea has undergone over time and theoretical and technological progress. The current literature highlights the current nature of this problem and contains various references to the relevant research activity of recent years, which considers the students' support as an important aspect of modern open and distance education (Simonson, Zvacek and Smaldino 2019). Recent works in distance learning magazines (Peters 2020) underlined the urgency of the debate in support of open and distance education and the enormous importance of developing theoretical models and applied tools on a case-by-case basis.

The COVID-19 coronavirus pandemic has created unprecedented pressure on all the education systems, obliging them to apply emergency distance education as a methodological tool for teaching, psycho-emotional communication, and student-teacher interaction. Given that the discussion on the emergence of good practices in the context of distance learning (Shamir-Inbal and Blau 2021). This paper investigates the effectiveness of good practices of direct support of students during distance education in computer science and electronics courses. Moreover, this paper investigates the pedagogical effectiveness of Remote Access Technology (RAT) in support of the educational process in laboratory lessons; RAT is utilized as a good practice for the direct support of the students (Huang 2019). The article presents and records the experiences, concerns, and suggestions of the trainees who participated in distance learning courses during the pandemic. The hypothesis of this study is the following: whether the RAT and specifically the free software LiteManager offers direct support to the remote guidance and supervision of students (Yang, et al. 2018). In the context of distance education, we also explore the usability and learning benefits that result from the use of the free LiteManager software in modern distance education (Petrenko, et al. 2020) during the covid-19 pandemic period.

The RAT technology is been examined for the usefulness of supporting the teaching of laboratory courses related to the specialties of VET (Köpsén 2020), especially when the training takes place outside the laboratory and immediate feedback from students is necessary (Telegin, Telegin and Kirichek 2019). In periods of regularity, teaching in computer labs requires immediate feedback to and from students and their guidance by the specialty teacher. This need becomes even greater during the distance education period when we use the RAT technology to offer immediate support to our students. The questions, which were tested with appropriate questionnaires, explored the technological and learning benefits arising from the educational utilization of this technology. The collection of empirical research material was made using electronic questionnaires in which respondents are students who were taught using this technology in the application of modern distance education.

In this paper, we explore as a good practice the application of remote access technology for the remote support of students during their participation in distance education. This study was conducted during the pandemic period in students who were taught computer and electronics courses and had a laboratory orientation. The target population of the research is the students of the Electronics department of the Vocational School in Perama, Piraeus, the junior high school of Paradissi, in Rhodes, as well as trainees in Vocational Adult Training Institutes in the region of Attica, who were trained using RAT technology. Learners who used the RAT were asked to complete a similar online questionnaire (Krosnick 2018).

In the next parts of the paper, we present a theoretical panorama about our subject, and then we present LiteManager as a distance education tool. Moreover, we present a case study with a Telecommunications lesson of the Specialty of Electronics. Outcomes and the collection of research data methodology follow and, at the end Conclusions and future work are highlighted.

2. Theoretical panorama

Teaching in a computer lab is a very demanding task that includes in addition to teaching, the individual support of each student or group of students per computer, the monitoring of their progress, and the necessary demonstration of techniques or procedures to perform a task. Unfortunately, the lack of proper equipment, such as a video projector, and often the poor layout of the classrooms due to lack of space, where the teacher cannot have visual contact with the screens of all the students, complicates the educational work of the teacher. In addition, the effort to attract the attention and participation of students is often pedagogically fruitless. Teaching courses in the computer lab is a very tedious process. The above problems make effective teaching difficult when the student classes are numerous and there is only one teacher in the computer lab. It is even more difficult to attract the student's attention to the educational process when it has in front of it a computer that also allows it to see its favorite pages on the internet.

Teachers today are faced with the challenge and the opportunity to use technology to teach. Computers are amazing educational tools, but they can also be a distraction from learning. The internet, instant messaging, emails, and games are a constant temptation for students. A big issue for teachers is that computers can distract students from educational activities. A similar picture is also observed in the context of distance education in the respective virtual classrooms. In the e-learning process, quite often teachers are face problems and, in addition, do not have a direct picture of the work done by the trainees on their computer. In their effort to directly support students and in addition, to have an overall picture of their participation, teachers are looking for the tools that will meet this need. A good solution to these problems is offered by the applications that allow the management and supervision of the students' computers by the teacher. These applications are usually based on remote access technology and they provide teachers with a complete environment through which real-time operations can be achieved, such as:

- Remote control of the students' computers.
- Locking of the computers so students can watch the teacher.
- Watching every student's monitor simultaneously.
- Performing live teaching by displaying the teacher's screen on the students' PCs.
- Transferring of student screens to other students in real-time.
- Sending messages to everyone.
- Highlighting points on the students' screens with an electronic marker.
- Sending or receiving files to and from the students' computers.
- Performing applications remotely on the students' devices.
- Monitoring applications on students' devices to see what they do every time.
- Conveying speech and sound to students independently or all together when showing them a particular screen.

Remote desktop utilities are not only limited to technical support; they can be used in many different ways, such as for remotely accessing the devices under control and the files on them from wherever one is located, to server management, and many other uses. In any case, remote control of the computer needs a lot of attention if we give the right to someone we do not know and do not fully trust. Remote access technology has found applications in many human activities, including the teaching of laboratory courses where students will have to implement various educational exercises (Potkonjak, et al. 2016). The corresponding software offers functions useful for managing the educational process in groups of students.

There exist various commercial software programs that offer the above services such as

NetOp School (https://www.netop.com/vision/),
NetSupport (https://www.netsupportsoftware.com/),
AristoClass (https://www.kvm-switches-online.com/minicom-aristoclass.html),
LanSchool (https://lanschool.com/), etc.

These are provided for a cost. There also exist free applications for school laboratory supervision such as iTALC (http://italc.sourceforge.net/download.php), EPOPTES (https://epoptes.org/), VENYON (https://veyon.io/en/), and LiteManager (http://www.litemanager.com/).

3. LiteManager

As part of our research, we used the free version of LiteManager (Figure 1). LiteManager was used in distance education, in the context of mixed learning. With the use of asynchronous and synchronous distance learning, mainly in courses that are laboratory-oriented and in which students should acquire practical skills and technical knowledge. LIteManager is software for remote control of computers via the internet and remote management of computers in local and global networks, which includes additional management functions of teaching in an active computer lab. In remote access to the computer screen, one can remotely control the desktop with the mouse and keyboard in a resizable window. LiteManager in its distributed version can manage up to 30 computers. LiteManager provides teachers with an integrated interface through which they can achieve real-time functions such as:

- Monitoring/monitoring students' screens and the work they do from the teacher's computer.
- Taking snapshots from students' screens.
- Remote control of the students' computers from the teacher's computer.
- Sharing the teacher's screen on the students' computers to demonstrate a specific function.
- Sending messages to students' computers.
- Locking at the students' computers to check whether they focus on another activity.
- Mass deactivation or activation of all laboratory computers
- Remote execution of commands (from the teacher's computer) on all students' computers.

- Connection of students from their home through VPN (Virtual Private Network) connections.

LiteManager offers fast and secure access to computers in real-time operation and supports reliable TCP/IP connections over local or global networks (LAN, WAN). In addition, LiteManager offers a range of easy-to-use utilities required for network management, such as utilities that allow one to access a computer file system, manage services and processes, start programs remotely, turn off a computer, from a remote computer, lock a computer, edit the registry remotely as well as perform audio and video chat, inventory, log screen and more. LiteManager requires few system resources to run. It can also be optimized for operation on low-speed networks (based on EDGE, GPRS) due to the ability to work in economy mode. All data transmitted over the network is compressed and encrypted using secure encryption algorithms. Two security subsystems are available with the ability to assign permissions to each user: password protection and the Windows security system. LiteManager among other functions includes appropriate functions for managing teaching through the teacher functionality.

As a case study of a course in which RAT was used, we present the course of Telecommunications – Telematics of the Specialty of Electronics (Figure 2).

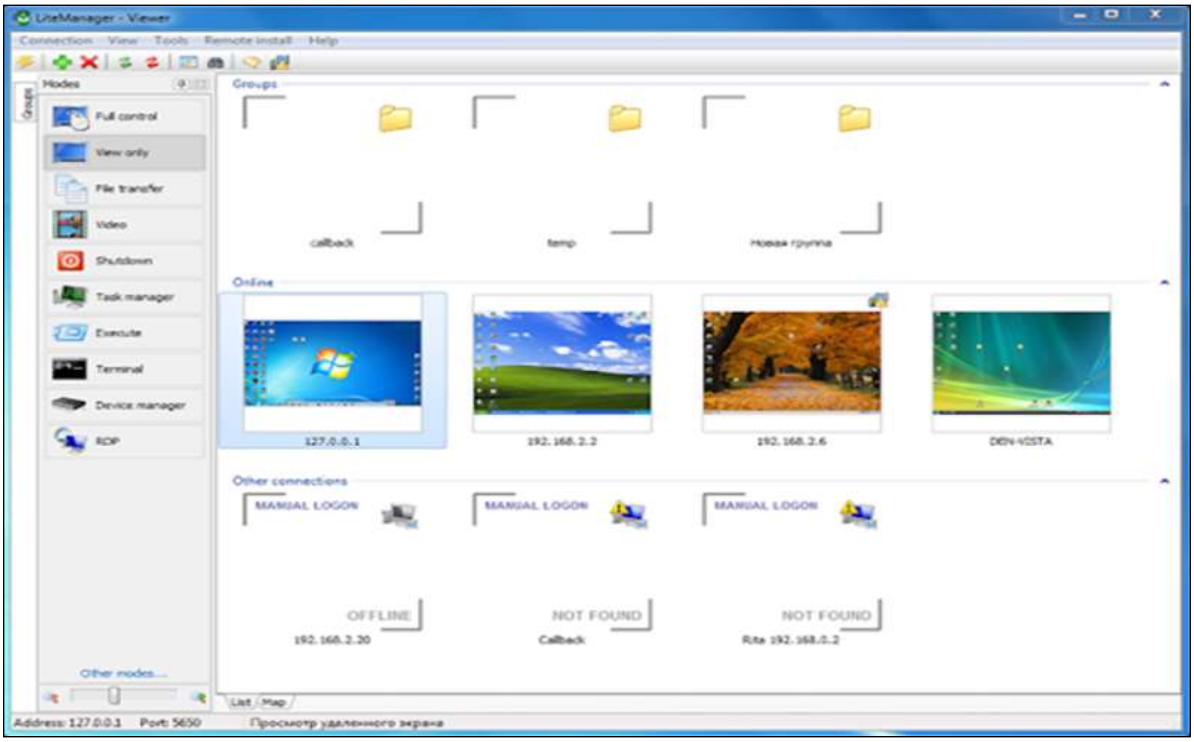


Figure 1: LiteManager

The purpose of the course is for the student to acquire all the necessary basic knowledge and skills related to telecommunications, telematics, wired and wireless data transmission, as well as the operation of the corresponding networks, systems, devices, and devices so that in combination with the rest of the infrastructure knowledge of the curriculum of the specialty, it can meet the requirements of the profession of the radio technician (radio technician), as they are determined by the existing legal provisions. This course is a continuation of the second part of the course "Introduction to Computer Systems and Communication Networks" of the 2nd grade, in the field of Electrical Engineering, Electronics and Automation.

The syllabus of the course is compatible with the certified professional outlines:

1. Installer - Maintenance of Telecommunication Systems for Homes and Small Offices (http://www.eoppep.gr/images/EP/EP_53.pdf)
2. Mobile Telecommunication Devices Technician (http://www.eoppep.gr/images/EP/EP87.pdf)
3. Telecommunications Technician (http://www.eoppep.gr/images/EP/EP_54.pdf)

The period in which the specific courses took place was during the lockdown in the academic years 2019 - 2020 and 2020-2021. About fifteen students per class and year participated in the 1st Vocational High School of

Perama. Students attended the lessons remotely, using both the asynchronous e-class platform and the Cisco WebEx platform. The teaching through the RAS software took place three to five hours of weekly lessons and involved the support of a laboratory exercise related to Telecommunications (Figure 3). After the end of the lessons, the students filled in online questionnaires.

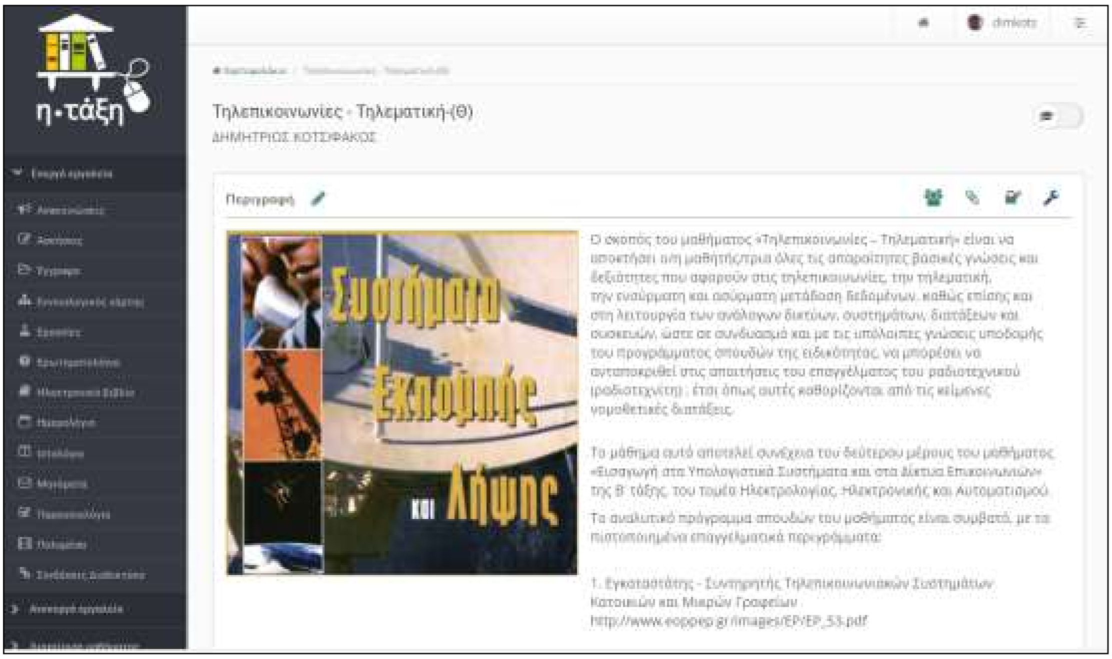


Figure 2: The course of telecommunications of the specialty of electronics

As a laboratory exercise, we worked on the Vehicle Network Integrated Simulator (VNetIntSim). VNetIntSim integrates transport models with Vehicular Ad Hoc Network (VANET) models. Specifically, we worked with the OPNET software, a communication network simulator. The support of the laboratory course was done with the Remote Access Software (RAS).

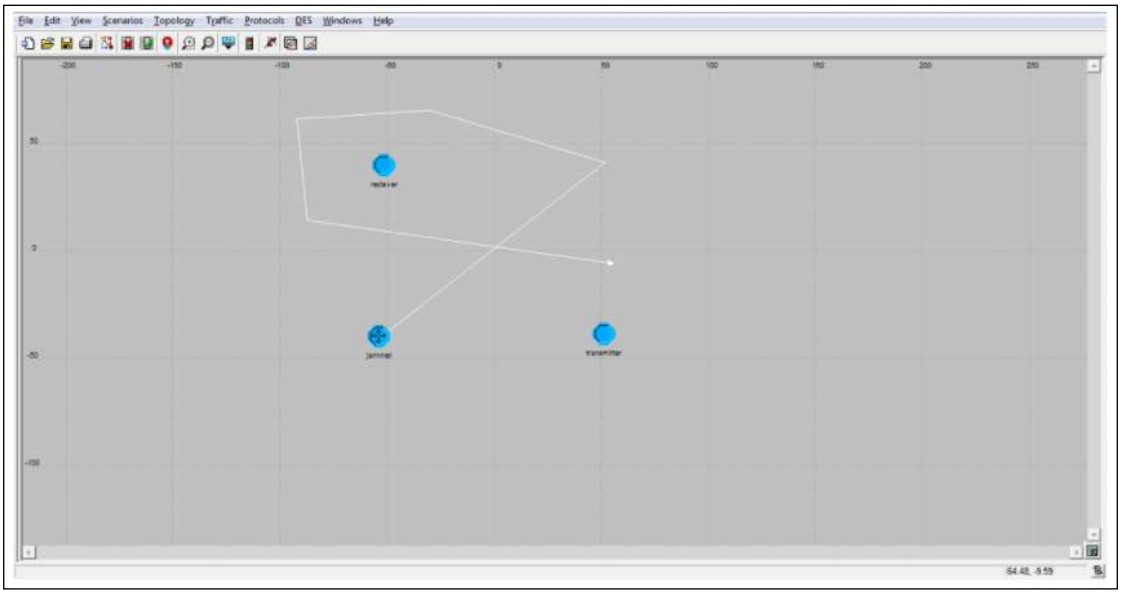


Figure 3: PNET NETWORK SIMULATOR (https://opnetprojects.com/opnet-network-simulator/)

4. Outcomes

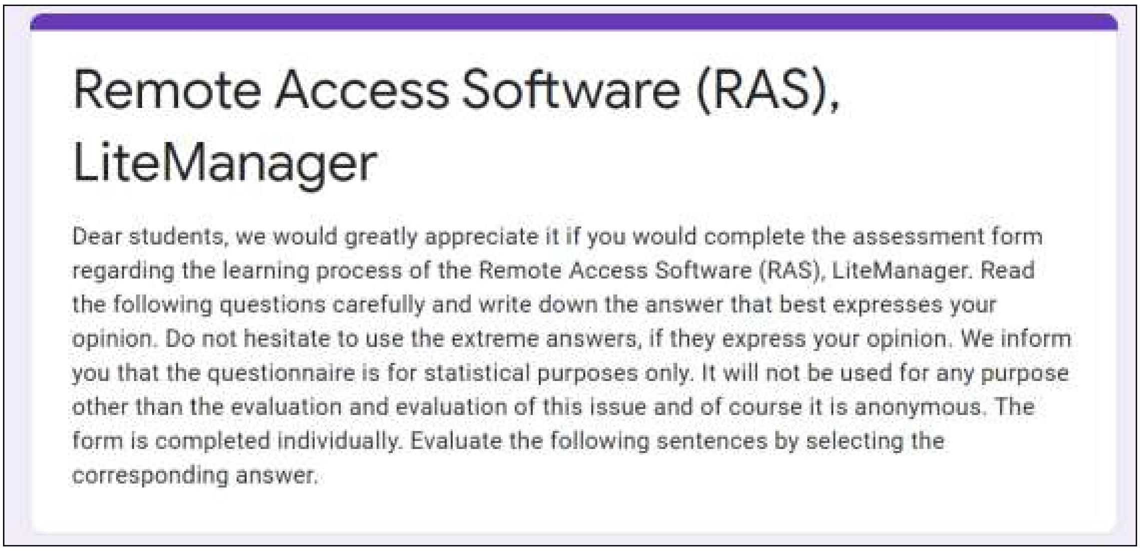
4.1 The collection of research data

New learning methods were organized for the virtual collaborative environments. Apart from the design of the course and the methodologies that were used, teachers also used some known tools to "control" the new reality of virtual labs. The crucial point of this research was that the "interactive" model "teacher-student-learning content" had to be organized remotely.

The questionnaires about RAS were distributed electronically, using the free drive.google.com (Google Forms) platform (https://tinyurl.com/57a83vhk), (figure 4). The evaluation method that was used for the outcomes of this study was based on four axes:

- a) the psychological-pedagogical parameters,
- b) the technical-functional parameters,
- c) the organizational-economic parameters, and,
- d) the social-cultural parameters (Barari, et al. 2020).

Teachers conducted and monitored all the learning activities, maintaining the interaction with the student at the same time. This interaction has to do at the first level the description-presentation of the lesson, and at the second level the reaction with the virtual world, to define the learning goals in each section. After the use of RAS software, students filled a questionnaire to record their experience from using RAS software. The outcomes of the processing of these questionnaires are presented in this paper (Elbery, Rakha and Y. ElNainay 2015)**.**



Remote Access Software (RAS), LiteManager

Dear students, we would greatly appreciate it if you would complete the assessment form regarding the learning process of the Remote Access Software (RAS), LiteManager. Read the following questions carefully and write down the answer that best expresses your opinion. Do not hesitate to use the extreme answers, if they express your opinion. We inform you that the questionnaire is for statistical purposes only. It will not be used for any purpose other than the evaluation and evaluation of this issue and of course it is anonymous. The form is completed individually. Evaluate the following sentences by selecting the corresponding answer.

Figure 4: The questionnaires of remote access software

4.2 Response distribution of RAS learning benefits (questions A1 – A3)

4.2.1 RAS learning benefits: Responses to questions A1 through A3

Table 1: Level of agreement: responses to questions A1-A3

	A1	A2	A3
1	0%	0%	0%
2	0%	0%	0%
3	0%	0%	0%
4	4%	4%	20%
5	24%	20%	24%
6	48%	52%	28%
7	24%	24%	28%
	100%	100%	100%

- **A1. The use of RAS has aroused my interest in the content of the study.**

This question had 96% positive responses by students and only 4% neutral responses. No negative response.

- **A2. The use of RAS supported me in completing my practical activities.**

This question had 96% positive responses by students and only 4% neutral responses. No negative response.

- **A3. By using RAS, I had direct support from my teacher.**

This question had 76% positive responses by students and only 20% neutral responses. No negative response.

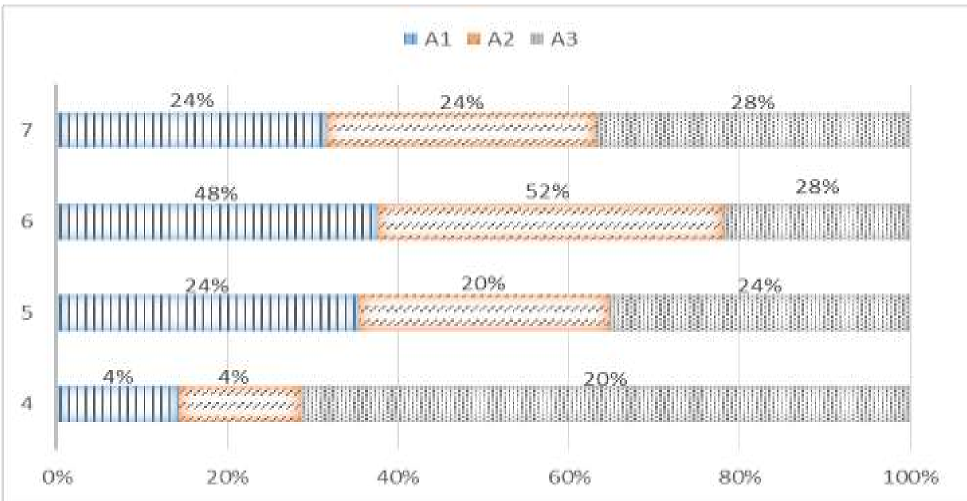


Figure 3: Responses to questions A1 through A3: Agreement with RAS learning benefits

4.2.2 Responses to questions B1 through B7: RAS usability

Table 2: Level of agreement: responses to questions B1-B7

	B1	B2	B3	B4	B5	B6	B7
1	0%	0%	40%	48%	0%	0%	52%
2	0%	0%	24%	36%	0%	0%	36%
3	0%	0%	12%	8%	0%	0%	4%
4	8%	8%	0%	0%	8%	12%	0%
5	20%	28%	12%	4%	28%	32%	4%
6	44%	32%	8%	4%	40%	28%	4%
7	28%	32%	4%	0%	24%	28%	0%
	100%	100%	100%	100%	100%	100%	100%

- **B1. The use of RAS has supported me in acquiring new knowledge and skills.**

This question had 92% positive responses by students and only 8% neutral responses. No negative responses.

- **B2. The use of RAS has expanded my technical knowledge and skills in the laboratory specialty courses.**

This question had 92% positive responses by students and only 8% neutral responses. No negative responses.

- **B3. By using RAS did not provide me with substantial support in distance education in specialty courses.**

A small percentage 24% of the students responded positively to this question and only a very large percentage 76% of the responses were negative. No neutral responses.

- **B4. I encountered many problems using the RAS.**

A small percentage 8% of the students responded positively to this question and only a very large percentage 92% of the responses were negative. No neutral responses.

- **B5. RAS is easy to use to support the educational process in distance education.**

A very large percentage 92% of the students responded positively to this question and only a small percentage 8% responded neutrally. There are no negative responses.

- **B6. The use of RAS during distance education supported me to deepen the content of the course.**

A very large percentage 88% of the students responded positively to this question and only a small percentage 12% responded neutrally. There are no negative responses.

- **B7. The experience of using RAS in the specialty courses was disappointing.**

A very large percentage 92% of the students responded positively to this question and only a small percentage 8% responded neutrally. There are no neutral responses.

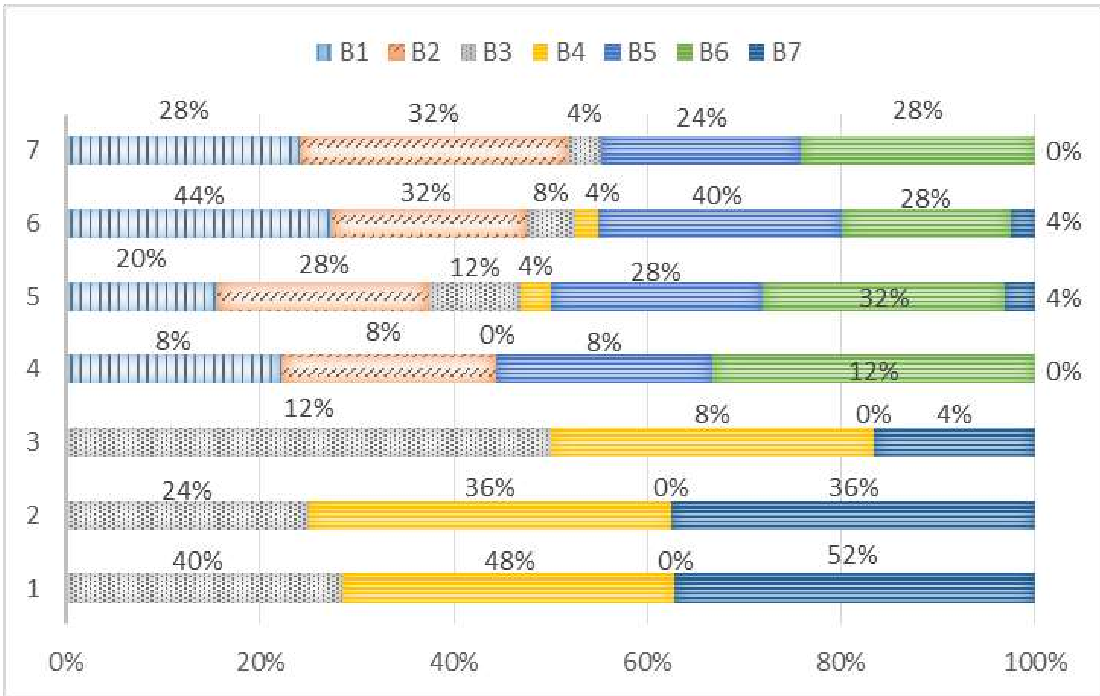


Figure 4: Responses to questions B1 through B7: Agreement with RAS usability

Table 3: Level of agreement: Responses to questions A1-B7

	A1. The use of Remote Access Software (RAS) has aroused my interest in the content of the study.	A2. The use of RAS supported me in completing my practical activities.	A3. By using RAS I had direct support from my teacher.	B1. The use of RAS has supported me in acquiring new knowledge and skills.	B2. The use of RAS has expanded my technical knowledge and skills in the laboratory specialty courses.	B3. By using RAS did not provide me with substantial support in distance education in specialty courses.	B4. I encountered many problems using the RAS.	B5. RAS is easy to use to support the educational process in distance education.	B6. The use of RAS during distance education supported me to deepen the content of the course.	B7. The experience of using RAS in the specialty courses was disappointing.
Mean	5,92	5,96	5,64	5,92	5,88	2,60	1,88	5,80	5,72	1,80
Std. Err of Mean	,162	,158	,223	,182	,194	,383	,254	,183	,204	,252
Median	6,00	6,00	6,00	6,00	6,00	2,00	2,00	6,00	6,00	1,00
Mode	6	6	6[a]	6	6[a]	1	1	6	5	1
Std. Deviation	,812	,790	1,114	,909	,971	1,915	1,269	,913	1,021	1,258
Variance	,660	,623	1,240	,827	,943	3,667	1,610	,833	1,043	1,583
Skewness	-,354	-,479	-,187	-,556	-,336	1,053	2,105	-,286	-,145	2,319
Std.Err Skewness	,464	,464	,464	,464	,464	,464	,464	,464	,464	,464
Kurtosis	-,214	,170	-1,283	-,260	-,903	-,198	4,705	-,616	-1,092	5,626
Std.Err Kurtosis	,902	,902	,902	,902	,902	,902	,902	,902	,902	,902
Range	3	3	3	3	3	6	5	3	3	5
Minimum	4	4	4	4	4	1	1	4	4	1
Maximum	7	7	7	7	7	7	6	7	7	6
Percentiles **25**	5,00	5,50	5,00	5,00	5,00	1,00	1,00	5,00	5,00	1,00
50	6,00	6,00	6,00	6,00	6,00	2,00	2,00	6,00	6,00	1,00
75	6,50	6,50	7,00	7,00	7,00	4,00	2,00	6,50	7,00	2,00
a. Multiple modes exist. The smallest value is shown										

5. Conclusions and future work

In this article, we focused on RAS and presented the organization of laboratory lessons of the Electronics Engineering Lab. The students completed the appropriate online questionnaire in which they evaluated the usefulness and pedagogical contribution of remote support technology through LiteManager. During the investigation we found that the use of distance access technology in distance education enables teachers to manage the virtual classroom (Chandrashekar A., C.Nagar and Guruprasad 2019), to provide immediate support to their distance learning students, to have real-time instant feedback in the virtual classroom (Polat and Ekren 2020), to receive real-time time the necessary snapshots of their virtual classroom, to be able to supervise their progress exams and in general, to perform their educational work with relative completeness. In addition, we found that the additional benefits for students concern cognitive and metacognitive skills from the use of advanced teaching methods. We explored the possibilities of remote access technology and through virtual classrooms, we used the remote support of distance learning education. The results of our research showed that RAT provides opportunities for self-regulatory knowledge and motivates students to learn effectively. Also, RAT cannot work in all types of laboratory courses; also, should not work in all phases of the class. Finally, with the weighted questionnaires that we distributed to the students, we found out the degree of effectiveness, the usefulness, and the pedagogical usefulness of distance education for the laboratory courses. The use of RAT was made exclusively for the teaching of laboratory-oriented courses. Future work will be to investigate the effectiveness of this technology and the ability to use this technology in other laboratory classes.

Acknowledgements

This work has been partially supported by UPRC (University of Piraeus Research Center) and by COSMOTE through a PEDION24 grant.

References

Barari, N., M. RezaeiZadeh, A. Khorasani, and F. Alami. Designing and validating educational standards for E-teaching in virtual learning environments (VLEs), based on revised Bloom's taxonomy. Interactive Learning Environments, 2020.

Chandrashekar A., V. S. C.Nagar, and K. Guruprasad. "A Skill Enhancement Virtual Training Model for Additive Manufacturing Technologies." International Conference on Remote Engineering and Virtual Instrumentation. Springer, Cham, 2019. 532-543.

Elbery, A., H. Rakha, and M. & Hoque, M. Y. ElNainay. "VNetIntSim - An Integrated Simulation Platform to Model Transportation and Communication Networks." 1st International Conference on Vehicle Technology and Intelligent Transport Systems - VEHITS. 2015. 133-143.

Fletcher, J. M., Lyon, G. R., Fuchs, L. S., & Barnes, M. A. Learning disabilities: From identification to intervention. Guilford Publications, 2018.

Huang, T. C. "Do different learning styles make a difference when it comes to creativity? An empirical study." Computers in Human Behavior, 2019: 252-257.

Köpsén, J. "Demands-based and employer-driven curricula: defining knowledge in higher vocational education and training." Studies in Continuing Education, 2020: 349-364.

Krosnick, J. A. Questionnaire design. In The Palgrave handbook of survey research. Palgrave Macmillan, Cham., 2018.

Peters, O. "Distance teaching and industrial production: A comparative interpretation in outline." Distance education: International perspectives, 2020: 95-113.

Petrenko, L., S. Kravets, O. Bazeliuk, L. Maiboroda, and I. Muzyka. "Analysis of the current state of distance learning in the vocational education and training institutions." E3S Web of Conferences, 2020: 10010.

Polat, Z., and N. Ekren. "Remote laboratory trends for Distance Vocational Education and Training (D-VET): A real-time lighting application." The International Journal of Electrical Engineering & Education, 2020.

Potkonjak, V., et al. "Virtual laboratories for education in science, technology, and engineering: A review." Computers & Education, 2016: 309-327.

Shamir-Inbal, T., and I. Blau. "Facilitating Emergency Remote K-12 Teaching in Computing-Enhanced Virtual Learning Environments During COVID-19 Pandemic-Blessing or Curse?" Journal of Educational Computing Research, 2021.

Simonson, M., S. M. Zvacek, and S. Smaldino. Teaching and Learning at a Distance: Foundations of Distance Education. 7th Edition. Charlotte, North Carolina, USA: Information Age Publishing, Inc, 2019.

Telegin, V. V., I. V. Telegin, and A. V. Kirichek. "Solid-state modeling and basic training of specialists in the field of mechanical engineering. ." IOP Conference Series: Materials Science and Engineering, 3 2019: 012004.

Yang, G., B. Y. Yu, S. M. Kim, and C. Yoo. "LiteVisor: A network hypervisor to support flow aggregation and seamless network reconfiguration for VM migration in virtualized software-defined networks." IEEE Access, 2018: 65945-65959

Towards a Framework for Teaching Secure Coding Practices to Programming Students

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DOI: 10.34190/EEl.21.048

Abstract: Internet presence in modern enterprises and government departments has led to the economy relying heavily on software applications in many sectors. This heavy reliance on software applications has increased the amount of sensitive information stored online, which has contributed to the growth of cyber-attacks posed to software application vulnerabilities. Exploits to these vulnerabilities have led to severe financial losses and has left these organisations with a bad reputation. The major cause of these software vulnerabilities is contributed to programmers' lack of the requisite knowledge relating to secure coding practices. These secure coding practices can be taught to programming students at universities, however, many programming lecturers also lack the knowledge relating to these secure coding practices, and how these can be integrated without adding more load to the lecturers and the students. This results to students not being taught these secure coding practices. This paper proposes a framework for teaching secure coding practices to programming students to help ensure an increase in knowledge and an improved adherence to secure coding practices. The proposed framework is based on experiences and lessons learnt at a South African university.

Keywords: secure coding knowledge, online learning, security behaviour

1. Introduction

The increase in the use of software applications in daily lives has raised the number of enrolments in universities for students wanting to study information technology related courses. With this increase, a number of educational standards needs to be held in order to produce graduates who are able to build these software applications (Chen, Hsu and Huang, 2016).

This increase in software applications raises the number of attacks these software applications are exposed to, with web applications more prevalent to attacks since they can be access anywhere with an internet connection (The Acunetix Team, 2019). Attacks posed on vulnerabilities existing in web applications may result from are programmers' lack of secure coding knowledge or non-adherence to secure coding practices. This lack of knowledge or adherence can be addressed by educating programming students and monitoring their adherence relating to secure coding practices (Mdunyelwa, Futcher and van Niekerk, 2019). While teaching programming is not an easy task, including secure coding practices would require an effective educational approach that covers both programming concepts and secure coding practices (Ardis *et al.*, 2015). A further challenge in the educational sector was raised in the wake of the Corona Virus (COVID-19) pandemic, which is a global public health emergency (Kar *et al.*, 2020). COVID-19, which spreads by being in contact with persons affected by the virus and has led to governments in countries to prohibit gatherings, or at least allow a limited number of people to gather (Department of Basic Education, 2020). Such prohibited gatherings include the traditional classroom teaching. Therefore, one-way teaching and learning can continue is via online learning, using a learning management system and a variety of technological devices (Florian and Zimmerman, 2015). In order for these educational approaches to be effective, they need to be designed and delivered in a sound pedagogical manner, such as brain-compatible principles (van Niekerk and Webb, 2016). The research presented in this paper was conducted before the COVID-19 pandemic, but with the presence of the COVID-19 pandemic, it is evident that approaches that will be effective for learning and teaching should be online learning.

This paper therefore seeks to address this problem by proposing a framework for teaching secure coding practices to programming students through an online learning approach. The context of the framework is in web applications' data access layer, developed in the .NET environment.

The next section presents the related literature relating to software applications, web applications, secure coding practices, and brain-compatible educational principles which provides the theoretical grounding of the proposed framework. This is followed by a discussion of the research methodology in Section 3 and the research context in Section 4. The over-arching research approach is addressed in Section 5. Section 6 highlights the key elements of the proposed framework whilst 7 concludes the paper and Section 8 highlights the ethical considerations of this study.

2. Literature review

Much of the world's information is accessed through software applications. This includes business and government information which is of critical importance. Securing such information has become one of the largest challenges of modern day (Chen, Hsu and Huang, 2016). It is critical that this information be stored safely as most organisations are reliant more on software applications and their ability to perform in a safe and secure manner (Saeli *et al.*, 2011). It is thus important for higher education institutions to graduate Information Technology (IT) professionals who regard the importance of security and the steps necessary for them to keep information secure in computer systems (Meng, 2018). Whilst this need exists, various organisations providing security analysis on software applications continue to indicate the same software applications vulnerabilities (Li, 2017).

2.1 Software applications

Information technology resources stem from the existence of two basic categories, namely hardware and software, where each includes multiple subcategories (White, 2016).

Software applications run on multiple platforms, including desktop, web and mobile, and typically provide functionality that is used by end users. It is the programmers' role to develop these applications to help end users achieve their goals. In this way, software applications assist end users in achieving their goals of what they are *supposed to do*. However, often programmers do not anticipate what these software applications *can be made to do* (White, 2016).

While thinking of what a software application *can be made to do i*s often an attacker's mentality, it is important that programmers adopt this mentality in order to address this through adopting secure coding practices (The Acunetix Team, 2019). The number of successful attacks posed on software applications indicate that programmers do not include secure coding practices as one of their objectives when developing software applications (Bishop *et al.*, 2017). Such secure coding practices are well-documented (Mdunyelwa, Van Niekerk and Futcher, 2017). These secure coding practices are effective, yet simple, making them easy for programmers to adopt. An example of a well-known software vulnerability caused by an ignorance of such basic secure coding practices is SQL injection (OWASP, 2017). SQL injection primarily result from a lack of input validation. SQL statements contained in the malicious input can be used to manipulate the underlying application database, resulting in unauthorised access to information resources (The Acunetix Team, 2019). This can be solved if programmers had followed basic secure coding practices for countering that vulnerability when developing their applications (Meng, 2018). Web applications are considered the most standard platform for representing data (Whitney, 2019). This exposes web applications to many risks since they can be accessed anywhere with an internet connection (White, 2016). Whilst secure coding practices for web applications can overlap with those for mobile or desktop applications, some are specific to the programming environments which web applications are developed on.

2.2 Secure coding practices

To develop secure web-based applications, developers must first understand the threats posed to such web-based applications (The Acunetix Team, 2019). In general, developers need to be aware of threats that is specific to their target platform and their chosen development environments. Currently, there is no single definitive list of security vulnerabilities applicable to all web applications. Additionally, application software at most organisations have their own set of unique security issues (Synopsis Editorial Team, 2019). Despite these challenges, organisations such as the Open Web Application Security Project (OWASP), SysAdmin, Audit, Network and Security / Common Weakness Enumeration (SANS/CWE), and Microsoft Developer Network (MSDN) describe various high-risks and weaknesses in a variety of publications. These organisations provide secure coding knowledge to organisations wanting to improve their programmer's security knowledge. They also provide vulnerability lists for different software applications (Mobile, Web, and Desktop), across various development environments (C#, Java, C++ etc). Each vulnerability in these vulnerability lists can be addressed by one or more secure coding practices. The secure coding practices used for this research were selected from OWASP.

These secure coding practices are for addressing vulnerabilities in the data access layer, for web applications developed in the .NET environment as shown in Table 1. The secure coding practices presented in Table 1 are basic secure coding practices for countering vulnerabilities in the data access layer of web applications in the .NET environment, and were taught to third year programming students. Most of these secure coding practices are addressed in some .NET frameworks, such as the entity framework. However, the students that this educational framework was implemented with, were working on basic asp.net web forms, where they would not be enabled to have access to the entity framework. Also, the security considerations in the entity framework are similar to the secure coding practices presented in Table 1 (White, 2016), hence these secure coding practices were identified as being important when teaching programming students.

Table 1: Secure coding practices. Adapted from OWASP (2017)

SP	Secure Coding Practices
SP1	Use Parameterised SQL commands for all data access, without exception.
SP2	Do not use SQL command with a string made up of a concatenated SQL string.
SP3	Properly validate input fields.
SP4	Apply the Principle of Least Privilege when setting up the database of your choice.
SP5	When using SQL Server, prefer integrated authentication over SQL authentication.
SP6	Using stored procedures is the most effective way to counter the SQL injection vulnerability.
SP7	Encrypt sensitive data in the database including connection strings.
SP8	Connection strings should be based in a configuration file.
SP9	Never write your own encryption.

Some researchers recommend that teaching secure coding practices would be more effective if done in introductory programming (Mdunyelwa, Van Niekerk and Futcher, 2017). It may be challenging to introduce secure coding practices at advanced programming classes, since students may be used to their old programming habits learnt in previous programming classes.

In order for these secure coding practices to be delivered effectively, they should be designed and presented according to brain-compatible educational principles (van Niekerk and Webb, 2016).

2.3 Brain-compatible educational principles

In response to the pressures created by increasing student numbers, and recently to the COVID-19 pandemic, many higher education institutions have turned to online learning courses to alleviate pressure. This adds a further challenge since many lecturers lack knowledge regarding the best ways to deliver content or facilitate learning through this medium (Clemons, 2005). One way to address this problem is through adhering to proven educational principles. Brain-compatible educational principles has been shown to be effective in the design of online learning (van Niekerk and Webb, 2016). These principles promote a learning approach that is centred on the student and that assures an effective, and lasting, learning process (Tufekci and Demirel, 2009). The use of brain-compatible principles can assist teachers in moving away from a traditional classroom-based approach by providing an alternative framework for learning and teaching (Caine and Caine, 1990). These principles provide a general understanding of the theoretical foundation for brain-compatible education (Caine and Caine, 1990). There is currently no single comprehensive list of brain-compatible principles. Table 2 combines various brain-compatible principles which are provided by some researchers (Caine and Caine, 1990; van Niekerk and Webb, 2016).

The brain-compatible principles that have been used in this study were selected from the list in Table 2. Although brain-compatible principles as described by these researchers (Caine and Caine, 1990; Jensen, 2000; van Niekerk and Webb, 2016) are effective for students' learning, some of these principles can be difficult for a lecturer to control. For example, principles like *Learning engages the entire physiology* and *The brain is a parallel processor* can be difficult to control, but it can be beneficial for students to understand in order to improve their learning.

Table 2: Comprehensive brain-compatible educational principles

1. There is no long-term retention without rehearsal.
2. Short, focused learning activities are best.
3. Learning is enhanced by challenge and inhibited by threat.
4. Emotions affect learning.
5. Learning involves both focused attention and peripheral perception.
6. The brain has a spatial memory and a set of systems for rote learning.
7. The brain simultaneously perceives parts and wholes.
8. Learning engages the entire physiology.
9. The brain is a parallel processor.
10. Learning is embedded in natural and social settings.
11. Each brain is unique.
12. The search for meaning is innate.
13. The search for meaning occurs through patterning.
14. Learning always involves both conscious and unconscious processes.
15. Learning with specific content is best.
16. Learning is a process of forming novel neutral networks or patterns.
17. Learners need to recognise and connect patterns by themselves.
18. Novel patterns can only form as extensions of existing patterns.
19. Learning should be given choices to accommodate different learning styles.
20. Learning must apply to real life experiences of learning.
21. Immediate feedback amplifies learning.
22. Learning is collaborative and influenced by interactions with others.

However, the principles in Table 3 could guide the lecturer when delivering the content and guides the student to work through the content.

Table 3: Brain-Compatible principles relevant to this study

1. The search for meaning occurs through patterning.
2. Learning involves both focused attention and peripheral perception.
3. We understand best when facts and skills are embedded in natural, spatial memory.
4. Immediate feedback amplifies learning.
5. Learners should be given choices to accommodate different learning styles.
6. Learning with specific content is best.

In an online learning environment, it is challenging to provide feedback to students who typically work mostly on their own. Tools that encourages reflections or self-assessment, which can be used to identify the desirable criteria or standards to which students should adhere when performing a task, would therefor assist both students and lecturers (Nicol and Macfarlane-dick, 2006). Since students would have been taught the theoretical aspects of the tasks, the feedback criteria would have to be simple for them to understand and would act as a memory aid for them.

2.4 Behavioural compliance monitoring

Since the outbreak of the COVID-19, educational institutions have replaced some or all aspects of the teaching with the necessary online experiences (Kar *et al.*, 2020). This includes educational technologies that can be used by students to assess their behaviour in the implementation of concepts whilst learning online. In many cases, online experiences are mostly theoretical in nature and require student to work on practicals offline here they would not have immediate feedback from their lecturer or an assistant. This is also important in a programming context which includes both theoretical and practical components, and especially in secure coding practices, where students need to meet certain security requirements (Finn, Thomas and Rawson, 2018).

This allows students to monitor their adherence to the set security requirements since these students would be working alone, with their own pace, at their convenient time. An example would be when students apply their acquired programming knowledge to their software applications, they could employ self-assessment tools such as scripts or checklists, rubrics, which would assist them in planning, monitoring and self-assessing the progress and adherence to secure coding practices (Finn, Thomas and Rawson, 2018). Panadero (Panadero, Jonsson and Botella, 2017) provides a list of common self-assessment tools where checklists are viewed as being simplistic, and an effective form of self-assessment, as researchers recommend these for students (Rowlands, 2007). Checklists, whether online or traditional paper checklists are considered to be the most effective means for students to inspect their adherence to the set software application requirements. These are normally provided to the students before engaging with the projects or activities, since it is important to establish guidelines prior to them working on the project (Scott, 2015). These provide guidance to the students by aligning their work to the set of requirements that has been provided to them.

3. Methodology

This research is presented as a case study since it describes an inquiry that investigates a contemporary phenomenon in depth and within its real-life context' (Yin, 2003). Creswell (2007) describes a case study as a 'bounded system' in the sense that the researcher should make the focus of the research, and the extent of the research, very clear in the research objectives. There is no single fixed structure for the presentation of case study research (Creswell, 2007).

In this paper the theoretical underpinnings and literature that informed the study is presented in Section 2 while the real-life context of the research is presented in Sections 4, 5 and 6. The focus of the research is presented in the form of five specific objectives, namely:

- **Objective 1:** To determine what secure coding practices a web application developer should adhere to in the .NET environment.
- **Objective 2:** To determine the adherence of third year software development capstone projects to the identified secure coding practices.
- **Objective 3:** To determine whether third year programming students have the requisite knowledge relating to secure coding practices.
- **Objective 4:** To design and implement an educational intervention to support programming students in the development of secure web applications.
- **Objective 5:** To determine the effect of the educational intervention on both student adherence and their requisite knowledge regarding secure coding practices.

These research objectives informed the research approach followed by this research study.

4. Research context

This research was conducted at a South African university, and the sample was drawn from students registered for their National Diploma: Information Technology (Software Development), engaged in their capstone projects. This diploma is a vocational qualification focusing on providing prospective students with the requisite skills for professional work.

During their diploma students initially learn a variety of end-user skills, foundational programming, and introductory relational database concepts. In their second academic year the students learn how to develop business applications. These applications are developed based on a 3-tier architecture approach. The 3-tier architecture consist of a Presentation Layer (PL), typically implemented using either ASP.NET web forms or .NET windows forms, a Business Logic Layer (BLL), and a Data Access Layer (DAL). All concepts learned during their first and second year enables the students to develop their capstone projects. Capstone project integrates the work learned across the entire qualification. Students engaged in their software development capstone projects has to develop a software application to solve an identified real-world problem. These projects typically take the form of a web, mobile, desktop or gaming application. The focus of this research was on web application projects developed in the .NET environment with a specific focus on the data access layer.

Students completed an online course which taught the identified secure coding practices as listed in Table 1. A course entitled the *Web Application Security* course was created and delivered using the *Moodle Learning*

Management System provided by the university. The course consisted of nine lessons, each of which addressed one of the identified secure coding practices. Students had to successfully complete a quiz after each lesson in order to progress to the next lesson. Finally, an assessment was conducted to determine how well students were able to adhere to secure coding practices.

5. Research approach

This research study followed a phased approach with four main phases.

Figure 1 illustrates the four main phases which includes behavioural analysis, knowledge assessment, educational intervention, and verification.

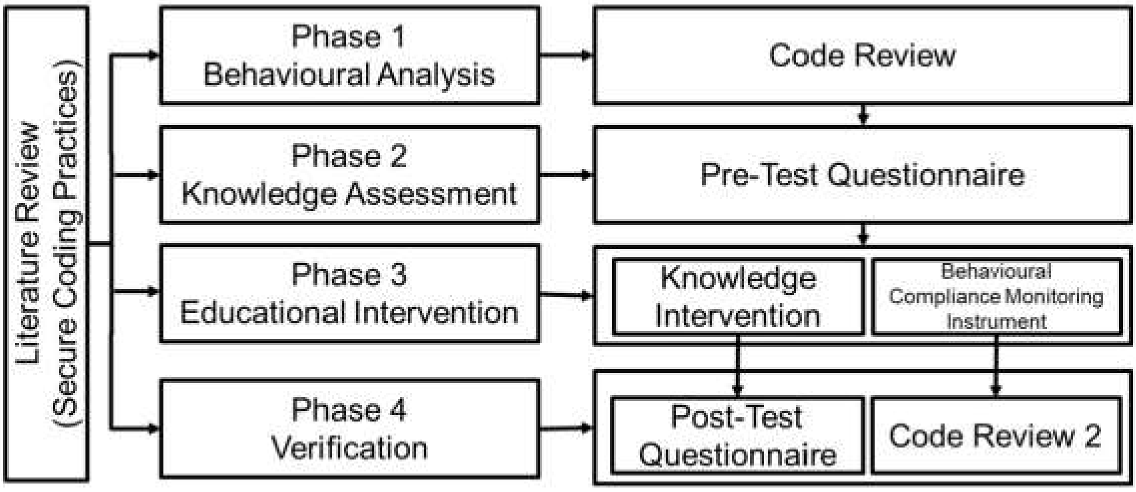

Figure 1: Phased research approach

The phases in this research were derived from the identified secure coding practices that is shown in Table 1. **Objective 1** of this research study was addressed through identifying these secure coding practices. Phases 1 and 2 of the study collectively seeked to determine both the adherence to the identified secure coding practices and the requisite underlying secure coding knowledge of students. Phase 1 relates to **Objective 2**, and Phase 2 relates to **Objective 3** of this research. The results indicated that these students lacked both behavioural adherence and knowledge relating to secure coding practices. The work presented in these phases together with the results indicating poor knowledge and adherence was published and presented in the 2017 Human Aspects on Information Security Assurance (HAISA) conference (Mdunyelwa, Van Niekerk and Futcher, 2017).

Phases 3 and 4 presented the educational intervention and the verification for this research which indicated improved secure coding knowledge and adherence to secure coding practices. These were published and presented at the 12th World Conference on Information Security Education (WISE 12) in 2019 (Mdunyelwa, Futcher and van Niekerk, 2019). These phases relate to **Objectives 4 and 5** of this research respectively.

6. Key elements of the proposed framework

To produce the proposed framework the researcher aligned the suggested key elements of the framework with the objectives of the study as seen in Section 3. These key elements and their inter-relationships are shown in Figure 2.

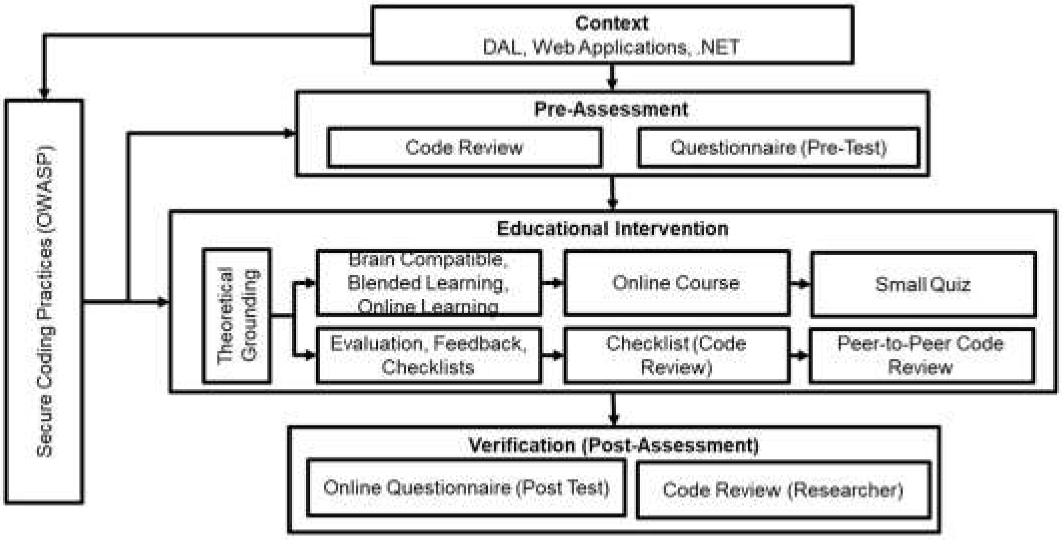

Figure 2: Key elements of the proposed framework

The identification of the key elements in Figure 2 were based on lessons learnt, and experiences gained whilst teaching secure coding practices at the South African university described in Section 4. These key elements are specific to the research conducted, but in each of the elements, a more general description is provided on how these can be implemented outside of this research.

- **Defining the Context (Objective 1)**: The researcher first defined the context for the secure coding practices. This was needed in order to identify the specific secure coding practices that had to be taught. This research focused specifically on the data access layer of web applications developed in the .NET environment. The secure coding practices used throughout this research were identified from OWASP as indicated in Table 1. In a more general context, the selection of the secure coding practices would be influenced by the integrated development environment (Java, C#, PHP etc), or the development platforms (Mobile, Desktop, or Web), which would also be defined by the context which they are used in.
- **Pre-Assessment - Code Review (Objective 2)**: A manual review of source code in previous capstone projects was conducted by the researcher. This review served to determine the extent to which these previous projects adhered to the identified secure coding practices. Using a code review of previously completed capstone projects to determine current adherence to secure coding principles was deemed valid since the students who developed those capstone projects were integrating learnt knowledge from all modules from first and second year of their course. These results can also be compared to the results of a different year since these students would have done the same modules in order for them to engage in the capstone project. The results from this code review indicated low levels of adherence and inconsistencies when developing their web applications.
- **Pre-Assessment - Questionnaire (Objective 3)**: Subsequent to the code review, the students' existing knowledge relating to the secure coding practices was evaluated in the form of a *pre-test*, by means of a carefully constructed and validated questionnaire. The results from the knowledge assessment showed that most students lacked the requisite knowledge relating to the identified secure coding practices.
- **Educational Intervention (Objective 4)**: Knowledge and behavioural adherence results showed the need for an educational intervention to address the lack of knowledge and low levels of adherence. The knowledge aspect was addressed through online lessons and the behavioural aspect was addressed by using a checklist provided to the students to monitor their own compliance with the identified secure coding practices.

The theoretical grounding which informed the knowledge aspect included theory on brain-compatible principles and online learning. For the behavioural aspect, the theory included evaluation and feedback, and theory on behavioural compliance monitoring through self-assessment tools such as checklists.

- **Post-Assessment - Verification (Objective 5)**: In order to determine the effectiveness of the educational intervention, verification of both the knowledge and behavioural aspects was required. The knowledge verification approach was an online quiz that was distributed to the students through the Moodle site, and this served as a post-test assessment for the knowledge aspect. For the behavioural verification, the researcher conducted a code review on students' capstone projects to measure their adherence to the identified secure coding practices, using the same code review checklist used in the pre-assessment and educational intervention phases. After the students have worked through the educational intervention, it is necessary to determine the effectiveness of the educational intervention. In doing so, the verification will depend on the nature of the entire educational intervention. The verification should also be based on the identified secure coding practices, which will depend on the context of the study.

The results from both the knowledge and behaviour verification showed an improvement in knowledge and a higher level of adherence to secure coding practices (Mdunyelwa, Van Niekerk and Futcher, 2017). These key elements were therefore deemed effective in teaching secure coding practices through an online learning approach, and therefore, informed the development of the proposed framework, as discussed in the next section. It is acknowledged that the implementation of this framework may come with varying challenges. These challenges may be determined by the specific context it is implemented in.

In addition, the successful implementation of such a framework would require the commitment of lecturers teaching programming. These lecturers would need to ensure that they have the necessary secure coding skills and knowledge to ensure that effective teaching and learning takes place.

7. Conclusion

This paper presents a framework for teaching secure coding practices to programming students engaged in their capstone projects. This framework has been effective in teaching secure coding practices and has improved students' knowledge and behaviour relating to the taught secure coding practices.

The limitations of this research are that it only focused on the data access layer of web applications developed in the .NET environment. The students selected for participation were students engaged in their third-year capstone projects. However, this framework can be used to teach secure coding practices to students working in different programming environments. Different educational and behavioural monitoring approaches for students can be employed when implementing this framework. It can also be used in formal education and should address both the knowledge and behavioural aspects of programming students.

References

Ardis, M. *et al.* (2015) 'SE 2014: Curriculum Guidelines for Undergraduate Degree Programs in Software Engineering', *Computer*, 48(11), pp. 106–109. doi: 10.1109/MC.2015.345.

Bishop, M. *et al.* (2017) 'Evaluating secure programming knowledge', *IFIP Advances in Information and Communication Technology*, 503, pp. 51–62. doi: 10.1007/978-3-319-58553-6_5.

Caine, R. N. R. and Caine, G. (1990) 'Understanding a brain-based approach to learning and teaching', *Educational Leadership*, (October), pp. 66–70.

Chen, B., Hsu, H. P. and Huang, Y. L. (2016) 'Bringing Desktop Applications to the Web', *IT Professional*, 18(1), pp. 34–40. doi: 10.1109/MITP.2016.15.

Clemons, S. A. (2005) 'Brain - Based Learning : Possible Implications for Online Instruction', (September 2005), pp. 1–10.

Creswell, J. W. (2007) *Qualitative enquiry & research design, choosing among five approaches*, *Book*. doi: 10.1016/j.aenj.2008.02.005.

Department of Basic Education (2020) *Government Gazette Staatskoerant*, *Government Gazette*. doi: http://dx.doi.org/9771682584003-32963.

Finn, B., Thomas, R. and Rawson, K. A. (2018) 'Learning more from feedback: Elaborating feedback with examples enhances concept learning', *Learning and Instruction*, 54, pp. 104–113. doi: 10.1016/j.learninstruc.2017.08.007.

Florian, T. P. and Zimmerman, J. P. (2015) 'Understanding by Design , Moodle , and Blended Learning : A Secondary School Case Study', *MERLOT Journal of Online Learning and Teaching*, 11(1), pp. 120–128.

Jensen, E. (2000) 'Brain-based learning: A reality check', *Educational Leadership*, 57(7), pp. 76–80. doi: 10.1080/00220973.2013.813367.

Kar, S. K. *et al.* (2020) 'COVID-19 pandemic and addiction: Current problems and future concerns', *Asian Journal of Psychiatry*, 51. doi: 10.1016/j.ajp.2020.102064.

Li, C. (2017) *ENHANCING SECURE CODING ASSISTANT WITH ERROR CORRECTION AND CONTRACT PROGRAMMING*.

Mdunyelwa, V., Futcher, L. and van Niekerk, J. (2019) 'An Educational Intervention for Teaching Secure Coding Practices', in *IFIP Advances in Information and Communication Technology*, pp. 3–15.

Mdunyelwa, V. S., Van Niekerk, J. F. and Futcher, L. A. (2017) 'Secure Coding Practices in the Software Development Capstone Project', in *Proceedings of the Eleventh International Symposium on Human Aspects of Information Security & Assurance (HAISA 2017) Secure*, pp. 282–291.

Meng, X. (2018) 'Static Analysis of Android Secure Application Development Process with FindSecurityBugs'.

Nicol, D. J. and Macfarlane-dick, D. (2006) 'Formative assessment and self-regulated learning : A model and seven principles of good feedback practice . Formative assessment and self-regulated learning : A model and seven principles of good feedback practice .', *Studies in Higher Education (2006),* 31(2), pp. 199–218. doi: 10.1080/03075070600572090.

van Niekerk, J. and Webb, P. (2016) 'The effectiveness of brain-compatible blended learning material in the teaching of programming logic', *Computers and Education*, 103, pp. 16–27. Available at: http://dx.doi.org/10.1016/j.compedu.2016.09.008.

OWASP (2017) *OWASP Top 10*. Available at: https://www.owasp.org/index.php/Top_10-2017_Top_10 (Accessed: 27 February 2018).

Panadero, E., Jonsson, A. and Botella, J. (2017) 'Effects of self-assessment on self-regulated learning and self-efficacy: Four meta-analyses', *Educational Research Review*, 22, pp. 74–98. doi: 10.1016/J.EDUREV.2017.08.004.

Rowlands, K. D. (2007) 'Check it Out! Using Checklist to Support Student Learning', *English Journal*, 96(6), pp. 1–67.

Saeli, M. *et al.* (2011) 'Teaching Programming in Secondary School : A Pedagogical Content Knowledge Perspective', 10(1), pp. 73–88.

Scott, C. L. (2015) 'The Futures of Learning 3: what kind of pedagogies for the 21st century?', *Education Research and Foresight*, pp. 1–21. doi: 10.1016/j.pse.2015.08.005.

Synopsis Editorial Team (2019) *Top 10 software vulnerability list for 2019*. Available at: https://www.synopsys.com/blogs/software-security/top-10-software-vulnerability-list-2019/ (Accessed: 28 November 2019).

The Acunetix Team (2019) *Web Application Vulnerability Report 2019*. Available at: https://www.acunetix.com/acunetix-web-application-vulnerability-report-2016/.

Tufekci, S. and Demirel, M. (2009) 'The effect of brain based learning on achievement, retention, attitude and learning process', *Procedia - Social and Behavioral Sciences*, 1(1), pp. 1782–1791. doi: 10.1016/j.sbspro.2009.01.316.

White, B. A. (2016) *Secure Coding Assistant: Enforcing Secure Coding Using the EclipseDevelopment Envorinment*, *Journal of Systems and Software*. Available at: http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:MISRA-C+:+2004+Guidelines+for+the+use+of+the+C+language+in+critical+systems#2%5Cnhttp://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:MISRA-C+2004:+Guidelines+for+the+Use+of+the+C+Lang.

Whitney, M. (2019) *Eside: The Integration of Secure Programming Educatrion into the IDE*, *Journal of Chemical Information and Modeling*.

Yin, K. (2003) 'Case Study Research Design and Methods, Third Edition, Applied Social Research Methods Series, Vol 5 by Robert Yin'.

Linking Digital Technologies to Learning in Higher Education: Skills, Tools and Practices

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Abstract: The innovation and rapid growth of internet technologies and devices have brought changes to the higher education landscape. Technologies such as virtual learning environments, cloud services, synchronous and asynchronous communication tools that can be accessed via the Internet have gradually emerged and gained ground, reshaping students' academic practices in different ways. Despite that, research shows that the potential of internet technologies to enhance students' learning experience has not been fully exploited. Several studies have reported that internet technologies in academic settings are used for convenience rather than for strengthening students' academic study habits. Additionally, according to research, higher education students are not aware of the enabling capabilities of internet technologies and how they can be used in the context of higher education. This paper presents part of a design-based research study that aimed to develop an instructional intervention that enhances undergraduate students' internet skills in the context of higher education. The intervention was based on the internet skills indicators from the Internet Skills Scale (ISS) proposed by Van Deursen, Helsper & Eynon (2014), which was validated for the context of higher education. To guide the intervention, we have developed a framework that links internet skills to internet technologies and their educational affordances in academic settings. The framework refers to five types of skills: Operational, Information-Navigation, Social, Creative, and Critical. For each of the skills' type, several internet technologies have been identified together with their potential to support academic practice. The framework can serve as a tool to perceive the affordances of internet technologies for learning in higher education and prepare higher education staff to better support the effective and productive use of the Internet in academic environments.

Keywords: internet technologies, internet skills, academic practice, framework, educational affordances, higher education

1. Introduction

The innovation and rapid growth in the use of internet technologies and devices, such as smartphones, tablets or laptops that work via mobile or wireless Internet, have reshaped the way young people communicate and learn (Ng, 2015; Hembrough & Jordan, 2020). At an institutional level, technologies such as virtual learning environments, cloud services, synchronous and asynchronous communication tools that can be accessed via the Internet have gradually emerged and gained ground, reshaping students' academic practices in different ways (Adams Becker et al., 2016). In a recent report on education in the digital age, the European Parliament's Committee on Culture and Education (2018) suggested that digital technologies should play an essential role in education, emphasising the efficient and productive use of the Internet. Particularly, digital technologies should enable students to create and contribute to the local and global knowledge ecosystem and develop lifelong learning habits, given the rapid pace of technological development. Moreover, students should be able to apply a critical perspective to the choice of digital tools, evaluating their contribution according to the needs of their work (Alexander et al., 2017). Ultimately, according to the European University Association, universities are responsible for ensuring that graduates possess the skills that will enable them to utilise digital technologies and prepare them for the labour market (Jørgensen, 2019).

It is worth noting that the younger generations spend much of their free time online and have already used various digital technologies outside formal education settings (Ng, 2012; Gosper, Malfroy, & McKenzie, 2013; Kennedy & Fox, 2013; Creer, 2018). However, relevant studies indicate that higher education students are not aware of the enabling capabilities of internet technologies and how they can be used in the context of higher education (Ng, 2012; Shopova, 2014; Šorgo et al., 2017). Research has shown that young people easily adapt to the use of the Internet at a technical level (e.g. accessing services, connecting to a WiFi network) (Ng, 2012; Kennedy & Fox, 2013). They are also very familiar with the use of internet technologies for communication purposes (Bullen, Morgan, & Qayyum, 2011; Gosper, Malfroy & McKenzie, 2013; Shopova, 2014; López-Meneses et al., 2020). However, they seem to experience difficulties using tools and services for online information search and evaluation (Hargittai et al., 2010; Head, 2013; Neumann, 2016; Weber, Hillmert, & Rott, 2018; McGrew et al., 2018) and content creation (Ng, 2012; Kennedy & Fox, 2013; López-Meneses et al., 2020).

Additionally, while higher education Institutions have welcomed the integration of digital technologies in teaching and learning, undergraduate students believe that their instructors use technology in basic ways to connect to learning materials and to encourage the use of online collaborative tools (Brooks, 2016). It is therefore essential for academic staff to deepen their understanding of effective integration of digital technologies into teaching, adopt approaches that leverage the educational affordances of a range of learning technologies and engage students on a deeper level (Kennedy & Fox, 2013; Johnson et al., 2013; Brooks, 2016).

2. Research purpose

A general finding that emerged from the literature was that in order to utilise the capabilities of digital tools effectively, it is essential to study the available online technologies and the possibilities they offer to help students achieve learning goals (Margaryan, Littlejohn, & Vogt, 2011; Ng, 2012). In this regard, researchers need to examine the skills, tools and practices that will enable undergraduate students to utilise internet technologies effectively and efficiently to support their learning. One of the main research questions which our study aimed to address is the following:

What are the characteristics of an intervention to strengthen undergraduate students' Internet skills and support them effectively in their academic pathways?

To answer the question, we implemented an instructional intervention that aimed to enhance undergraduate students' internet skills. The study followed a design-based research (DBR) approach, which aims to develop new theories, techniques and practices that have a potential impact on learning and teaching in real environments (Barad & Squire, 2004; Anderson & Shattuck, 2012). The DBR approach deemed appropriate for the study's purpose as it aims to identify educational problems for which there are no research-based principles of planning and development in terms of activity structure and support (Plomp, 2017). In the context of implementing educational interventions with digital tools, the DBR emphasises feedback processes that can be given from experts in the field and from those involved, in our case, undergraduate students. The feedback refers to the approaches and tools used which can be modified or replaced if their use fails to promote active participation (Wang & Hannafin, 2005).

The study presented herein was developmental, and it was conducted in three phases: the preliminary phase, the development/prototyping phase, and the assessment phase. This paper refers to the second phase or the development/prototyping phase and, in particular, to the design materials and the learning experience. The third phase refers to the assessment of the intervention.

2.1 Participants

Fifty-eight undergraduate students from the University of Cyprus participated in the study for three consecutive semesters during the academic years 2017-2018 and 2018-2019. Students attended a course about the use of digital technologies for teaching and learning. The course is offered at an undergraduate level, and it is an elective course for students of all the university departments.

2.2 Research instruments and processes

The research data were collected from different sources (self-assessment questionnaires, open-ended questionnaires, design materials, and reflective journal records from teaching observations). During the preliminary phase, we conducted a literature review to identify the types of skills needed for the effective and productive use of the Internet in higher education, and we validated the self-assessment questionnaire for internet skills in order to measure the learning outcomes. Additionally, we examined data from an open-ended questionnaire and teaching observations regarding students' perceptions and experiences with digital technologies for learning. During the development/prototyping phase, an iterative design process took place to develop an instructional intervention by implementing three research cycles. The research processes that were undertaken were the following: a) reflection on the results from the preliminary phase to identify the internet tools that could best support the learning process based on internet skills indicators, b) exploration of students' learning needs to inform the design of learning environments, and c) design and development of tools and activities. In this paper, we refer to the first among the three processes. In this regard, we present the framework used to guide the development of the learning environments for internet skills education. For this purpose, we refer to data derived from the observation of two research cycles (twenty-two course observations) regarding the perceived affordances of the internet tools based on the perceptions and experiences of 35 undergraduate students (preliminary phase and prototyping/development phase). It is worth noting that the design materials were developed based on the internet skills indicators from the Internet Skills Scale (ISS) proposed by Van Deursen, Helsper & Eynon (2016), which was validated in this study for the context of higher education during the preliminary research phase.

3. Research results

In order to define the characteristics of an intervention to strengthen undergraduate students' Internet skills and support them effectively in their academic pathways, we first identified the set of skills needed to use the Internet effectively. During the development/prototyping phase, an emphasis was placed on utilising internet tools to help students draw connections to real life. These tools represent many of the activities that young people carry outside academia and act as a natural link between the skills developed from an everyday environment, possibly for fun, to a learning environment (Groff, 2013). Additionally, during the course, we examined students' learning needs and experiences to gain insight into the educational affordances of digital technologies. The concept of affordances refers to the actual and perceived properties of an object. These properties allow and facilitate specific types of interaction (Angeli & Valanides, 2013). According to Lee and McLoughlin (2008), the educational affordances of digital tools for learning are ultimately dependent on the views and perceptions of the learners because "*how learners perceive the possibilities of the tools and their "ideal" use(s) in the context of their learning may be markedly different to the ideas and intentions of the educators and educational technologists who design them*" (p. 3)

For the purpose of our study, the digital tools were selected based on their affordances to support the development of the skills as referred to the validated ISS, such as accessing, retrieving and evaluating information (internet browsers, search engines, data formats, cloud services), communicating and collaborating (social networking services, online content sharing) and creating digital content (multimedia, presentation software).

Considering the above, we developed a framework that links internet skills to internet technologies and their educational affordances in academic settings. The framework refers to five types of skills: Operational, Information-Navigation, Social, Creative, and Critical. Table 1 presents the mapping of tools and services for the development of Internet skills organised by skill set based on the validated ISS (Van Deursen, Helsper, & Eynon, 2014. 2016) along with the possibilities they can offer to support learning.

Table 1: Mapping of tools and services for internet skills education in academic settings

Operational skills		
Internet skills	Internet technologies	Academic affordances
I know how to bookmark a website.	Internet browsers	Managing the vast amount of information available on the Internet Organising and storing academic work Managing academic study Optimising the use of online services Minimising the implementation time of academic tasks Personalizing the learning experience Adjusting settings in terms of preferences and learning needs
I know how to use shortcut keys (e.g. CTRL-C for copy, CTRL-S for save)	Internet browsers Online tools which support keyboard shortcuts	
I know how to complete online forms.	Internet browsers Online tools which require filling forms Email account	
I know how to adjust privacy settings.	Internet browsers	
Information-Navigation skills		
Internet skills	Internet technologies	Academic affordances
Sometimes I end up on websites without knowing how I got there.	Internet browsers Search engines	Managing the information search process Accessing websites and databases with academic content
I find it hard to find a website I visited before.		
I find the way in which many websites are designed confusing.	Internet browsers (Web pages)	

All the different website layouts make working with the internet difficult for me.		Organising information search processes to align search results to the academic context Using advanced features of multiple information retrieval services
I get tired when looking for information online.	Search engines Metasearch engines Online catalogues Online databases	
I should take a course on finding information online.		
I find it hard to decide what the best keywords are to use for online searches.		
Social skills		
Internet skills	Internet technologies	Academic affordances
I would feel confident writing and commenting online.	Social networking services Email account Collaborative authoring tools	Managing communication processes in the academic environment Sophisticated use of multiple social networking services Managing digital identity
I am confident about writing a comment on a blog, website or forum.	Social networking services Email account Collaborative authoring tools	
I know which information I should and shouldn't share online.	Social networking services Online information sharing tools (e.g. blogs, wikis) Collaborative authoring tools	
I know when I should and shouldn't share information online.		
I am careful to make my comments and behaviours appropriate to the situation I find myself in online.		
I know how to change who I share content with (e.g. friends, friends of friends or public).	Social networking services Online information sharing tools (e.g. blogs, wikis)	
I feel comfortable deciding who to follow online (e.g. on services like Twitter or Tumblr).		
Creative skills		
Internet skills	Internet technologies	Academic affordances
I know how to create something new from existing online images, music or video.	Online content creation tools (editing text, images, sound) Cloud services Collaborative authoring tools	Creative production and expression using a variety of tools Communicating knowledge in academic and professional communities
I know how to make basic changes to the content that others have produced.		
I would feel confident putting video content I have created online.	Online video creation tools Cloud services Video hosting platforms	
I know how to design a website.	Online website creation tools	
I know which different types of licences apply to online content.	Creative Commons Licenses	
Critical skills		
Internet skills	Internet technologies	Academic affordances
Sometimes I find it hard to verify information I have retrieved.	Search engines Metasearch engines Online catalogues Online databases	Managing the process of selecting search results Selecting search results based on criteria that are consistent with the academic context (validity and reliability)
I am confident in selecting search results.		
I carefully consider the information I find online.		
I know which apps/software are safe to download.	Internet browsers	

As mentioned above, during the preliminary phase, we identified different learning needs regarding students' internet skills which are related to academic practice. In order to address these needs, we mapped the available internet tools and their educational affordances based on students' perceptions and experiences. Specifically, regarding the Operational skills set, there was a need to present the most advanced use of internet browsers, such as adjusting privacy settings and browsing safely, applying keyboard shortcut functions and bookmarking. According to the data collected from the observation of each meeting, the added value of optimising the use of internet browsers is linked to the personalisation of the learning experience, as it allows the organisation and management of documents and the implementation of tasks at the individual level. For this purpose, it was considered appropriate to include Internet browsers and online tools which support keyboard shortcuts, such as cloud services. The use of online tools requires active email accounts and an understanding of filling and submitting online forms during the registration process.

Concerning the Information-Navigation skills set, the need emerged to present advanced search strategies for information search online, such as keyword search or search in specific databases. In particular, the observation data showed that students were not familiar with the more advanced uses of search engines and were also unfamiliar with information search strategies, such as selecting the most appropriate keywords to perform an academic query. In this regard, it was essential to select Internet tools related to information search that would allow them to navigate to different websites and manage the vast amount of information found online to carry out their academic work. In this regard, the processes of using search and meta-search engines, or using Internet browsers to navigate to websites, databases, and online catalogues with academic content offer a range of options for easy access to information, such as using the "search" function, reading the breadcrumbs, and working with indexes/content directories.

In regard to the Social skills set, there was a need to enhance the instructional material with netiquette rules. In general, the use of the Internet was linked to the need for effective communication in the academic environment through various media. One of the basic tools reported for online communication was email. Additionally, although the use of social networks among students is widespread, at least concerning their daily communication, the academic practice requires different types of communication skills, such as following netiquette rules. For this purpose, we selected tools such as social networking services, collaborative authoring tools and online information sharing tools (e.g. blogs, wikis), which provide a range of opportunities for online interaction and communication. Moreover, students expressed their interest in learning how to use web services to create professional web profiles and manage their different digital identities and reputation online. For this purpose, we reported social networking services that are related to professional and academic communities.

Moreover, regarding the Creative skills set, students preferred digital tools, which enabled them to work autonomously and modify, adapt, and reorganise their content. In this regard, it was essential to utilise online content creation tools and cloud services in order for students to be able to store and access their work at any time. In university settings, students found added value in content creation activities which enabled them to design and develop online multimedia presentations and posters and that could be applied to their study and work in academia or a professional setting. For this purpose, we reported online tools for editing text, images, and sound, tools for video creation and video hosting platforms, and for online website creation. It is worth noting that during the content creation process, students welcomed peer feedback. For this purpose, collaborative authoring tools which support instant communication between peers were also included. Also, there was a need to present information on how students could protect the content they created by using online licenses in order to feel more comfortable sharing their work/publications by securing their copyright. In this regard, the Creative Common Licenses was also reported as a useful internet-based service.

Lastly, concerning the Critical skills set, it was important to refer in detail to procedures, strategies, and tools to support students in the information retrieval process to obtain relevant and high-quality results from reliable sources. Furthermore, issues related to personal responsibility for disseminating information and knowledge needed to be highlighted. In general, the use of the Internet with a critical perspective was related to the evaluation and selection of the most appropriate online sources for academic purposes. To achieve the above, we have included tools, such as Internet browsers that provide access to various information sources, search engines, metasearch engines, online catalogues and online databases with academic content.

4. Discussion

Internet-based technologies offer freely accessible web publishing tools that can greatly impact academic practices at both institutional and individual levels in higher education. The present study examined how institutions can meet the challenges that arise in utilising digital tools to design and develop programmes to enhance students' Internet skills in undergraduate courses. The innovation of the present study lies in considering both the technical capabilities of digital tools and their affordances to support learning objectives in academic settings through the examination, analysis and application of the possibilities they offer in real learning environments. Specifically, through the review of the relevant literature regarding internet skills in higher education settings and the investigation of students' perceptions and experiences with the use of digital technologies, we identified several educational affordances for internet skills education.

In particular, we presented a framework that links internet skills to internet technologies and their educational affordances in academic settings. The framework can serve as a tool to perceive the affordances of internet technologies for learning in higher education. In this regard, higher education students could better understand the enabling capabilities of internet technologies and how they can be used in the context of higher education to support their academic practices. Additionally, it could help instructors to better understand students' experiences and expectations for using digital technologies for their academic work and prepare them to better support the effective and productive use of the Internet in academic environments. It could also be used to create or revise programs to enhance Internet skills in formal and informal learning environments for the younger generations.

5. Limitations and future research directions

In the present study, the use of Internet technologies took place mainly during a course about teaching and learning with technology. Therefore, any reports on the use of the tools and practices in other courses took place orally from the students' testimonies. It is suggested that future research explores the process of transferring Internet skills in academic studies. Such research could focus on the development of Internet skills by subject area.

References

Adams Becker, S., Freeman, A., Giesinger Hall, C., Cummins, M. and Yuhnke, B. (2016) "NMC/CoSN Horizon Report: 2016 K-12 Edition", [online], The New Media Consortium, https://files.eric.ed.gov/fulltext/ED570463.pdf.

Alexander, B., Adams Becker, S., Cummins, M. and Giesinger, Hall C. (2017) "Digital Literacy in Higher Education, Part II: An NMC Horizon Project Strategic Brief", August, Vol 3.4, [online], The New Media Consortium, https://library.educause.edu/-/media/files/library/2017/8/2017nmcstrategicbriefdigitalliteracyheii.pdf.

Anderson, T. and Shattuck, J. (2012) "Design-based research: A decade of progress in education research? ", *Educational Researcher*, Vol 41, No 1, pp 16-25.

Angeli, C. and Valanides, N. (2013) "Technology mapping: An approach for developing technological pedagogical content knowledge", *Journal of Educational Computing Research*, Vol 48, No 2, pp 199-221.

Barad, S. and Squire, K. (2004) "Design-based research: Putting a stake in the ground", *Journal of The Learning Sciences*, Vol 13, No 1, pp 1-14.

Bullen, M., Morgan, T. and Qayyum, A. (2011) "Digital learners in Higher Education: Generation is

Not the Issue", *Canadian Journal of Learning and Technology*, Vol 37*, No* 1, [online], Canadian Network for Innovation in Education, https://www.learntechlib.org/p/42755/.

Brooks, C. (2016) "*ECAR Study of Undergraduate Students and Information Technology, 2016. Research report*". [online], Educause Center for Analysis and Research, https://er.educause.edu/~/media/files/library/2016/10/ers1605.pdf?la=en.

Creer, A. (2018) "Introducing Everyday 'Digital Literacy Practices' into the Classroom: An Analysis of Multi-layered media, Modes and their Affordances", *Journal of New Approaches in Educational Research*, Vol 7, No 2, pp 131–139.

European Parliament (2018) "*On education in the digital era: challenges, opportunities and lessons for EU policy design"*, [online], http://www.europarl.europa.eu/doceo/document/A-8-2018-0400_EN.html.

Gosper, M., Malfroy, J. and McKenzie, J. (2013) "Students' experiences and expectations of technologies: An Australian study designed to inform planning and development decisions", *Australasian Journal of Educational Technology*, Vol 29, No 2, pp 268-282.

Groff, J. (2013) "Technology-rich innovative learning environments", [online], http://www.oecd.org/education/ceri/Technology-Rich%20Innovative%20Learning%20Environments%20by%20Jennifer%20Groff.pdf.

Hargittai, E., Fullerton, L., Menchen-Trevino, E. and Thomas, K. Y. (2010) "Trust online: Young adults' evaluation of web content", *International journal of communication*, Vol 4, No 1, pp 468-494.

Head, A. (2013) "*Learning the ropes: How freshmen conduct course research once they enter college"*, [online], https://files.eric.ed.gov/fulltext/ED548262.pdf.

Herrington, J., Oliver, R. and Herrington, A. (2007) "Authentic learning on the web: Guidelines for course design", [online] https://ro.uow.edu.au/edupapers/48.

Hembrough, T. and Jordan, J. (2020) "Creating a Digital Writing Classroom: A Mixed Methods Study about a First-Year Composition Tablet Initiative", *International Journal of Instruction*, Vol 13, No 2, pp 567-586.

Johnson, L., Adams Becker, S., Cummins, M., Estrada, V., Freeman, A. and Ludgate, H. (2013) "NMC horizon report: 2013 higher education edition", [online], The New Media Consortium, https://virtualeduca.org/documentos/2013/2013-horizon-report-he.pdf.

Jørgensen, T. (2019) "*Digital Skills: Where Universities Matter*", [online], European University Association, https://eua.eu/downloads/publications/digital%20skills%20%20where%20universities%20matter.pdf.

Kennedy, D. M. and Fox, R. (2013) "'Digital natives': An Asian perspective for using learning technologies", *International Journal of Education and Development using ICT*, Vol 9, No 1, pp 65-79.

Kennedy, G. E., Krause, K. L, Judd, T. S., Churchward, A. and Gray, K. (2008) "First year students' experiences with technology: Are they really digital natives?", *Australasian journal of educational technology*, Vol 24, No 1, pp 108-122.

Lee, M. J. and McLoughlin, C. (2008,) "Harnessing the affordances of Web 2.0 and social software tools: Can we finally make" student-centered" learning a reality?", [online], Association for the Advancement of Computing in Education (AACE), https://researchoutput.csu.edu.au/ws/portalfiles/portal/9663879/Lee_McLo_EDMEDIA08.pdf.

López-Meneses, E., Sirignano, F. M., Vázquez-Cano, E. and Ramírez-Hurtado, J. M. (2020) "University students' digital competence in three areas of the DigCom 2.1 model: A comparative study at three European universities", *Australasian Journal of Educational Technology*, Vol 36, No 3, pp 69-88.

Gosper, M., Malfroy, J. and McKenzie, J. (2013) "Students' experiences and expectations of technologies: An Australian study designed to inform planning and development decisions", *Australasian Journal of Educational Technology*, Vol 29, No 2, pp 268-282.

Margaryan, A., & Littlejohn, A. and Vogt, G. (2011) "Are digital natives a myth or reality?: University students' use of digital technologies", *Computers & Education*, Vol 5, No 2, pp 429-440.

McGrew, S., Breakstone, J., Ortega, T., Smith, M. and Wineburg, S. (2018) "Can students evaluate online sources? Learning from assessments of civic online reasoning", *Theory & Research in Social Education*, Vol 46, No 2, pp 165-193.

Neumann, C. (2016) "Teaching digital natives: Promoting information literacy and addressing instructional challenges", *Reading Improvement*, Vol 53, No 3, pp 101-106.

Ng, W. (2015), *New Digital Technology in Education*, Springer International Publishing, Switzerland.

Ng, W. (2012) "Can we teach digital natives digital literacy?", *Computers & Education*, Vol 59, No 3, pp 1065-1078.

Plomp, T. (2007) "Educational Design Research: an introduction", [online], https://www.researchgate.net/profile/Brenda_Bannan/publication/263733328_The_Integrative_Learning_Design_Framework_114_-_133_An_Illustrated_Example_from_the_Domain_of_Instructional_Technology/links/0046353bc22945ecfd000000/The-Integrative-Learning-Design-Framework-114-133-An-Illustrated-Example-from-the-Domain-of-Instructional-Technology.pdf#page=12.

Shopova, T. (2014) *"*Digital literacy of students and its improvement at the university", *Journal on Efficiency and Responsibility in Education and Science"*, Vol 7, No 2, pp 26-32.

Šorgo, A., Bartol, T., Dolničar, D. and Boh Podgornik, B. (2017) *"*Attributes of digital natives as predictors of information literacy in higher education", *British Journal of Educational* Technology, Vol 48, No 3, pp. 749-767.

Van Deursen, A. J., Helsper, E. J. and Eynon, R. (2016) *"*Development and validation of the Internet Skills Scale (ISS)", *Information, Communication & Society*, Vol 19, No 6, pp 804-823.

Van Deursen, A. J. A. M., Helsper, E. J. and Eynon, R. (2014) "*Measuring digital skills. From digital skills to tangible outcomes. Project Report"*, [online], University of Oxford, Oxford Internet Institute, http://www.oii.ox.ac.uk/research/projects/?id=112.

Wang, F. and Hannafin, M. J. (2005) "Design-based research and technology-enhanced learning environments*", Educational Technology Research and Development*, Vol 53, No 4, pp 5-23.

Weber, H., Hillmert, S. and Rott, K. J. (2018) "Can digital information literacy among undergraduates be improved? Evidence from an experimental study*", Teaching in Higher Education*, Vol 23, No 8, pp 909-926.

Expansive Learning During Pandemic Teaching: Collaborative Digital Textbooks in Secondary Biology Courses

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DOI: 10.34190/EEL.21.068

Abstract: This paper presents partial findings from a larger mixed methods case study that explored a high school biology teaching team's pedagogical approaches to engaging with electronic textbooks (e-textbooks) in face-to-face, online, and hybrid teaching environments during the Covid-19 pandemic. Despite a growing body of literature on electronic textbooks, most researchers have used quantitative methods to understand users' implementation of and satisfaction with this technology, and have done so in higher education settings. Largely absent from the literature are accounts of how different affordances associated with e-textbooks are employed as pedagogical tools in general and their use in secondary schools more specifically. Conducted within the framework of cultural-historical activity theory, the project captured evidence of the tensions associated with three cycles with regard to the teachers' use of the e-textbook as classes moved from one learning environment to another. Data collection was conducted over an eleven month period that spanned two school years; data were generated through close- and open-ended questionnaires as well as document analyses. Two of the three documents occurred naturally in different phases of the teaching process while the third provided the historical context out of which one of the others developed and the social context in which it had been situated. The preliminary findings presented in this paper suggest that technical competence and content knowledge do not guarantee pedagogical prowess with education technologies, even those that teachers have used for years, as was the case in this study. The findings further suggest that there is a need for robust pedagogical practices that support the use of e-textbooks and their tools beyond replicating the use of physical textbooks. Such practices did not develop as a result of familiarity with the e-textbook or changes to the environment that positioned the e-textbook for a more prominent role, suggesting a need for specialised training.

Keywords: e-textbooks, tools, secondary school, teachers, activity theory, case study

1. Introduction

The ubiquity of electronic media has given rise over the last decade to the mainstream use of electronic textbooks (Lin, Liu and Kinshuk, 2015). Although some are simply digital versions of their paper predecessors, others offer interactive features to engage users.

Research suggests such rich, readily-accessible electronic texts might diminish comprehension, fostering passive readers who accept content without critically questioning connections between a text's multiple modes (Wolf and Barzillai, 2009). Kress (2003) argues that readers may be unsure how to organise the small texts that constitute larger texts.

Some governments advise training new and experienced teachers when introducing education technologies (Department for Education, 2019; U.S. Department of Education, 2017). Likewise, teachers and school leaders have been told they must develop new technology-centred academic skills that build students' comprehension and support learning (Karchmer-Klein and Shinas, 2012).

2. Literature review

Users' engagement with e-textbooks is under-studied, especially outside higher education institutions. Within those settings many instructors express enthusiasm about the interactivity that e-textbooks offer, specifically text-based tools for mark-ups and communication (Abaci, Morrone and Dennis, 2015; Bossaller and Kammer, 2014; Cuillier and Dewland, 2014; Schuh, Van Horne and Russell, 2018). These tools are often cited the reason for adoption (Bossaller and Kammer, 2014; Giacomini et al, 2013).

More often than not, however, instructors do not use e-textbook tools. Schuh, Van Horne and Russell (2018) discovered from the log data of eight university instructors that, on average, they highlighted just 4.13 passages in the e-textbook per term. Similarly, only two instructors were found to have used the assessment tool: one used publisher-created assessments whilst the other created assessments that were then placed throughout readings.

Giacomini et al (2013), whose 17 instructor participants opted for electronic versions of the textbooks already in place, suggest this may go back to instructors' prior use of the paper version of the textbook for which they had previously developed "robust feedback and interaction mechanisms" (p. 14). The instructors had little need to interact with the e-textbook to meet their instructional needs; the e-textbook tools, the authors contend, did not enhance what already existed but merely duplicated it. Schuh, Van Horne and Russell (2018) revealed that two of eight participating instructors abandoned their e-textbooks entirely and returned to their physical textbooks during the first semester of use.

Abaci, Morrone and Dennis (2015) argue that using e-textbook tools is "more convenient and more contextualized for the student" (p. 10). Instructors asserted during interviews that they chose not use the communication tools because "they did not need one more place to check for questions and comments" (p. 14), a sentiment echoed by an instructor from another study who discouraged students from using the question tool in favour of sending questions via email (Schuh, Van Horne and Russell, 2018).

Schuh, Van Horne and Russell (2018) found that "instructors who incorporated the e-textbook into their own planning and instructional design…[created] a feedback loop [that] continued to mediate the instructors' activity" (p. 314). However, these researchers also found that the majority of the instructors in their study viewed the e-textbook as a tool best suited only for students rather than one for themselves as well. Similar views were expressed in other studies (Abaci, Morrone and Dennis, 2015; Giacomini et al, 2013).

Perhaps a barrier to instructor engagement is the professional development offered (Weng et al 2018). Institutional support for adopting e-textbooks was high in all of these studies, but not one provides details of initial professional development. Some (Bossaller and Kammer, 2014; Schuh, Van Horne and Russell, 2018) mention on-site training was provided for instructors. Where support was available from the university upon request, instructors sometimes chose to teach themselves rather than seek assistance from those trained to use the e-textbooks, usually members of the IT department (Abaci, Morrone and Dennis, 2015).

For many instructors, the e-textbook is part of a complex system carefully crafted over time and includes multimedia support materials in addition to online formative and summative assessments capable of providing immediate feedback to students (Giacomini et al, 2013). The need for instructors to interact with an e-textbook may be less obvious when they "are familiar with the content and do not need the tools to mediate or scaffold their own understanding or teaching" (Schuh, Van Horne and Russell, 2018).

Whilst it may seem introducing an e-textbook is a simple swap of paper for screen, those same instructional strategies that worked before may no longer be effective. Some aspects of the course may need to be reimagined in order to meaningfully engage students with these complex e-textbooks (Bossaller and Kammer, 2014; Weng et al, 2018).

3. Methodology

This study was guided by the following research question: How do teachers engage e-textbooks to enact the curriculum? Activity theory, developed as a means to understand human activity and which has come to view activity as taking place within distinct but interacting systems, was the framework.

3.1 Activity theory

An activity system is comprised of six elements functioning as an integrated network to engage in some activity. The system is characterised by a *subject*, the individual or group undertaking activity directed toward an *object*, the thing to be changed (Engeström and Miettinen, 2005). The subject assumes roles and responsibilities, the *division of labour*, in pursuit of the object. To transform objects into outcomes, the subject uses mediating *tools* (Kuutti, 1996), carefully selected and used with the object in mind (Nardi, 1996). Within a given system, those who share a common object and have influence on the activity form a *community* that behaves in accordance with particular *rules.* Figure 1 illustrates the activity system for this study.

Activity systems that introduce changes, such as e-textbooks, may create tensions and undergo expansive transformations (Engeström, 2001), but only if the changes alter their activity patterns or the object. Because the teachers in this study had introduced the e-textbook two years earlier, this study is focussed on the actions surrounding the teachers' use of the e-textbook and the potential for expansive transformation.

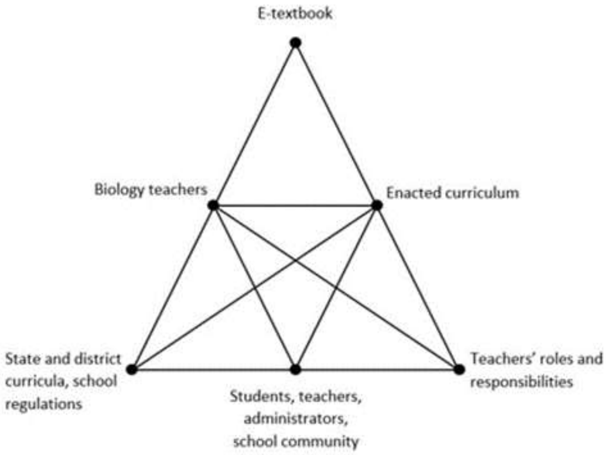

Figure 1: Activity system for study

3.2 Setting

This mixed methods case study was conducted at a suburban high school in the Midwestern United States. Since 2012 students have been required to bring their own device to school daily, teachers have long been expected to incorporate technology into classroom activities, and multiple courses have adopted e-textbooks.

Participants included four biology teachers and 159 students; all had access to the e-textbook through their devices and the physical textbook in the classroom. Data and findings presented here relate to the teachers. Two teachers, Alex and Blake, participated in the spring semester; Casey and Dana joined in the autumn.

3.3 Data collection and analysis

Data were collected throughout 2020, before and during Covid-19 closures. Face-to-face teaching took place from January to mid-March but was replaced by online teaching from late March through May. The new school year began in August using a hybrid mode, with students split into two groups that rotated daily between face-to-face teaching and self-paced online learning.

Instruments were designed for complementarity and triangulation. Table 1 lists the purpose of data sources and provides reference codes used throughout this paper. Descriptive statistics from questionnaires are presented; qualitative sources were analysed using the constant comparative method.

Table 1: Summary of data sources

Source	Purpose	Code
Questionnaire, close-ended	30 questions: Gathered demographic information, established activity system, described e-textbook engagement	JanTQ
Assignment protocol	Exemplified teachers' enacted practice; numbers indicate which of four assignments is referenced (*e.g.*, AP1)	AP
Cover form	Explained intended e-textbook engagement; numbers indicate which of four covers is referenced	CF
Questionnaire, open-ended	Explored individual teacher responses to the closed-ended questionnaire	MayTQ
Transcript, planning meeting	Identified team's intention to adjust learning goals, objectives and teaching practices whilst in hybrid mode	PM
Questionnaire, open-ended	Explored team's perceptions of teaching with an e-textbook; numbers indicate which of four prompts is referenced	FG

4. Findings and discussion

The teachers enacted the curriculum similarly in each environment (Table 2), but their e-textbook engagement decreased over time. This was likely due to a fundamental contradiction within the activity system in which the teachers expressed a preference for physical textbooks and largely replicated their previous practices after adopting an e-textbook. Tensions within the activity system increased in each environment until the teachers ultimately abandoned the e-textbook.

Table 2: Teachers' actions to enact the curriculum in each environment

Curricular Action	Face-to-face	Online	Hybrid
Lecturing	X	X	X
Reading text with students	X		
Providing reading support	X	X	X
Creating practice opportunities	X	X	X
Assessing students	X	X	X

4.1 Face-to-face environment

The initial questionnaire (JanTQ) asked teachers how frequently they used the e-textbook for common pedagogical tasks; their answers are presented in Figure 2. Numbers correspond to the following frequencies: 1=Never, 2=Once/twice a year, 3=Once/twice a term, 4=Once/twice a month, 5=Every/nearly every week.

Figure 2: Frequency of e-textbook use for pedagogical tasks

Additional data revealed the biology team based weekly lectures on PowerPoints accessed through the e-textbook platform's teacher dashboard (MayTQ). They also used the key questions from each chapter subsection as the foundation for unit objectives (PM 714-727), a form of guided notes (708-711), that supported students' biweekly readings inside and outside the classroom.

These data support Blake's reported e-textbook use related to preparing lectures and in-class activities but partially contradict Alex's reported use. Alex gave weekly lectures but reported engaging the e-textbook to prepare them only once or twice a year. Given the teachers' prior use of the physical textbook, it is possible that Alex did not consult the text when preparing lectures and, unlike Blake, did not consider materials accessed through the e-textbook platform to be e-textbook engagement.

It is also possible that Alex reported use of the e-textbook *during* lectures rather than when *preparing* them. When asked how the e-textbook was used in class, Blake said, "When we would read together in class…[o]nline texts seemed to create the opportunity for distractions if we weren't monitoring them" (MayTQ). Alex revealed, "I do like using a physical textbook in the classroom" (MayTQ). Whilst it is clear that students used the physical textbook in the classroom (MayTQ), the teachers' statements suggest that they may have also.

Whereas other studies (Abaci, Morrone and Dennis, 2015; Giacomini et al, 2013; Schuh, Van Horne and Russell, 2018) have reported that instructors view the e-textbook as a tool for students rather than themselves, these teachers incorporated e-textbook materials as part of their own practice but limited students' – and perhaps their own – access to the e-textbook, relegating its use to outside the classroom. Both Alex and Blake used the e-textbook not for the content of its pages, since they were already familiar with that, but as a resource for materials to share with students. In their responses to the initial questionnaire, both teachers indicated that they used the e-textbook at least once a month to create formative or summative assessments. Alex said, “The most common tool we use from the e-textbook is the formative assessments features. I use the chapter assessments as good formative assessments for students leading up to the test” (FG4). As Table 3 shows, Alex’s top goal after adopting the e-textbook was to incorporate formative assessments (JanTQ).

Table 3: Teachers’ rankings of original goals for e-textbook use

Goal	Alex	Blake
Encourage students to highlight, makes notes, etc.	3	
Increase student collaboration		5
Increase student engagement through the e-textbook’s tools	2	4
Integrate formative assessments	1	3
Reduce time spent creating supplemental materials	4	1
Track student usage	5	2

When the teachers were asked how they worked toward achieving their original goals, Alex said, “I assigned at least one interactive assignment with students per unit – either a virtual lab or an interactive worksheet that engaged students with the various e-text tools” (MayTQ). Blake, who wanted to reduce time spent creating materials, “use[d] the e-text for slides, images, graphs and guided reading worksheets” (MayTQ). Both teachers said they taught themselves or already knew how to use the tools that helped them support students and provide opportunities for practice before assessing students. Blake also learned about the tools from a training session, but Alex “would have like the textbook rep to come out and show us best methods on how to implement the textbook with our curriculum” (MayTQ). When they implemented it three years before this study, these teachers wove the e-textbook into a larger, existing network of edtech tools (MayTQ, PM). Giacomini et al (2013) found that the e-textbook is often only one part of a complex system carefully crafted over time, which often already includes the support that e-textbook tools offer users such as supplemental multimedia support materials as well as formative and summative assessments capable of providing immediate feedback to students.

Both teachers described the e-textbook as a supplement to their instruction for students (FG4) and, aside from the materials they adapted, indicated they had little need for it. Alex said, “I [did] use the textbook to create chapter worksheet [sic] and a unit review, but I have done that in years past” (FG1). Schuh, Van Horne and Russell (2018) reported that instructors who adopted the electronic version of a physical textbook they had previously used were unlikely to use tools to mediate their interactions with a familiar text because they had no need to scaffold their understandings of content they had taught for years. The teachers’ use of the e-textbook as a resource for teaching and learning materials situated it as a replacement for its physical counterpart and further supports previous research (Giacomini et al, 2013). Despite selecting this e-textbook, neither teacher utilised its variety of affordances, constraining their use to familiar tools available through the teacher dashboard. This demonstrates a contradiction – a fundamental tension within the structure of the teachers’ activity system (Engeström, 2001) – between the teachers and the e-textbook (Figure 3) that severely restricted the e-textbook’s influence on teaching practices, thereby limiting the possibility for expansive transformations within the face-to-face environment.

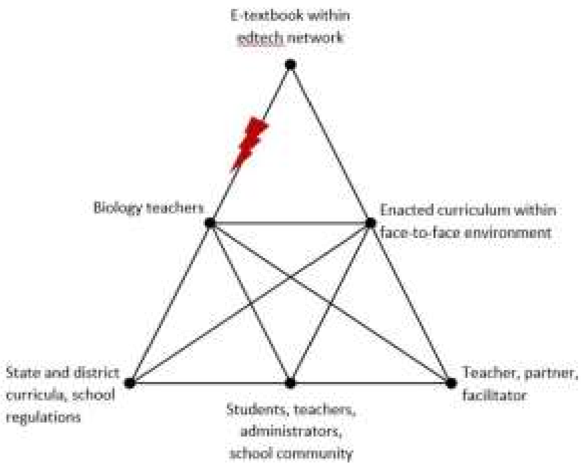

Figure 3: Activity system and tension during face-to-face environment

4.2 Online environment

When the school transitioned from face-to-face to online classes, the teachers adopted a flipped classroom approach, and their network of edtech tools became ancillary to their practice. Weekly lectures and PowerPoints that had previously helped students complete their unit objectives in class were now recorded through Zoom and posted to each teacher's new YouTube page (PM910-937). Class meetings were devoted to reinforcing concepts from the recorded lectures and answering questions. As Giacomini et al (2013) found in their study of university instructors' practices with e-textbooks, this e-textbook was part of a frequently-used network of multimedia supports.

Because of these changes Alex, who taught the on-level biology course, said once classes moved online, teaching had to be adapted to the new environment:

> *I provided more support then [sic] I did in the classroom. I helped direct students to where to find the information in the textbook, whereas in the classroom, I let them figure it out on their own or use help from a peer. (MayTQ)*

Blake, who taught the advanced biology course and previously expected students to use the e-textbook once or twice a month (JanTQ), said the e-textbook took on a new importance: "I expected [students] to use [the e-textbook] daily. All of the questions and daily assignments could be answered by using the e-text."

It must be noted that, despite a stated expectation for students to use the e-textbook, Blake's students were allowed to take home a copy of the physical textbook:

> *We told kids to grab a book if they needed it before spring break. We also gave them the opportunity after break for one day with designated times and pickup locations to grab a book if they needed one. (Blake, MayTQ)*

Alex's students, who had also used the physical textbook in class, did not have the same chance: "They were all turned in before spring break so students did not have access to the physical textbook" (MayTQ).

This new teaching mode brought with it new tools, new responsibilities, and new tensions (Figure 4). One of these tensions arose inside the subject node when Blake provided students with physical textbooks but Alex did not. Blake's decision was not surprising – after all, students had used the e-textbook in class all year – but the contrasting decisions within what had to that point been a unified team were surprising. It is unclear why both on-level and advanced students were not given the opportunity to take home a physical textbook, but each teacher had only a class set so there may not have been enough.

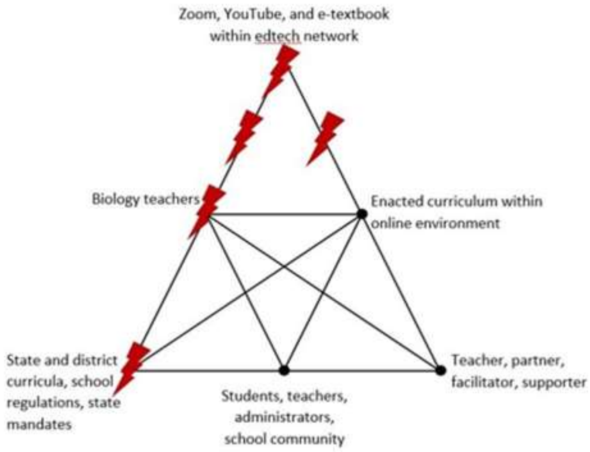

Figure 4: Activity system and tensions during online environment

The teachers, who had access to both the physical textbook and the e-textbook, tried new resources from their own e-textbooks. Blake

> *assigned a lot of "online exit questions" that were comprehension questions found at the end of assigned sections. We also did a couple virtual labs that were included in the e-text. (MayTQ)*

Although Blake found that "[l]abs toward the end of the semester were really great tools to bring the material to life" (MayTQ), Alex had a different experience: "I utilized some of the digital labs and interactions but often [found] that some of the instructions [were] unclear and confusing to students" (MayTQ). Due to these difficulties, Alex went outside the e-textbook for enrichment activities: "I often [used] HHMI, PBS, PHeT simulations, and some other digital labs instead" (MayTQ).

It was in their use of edtech enrichment materials that the teachers' practices expanded during this time. Both teachers trialled new ways of assessing students with e-textbook resources and located external materials that worked with the e-textbook curriculum rather than displacing it. Both teachers went outside the e-textbook to find supplemental videos that linked directly to the student objectives and reinforced their lectures (PM1276-1322). Blake's third sample assignment exemplified this: it prompted students to view a series of six videos on an outside website (Assign3) then incorporate that information with notes from readings and recorded lectures to write an essay that addressed the unit's overarching question (Cov3).

When asked how the experience of teaching online changed their goals for using the e-textbook and other technology in the future, both teachers indicated an intention to continue using the e-textbook.

> *[Teaching online] helped me navigate how to use it better as an instructor...I'd like to work with [students] on some of the activities they would like to "choose to do" going forward when they know how to access and use the e-text better. (Blake, MayTQ)*
>
> *I think I would like to explore more of the interactive tools that the textbook uses (such as inquiry labs and videos) to use in my classroom in lieu of some of the pen and paper assignments. Students work best if they have repeatability and don't have to go to different websites or pages to complete their work, so I would like to use the textbook more consistently. (Alex, MayTQ)*

Finding ways to implement new technologies whilst teaching within an online environment for the first time was a testament to their ability to use technology as an effective teaching tool. However, such sophisticated use of technology must be viewed in contrast to their use of the e-textbook: with the exception of assigning self-grading assessments and their intention to try new activities, the teachers' e-textbook engagement in the online environment again largely replicated their previous practices with the physical textbook.

4.3 Hybrid environment

Before the school year began, the team planned a technology-rich unit to support students inside and outside the hybrid classroom. Lectures still incorporated slides from the e-textbook and were watched outside class time, but teachers replaced YouTube with an app that prevented fast forwarding and prompted students to answer questions throughout videos (PM650-665). In class, fearing students might pass Covid-19 to one another through shared physical textbooks, the teachers decided that students would have access only to the e-textbook, a definite change from the face-to-face environment.

Because the shorter class periods associated with this hybrid environment increased the likelihood of students completing assignments at home, Alex said

> *the first thing we did was to show students how to use the e-textbook. We did a textbook scavenger hunt which showed the students how to find chapters, annotate, and highlight the textbook. (FG4)*

Despite the team's efforts to familiarise students with the e-textbook, students encountered problems.

> *The biggest issue I had was getting students to log into the book at home…[S]ometimes it was user-error and sometimes it was a compatibility issue (Casey, FG1).*
>
> *[W]e had lots of problems accessing the material, logging in, etc. (Dana, FG1)*
>
> *If students didn't remember how to log on or if they couldn't find the link – then they just gave up trying. On some devices, the online textbook just simply wouldn't load. (Alex, FG1)*

Although students continued to use the e-textbook to complete assignments at home while in hybrid mode (FG1), Alex and Blake both described students' capability to use the e-textbook as "surface level" (FG3). Alex said the team "reverted to physical textbooks while in the classroom since they were easier for students to access and use" (FG1). Dana said

An online text adds "distance" to the class and increases the anxiety of having to log in and figure out what to do next – seems trivial but the perceived extra steps are a big impediment. As soon as I could I got my kids actual textbooks and we "toured" the chapters in class…I want them familiar with the book. I want them to know that it is important and has information necessary for their success. (FG1)

It is no wonder the teachers opted to use physical textbooks in class: this was a familiar practice for them when so much of what they were doing was unfamiliar. However, the original contradiction between the teachers and the e-textbook – as well as the tensions that formed in the online environment – persisted into the hybrid environment (Figure 5). By removing the e-textbook from the classroom, these teachers removed most of the conflict present between the subject, object, and tools nodes of the activity system's upper triangle, the only part of the system that is entirely within their control.

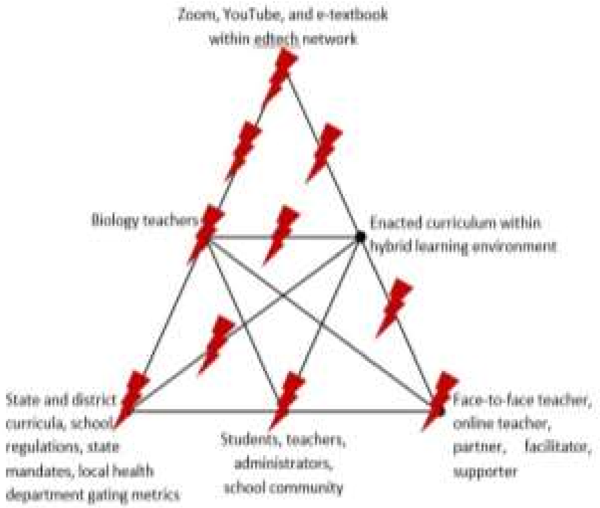

Figure 5: Activity system and tensions during hybrid environment

Alex, Blake, and Casey had used the e-textbook for three years – and the physical textbook before that – when schools adapted instructional modes in response to the pandemic. When asked how, if at all, they had adjusted their instruction since teaching with this e-textbook (FG2), they said they had not.

I really haven't modified too much of the instruction since using this book…I feel that the e-text fits what we need to do well, especially in the current climate we're in. (Blake).

I haven't modified the course that much. We still use the text as a supplement and to answer questions on worksheets or do other homework…I am trying to use more of the supplementals from the book to better reach the students. (Casey)

We have been lucky enough to be in hybrid where we can at least see the students and interact with them in the classroom. For this reason, the physical textbook remains the primary resource for class activities and worksheets and the online textbook is a supplemental resource if a student needs to use it at home. (Alex)

The teachers' responses were in keeping with previous research that found instructors maintained instructional strategies that had been successful with paper texts after adopting electronic texts (Bossaller and Kammer, 2014; Weng et al, 2018). There teachers went further and also maintained students' use of the physical textbook, something university instructors could not easily dictate. Additionally, none of the responses addressed practice but instead focussed on the stability of the course and its curriculum, and the e-textbook's role as a supplement.

This is not to say that these three teachers did not adjust their teaching during the past four years. It is more likely they tried a few new activities and resources each year, absorbing into their practice those that were successful and discarding those that were not. Some of these likely came from the e-textbook but more came from outside it. Small changes are easily overlooked, especially when teaching in the midst of a pandemic.

5. Conclusion

The findings from this study support that teachers in face-to-face environments may engage e-textbooks' supplemental materials but that they rarely engage the text or text-based tools of familiar textbooks.

Furthermore, the findings suggest teachers' lack of engagement in the traditional face-to-face environment might make it easier to reduce the use of or abandon the e-textbook altogether when tensions arise and threaten the outcome of the system's activity.

These two semesters created tensions within the teachers' activity system that had the potential to begin expansive transformations regarding the teachers' use of the e-textbook. However, the e-textbook was not fully positioned within the system before the pandemic affected the schooling environment. Expecting expansions to teachers' engagement practices during this time might be unrealistic, especially due to other changes the teachers had no choice but to implement.

Given their extensive use of edtech, these teachers were comfortable incorporating technology into their teaching but, when adopting this e-textbook, opted for familiarity over functionality. Perhaps because of a lack of training, they duplicated some available affordances through their edtech network. When selecting an e-textbook, teachers should consider how they engage textbooks and how an e-textbook can enhance existing teaching and learning practices. Only when users recognise e-textbooks' affordances can they be more than replacements for their physical counterparts and the practices surrounding such texts be transformed.

References

Abaci, S., Morrone, A. and Dennis, A. (2015) "Instructor Engagement with E-texts", *Educause Review*, [online] https://er.educause.edu/articles/2015/2/instructor-engagement-with-etexts.

Bossaller, J. and Kammer, J. (2014) "Faculty Views on eTextbooks: A Narrative Study", *College Teaching*, Vol. 62, No. 2, pp 68-75.

Cuillier, C. A. and Dewland, J. C. (2014) "Understanding the Key Factors for e-Textbook Integration into a Business Course: A Case Study", *Journal of Business & Finance Librarianship*, Vol. 19, No. 1, pp 32-60. Department for Education. (2019) "Realising the Potential of Technology in Education," [online], https://www.gov.uk/government/publications/realising-the-potential-of-technology-in-education.

Engeström, Y. (2001) "Expansive Learning at Work: Toward an Activity Theoretical Reconceptualization", *Journal of Education and Work*, Vol. 14, No. 1, pp 133-156.

Engeström, Y and Miettinen, R. (1999) "Introduction", In Engeström, Y., Miettinen, R., and Punamaki, R.L. (eds.) *Perspectives on Activity Theory*, pp. 19-38, Cambridge University Press, Cambridge.

Giacomini, C., Wallis, P., Lyle, H., Haaland, W., Davis, K. and Comden, D. (2013) "Exploring eTextbooks at the University of Washington: What we Learned and What is Next", [online], University of Washington, Seattle, https://itconnect.uw.edu/wp-content/uploads/2013/10/UWeTextCampusReport.pdf.

Karchmer-Klein, R. and Shinas, V. H. (2012) "Guiding Principles for Supporting New Literacies in Your Classroom", *The Reading Teacher*, Vol. 65, No. 5, pp 288-293.

Kress, G. (2003) *Literacy in the new media age,* Routledge, London.

Kuutti, K. (1996) "Activity Theory as a Potential Framework for Human-computer Interaction Research", in B.A. Nardi (Ed.), *Context and Consciousness: Activity Theory and Human-computer Interaction*, pp. 17-44, The MIT Press, London.

Lin,Y. C., Liu, T. C. and Kinshuk. (2015) "Research on Teachers' Needs When Using Etextbooks in Teaching", *Smart Learning Environments*, Vol. 2, No. 1, pp 1-17.

Nardi, B. A. (1996) "Studying Context: A Comparison of Activity Theory, Situated Action Models, and Distributed Cognition", in B.A. Nardi (ed.), *Context and Consciousness: Activity Theory and Human-computer Interaction*, pp. 35-52, The MIT Press, London.

Schuh, K. L., Van Horne, S. and Russell, J. E. (2018) "E-textbook as Object and Mediator: Interactions Between Instructor and Student Activity Systems", *Journal of Computing in Higher Education*, Vol. 30, No. 2, pp 298-325.

U.S. Department of Education, Office of Educational Technology. (2017) "Reimagining the Role of Technology in Education: 2017 National Education Technology Plan Update", [online], https://tech.ed.gov/files/2017/01/NETP17.pdf.

Weng, C., Otanga, S., Weng, A. and Cox, J. (2018) "Effects of Interactivity in E-textbooks on 7th Graders Science Learning and Cognitive Load", *Computers & Education*, No. 120, pp 172-184.

Wolf, M. and Barzillai, M. (2009) "The Importance of Deep Reading", in Scherer, M. (ed.), *Challenging the whole child: Reflections on best practices in learning, teaching, and leadership,* pp. 130-140, ASCD, Alexandria.

Virtual Worlds to Teach Sustainability Topics in Distance Learning

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Abstract: This paper presents new results concerning experimentation focused on the theme of environmental sustainability, carried out during the COVID-19 pandemic, using a virtual world based on the 3D platform Opensimulator. An educational environment, the "Sustainability Hub" island, has been developed where students and teacher find paths relative to exploitation of georesources, climate change, environmental sustainability indicators, and circular economy. Four schools located in different Italian regions were involved, with a total of 650 students, with ages between 11 and 13 years. Students have been divided into two groups, each experiencing the virtual world using a different mode. Tests and questionnaires have been administered to evaluate the acquisition of knowledge about sustainability topics as well as the users' level of interest for the activity and topics. From the analysis of data obtained from the teachers and students involved, we find that this virtual word was a useful and effective tool to teach sustainability in distance learning mode and, especially during COVID-19 lockdowns, it allowed the acquisition of new knowledge and interest among students. The need of a desktop or laptop personal computer, rather than tablets, and/or sometimes poor bandwidth of home internet connections, was found to be an important issue to consider for the development of distance learning activities.

Keywords: virtual worlds, teaching sustainability, distance learning, Opensimulator

1. Introduction

The United Nations resolution "Transforming our world: the 2030 Agenda for Sustainable Development" stressed the key role of education to increase awareness towards sustainability topics and improve students' skill to be real change-makers in the future. Moreover, digital literacy is considered one of the skills of the 21° century (Dede, 2009). In this framework, virtual worlds can be a useful tool to join information and communication technology (ICT) with content related to sustainability, to share with large number of students. The open-source multi-user 3D application server Opensimulator allows the creation of constructivist scenarios that follow the Wilson definition (1996) and the Jonassen principles (1999) of a constructivist platform to be used in educational contexts. Opensimulator is a flexible and customizable platform, suitable for set up learning scenarios. A specific app, called viewer (e.g. Firestorm – firestormviewer.org) is the graphical user interface to access the world and act as an avatar. Viewer built-in tools allow users 3D modeling, coding, interacting with objects and other avatars, as displayed in Table 1.

Table 1: Built-in tools in an Opensimulator-based virtual worlds' viewer

Function	Tool	Educational use
Synchronous and asynchronous communication	Text chat Voice	Brainstorming Meetings
3D Modeling	Building modeling terrain	Learning environments 3D learning objects
Coding	Interactive panels 3D learning objects	Multimedia presentations and videos Quizzes Links to web external resources 3D visualizations of concepts
Photography	Camera Photo tools	Annotation, Lessons
Movements	Walking, running, flying Animations, gestures	Role playing Storytelling
Avatar Customization	Appearance	Avatar clothes, accessories and costumes for roleplay and storytelling
Storage	Inventory	Repository of objects, scripts, textures, animation, annotation, body parts
Travel	Teleport and Hypergrid teleport	Moving from a scenario to another, also in different virtual worlds

Therefore, from a technical point of view, the Opensimulator-based virtual worlds viewers include the tools needed to work and collaborate together, with a sense of presence and students' collaboration and social inclusiveness (Contreras et al.,2018).

In Italy, the transversal teaching of civic/environmental education in the first and second cycle of education has been introduced in the school year 2020-2021, with the aim to raise awareness of responsible citizenship starting from childhood. Constitution, Sustainable Development and Digital Citizenship have been the main themes, approached in a transversal and interdisciplinary perspective, to pursue a plurality of learning objectives and skills not attributable to a single discipline only.

Meanwhile, in the same year, the majority of Italian schools were in distance learning mode, depending on regional restrictions due to COVID-19 pandemic. So, some classes were totally in remote learning, some classes in persons and others in a blended mode. Especially in exceptional situations, such as the COVID-19 pandemic, distance learning has been determinant for education and the completion of the scholastic year, although it struggled to create an environment conducive to student-centric learning.

The major challenge of distance learning is, in fact, the capacity of engaging students, avoiding the simple digitalization of a traditional lecture. Ranieri (2021) stated that, during the COVID-19 lockdowns, Italian teachers "kept on applying their usual pedagogy and books", not adjusting the teaching mode to the new forced situation.

The Italian National Institute for Documentation, Innovation and Educational Research (INDIRE) in a preliminary report (2020) highlighted that "videoconferencing lessons were the most widely pursued activities in each school order, (89.7% K1-K5 teachers, 96.7% K6-K8 teachers, and 95.8% K9-K12 teachers). This project aimed therefore to investigate virtual teaching methods more interactive than online screen-sharing of content, to better engage students and to test the possibility to use virtual worlds as laboratory experience.

In the frame of a wider research project carried out at University of Camerino, an e-learning project on 2030 Agenda Sustainable Development Goals (SDGs) has been previously carried out, using a virtual world based on the open-source multi-user 3D application server Opensimulator. The e-learning project on the 2030 Agenda was then developed to support the Citizenship Education curriculum in the Italian schools by developing a virtual island, the Sustainability Hub, dedicated to K6-K8 students, giving them the possibility to participate in two modes: a) in an interactive lesson in screen-sharing mode, or b) by accessing the world directly as avatars. This choice was made by the teachers, after a presentation of the activity and taking into consideration the availability of computers to the students.

2. The "Sustainability Hub" island

The "Sustainability Hub" island (figure 1.) resides in Techland, an Opensimulator-based virtual world managed by one of the authors (MO) and focused on STEM topics (Science, Technology, Engineering, Mathematics). Recently a section devoted to Sustainability has been added (Occhioni and Paris, 2021). The Sustainability Hub represents the starting point to approach the paths related to Sustainability and 2030 Agenda, from which students can move to other islands to deepen aspects as waste management, urban sustainability, renewable energy, geo-resources.

This island is divided into thematic areas presented in the introductory "welcome area", containing topics, project objectives, missions to carry out, and instructions for familiarization with the tools of the viewer.

Figure 1: The "Sustainability Hub" island

Then, the students can find general information regarding each topic, such as:

- the current global scenario (climate change, demographic growth, overexploitation of resources, hunger and poverty, loss of biodiversity)
- resources (concept of resource and waste, the main geo-resources, introduction to the concept of circular economy)
- sustainability indicators (water footprint, carbon footprint, ecological footprint, ecological rucksack)
- 2030 Agenda (Sustainable Development Goals and targets, sustainability pillars, objectives and results)
- the interactive game “Sustainable City” (Beccaceci et al., 2020).

In each section, it is possible to find information panels, web links to external resources, online games, interactive quizzes, as well as interactive 3D objects that explain environmental sustainability concepts. These objects are appropriately programmed for the students’ age, and to react to the user’s touch with changes in position, shape, size, colour and transparency that make "visible" the concept to be explained.

3. The experimentation

The study involved 650 K6-K8 students from 4 different schools in 4 different regions of the north, central and south Italy, during a lockdown period due to COVID-19, in the first five months of 2021. Prior to experiments with students, the island was experimented by a group of 21 teachers of elementary, middle, and high school to test its effectiveness (Occhioni et al., 2021a) and to have further comments and suggestions. Then the island was tested with a small group of 87 students from two different schools to refine the education protocol and the technical procedure (Occhioni et al., 2021b).

A large-scale experimentation followed, where 2 other schools were added to the experimentation, up to the final total of 650 students. This experimentation was included in the curricular and co-curricular activity of the school, following scheduled meetings.

To run the viewer Firestorm, it is necessary to have a desktop or laptop personal computer, since smartphones and tablets don’t work with Firestorm. Instructions to download, install and configure the viewer were previously delivered to students. So, schools chose for their classes one of the following approaches to experiment the Sustainability Hub Island, depending on the hardware requirements:

- participating in screen-sharing mode through the mediation of the researcher avatar, playing some online activities;
- accessing individually to the island as avatars and freely exploring contents after initial training using the PCs
- a blended approach, where in the same class students used one or the other mode.

The present paper shows the results of the experimentation, where students were divided in two groups, the Sharing Screen Group and the Virtual World Group. The actions characterizing the activities are reported in Table 2 and the two different approaches are compared below (sections 3.1 and 3.2).

3.1 The sharing-screen mode (SS)

The activity has been developed to meet the needs of the schools, since it was of fundamental importance to find new ways to involve the students, already emotionally affected by a long period of lockdown, to interact somehow with peers as well as engage them with something new. This activity mode activity was carried out by screen-sharing on a meeting platform. The researcher’s avatar was a kind of assistant that interacts with 3D objects and shows graphics, information, external links in screen-sharing mode on a collaborative platform. Students could interact with the educational path asking questions, making observations, requesting to deepen some topics. Through the chat, the students received links to online games and quizzes, to solve alone or in groups. In addition, all the information on the island was provided to the pupils as multimedia presentations, to be used independently.

3.2 Virtual World Group (VW)

This activity mode, developed to teaching sustainability issues as a laboratory activity, has been implemented to provide further support to students who had suitable devices and a good internet connection to access in the virtual world. The activity was divided in two meeting of 2 hours each. During the preliminary training of 2 hours, the Virtual World Group learnt to handle their own avatar in order to accomplish the missions, and to familiarize themselves with the island map and the various functions of the viewer.

Table 2: Built-in tools in an Opensimulator-based virtual worlds' viewer

Action	Screen-Sharing Group	Virtual World Group
Participation	Screen sharing mode by collaborative platforms (2-hours activity)	Access to Sustainability Hub as avatar (2-hours of training and 2-hours of activity in 2 different meetings).
Exploration	Guided exploration of the researcher avatar in screen sharing mode	Free exploration of the island Sustainability Hub
Interaction	Observing the interaction through the researcher avatar	Interaction with 3D objects to visualize concepts and get information
Communication	Meeting chat	Text chat and voice
Information fruition	Multimedia presentation by researcher in sharing screen mode	Use of educational resources independently (multimedia presentation, external web links and games)
Interactive games	Online Games (learningapp.org; genially.org)	Online Games (learningapp.org; genially.org)
Discussion	Brainstorming with teachers and researcher	Brainstorming among pairs
Self - assessment	Online forms	Interactive quizzes on interactive panels
Deepening	Consulting delivered multimedia presentation	Access to the island also at own student's pace

In this phase it was noticed how important it is for students to customize their own avatar, since they didn't start the activity until they felt comfortable with their digital identity. Then, in a second meeting, the students were free to explore the island through interactive tools for two hours, consulting information and accessing games and quizzes. They experienced the same topic as the Screen-Sharing Group, but through interactive 3D objects.

At the end of the activity a final online test and a satisfaction questionnaire were administered to both groups.

In addition, all teacher involved in the experimentation with their students participated also to online interviews and responding to satisfaction questionnaires. Their opinions were valuable to better understand the interest, motivation, and level of sustainability awareness of students.

4. Results

The data obtained from the satisfaction questionnaires and the final tests suggest that most of the participating students (575 out of 650 pupils - 88,5%) responded to the final test and the satisfaction questionnaire, 136 from the Virtual World Group and 439 from the Screen-Sharing Group. In Figure 2 results of the students' open-answer questions of the satisfaction questionnaire are shown. Answers have been grouped in categories with similar topics for simplicity. The questions were in general related to determine the perception of advantages or problems related to the use of virtual worlds and the learning about sustainability topics through this activity.

Figure 2 shows that both students' groups state that virtual worlds are fun and captivating, facilitate learning and can help to increase sustainability awareness. In addition, for both groups although especially the VW group, virtual words helped them to feel near their classmates as they were there in COVID-19 lockdown, so they appreciated this opportunity to interact with their classmates. Students of the VW group also stressed that the use of virtual worlds can improve their ICT skills. Even the Sharing-Screen group were positive with this activity highlighting there are advantages in this type of lessons. In the following, some of the students' statements from both groups are reported as examples:

"Using this virtual world was more fun and pleasant to understand the concepts related to sustainability, also because it is possible to go exploring to find games and activities to do. Even if we are in distance learning, it was still a nice experience".

"In my opinion, using a virtual world of this kind for distance learning is very innovative and appealing and make school fun and interesting".

"Although I'm not a big fan of this program, I must say it was a different experience from the usual video lesson and involved us more than usual. In my opinion, using a video game (or a virtual world) for teaching (not only when we are at a distance), could involve more students than the normal lesson if, of course, the game is well developed".

"In my opinion a virtual world of this kind can help to be closer, especially in this period, because it is a way to communicate more and to practice educational experiences despite the distance".

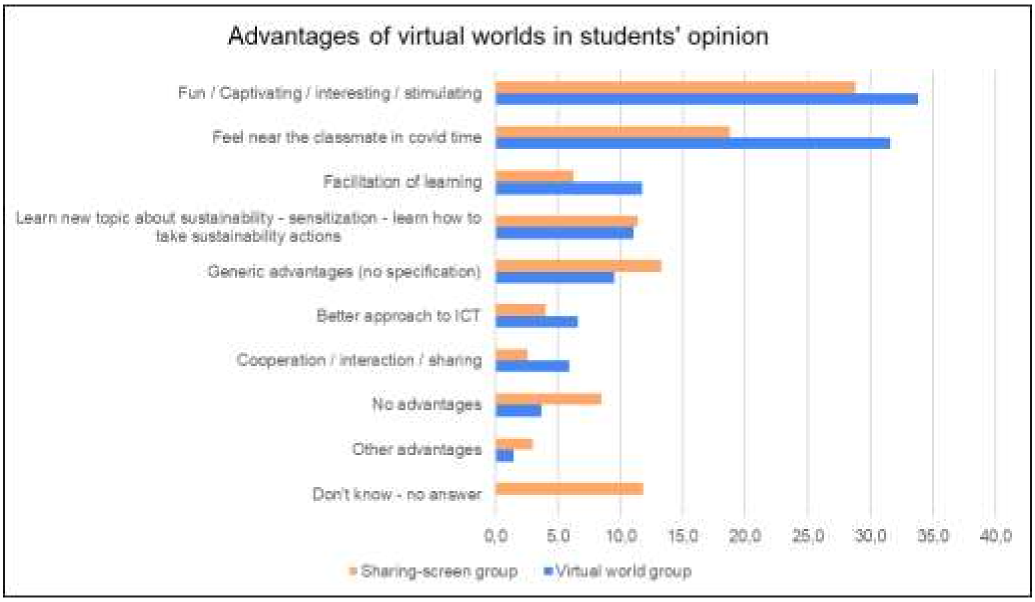

Figure 2: Results of the open-answers questions of the students' satisfaction questionnaire about the use of virtual worlds in distance learning, expressed as a percentage of responses from the total number of pupils in each group

Teachers' satisfaction questionnaires aimed to evaluate, from a didactic point of view, the interest, motivation, and sustainability awareness of students. Therefore, they observed their students during the online activities and collected their feedbacks in the days following the experimentations. Table 3 summarizes some open answers given by the 11 teachers involved in this part of the experimentation. In teachers' opinion, students showed an enthusiastic motivation and participation during the activity and a high interest on sustainability topics after the activity itself. In addition, teacher's questionnaires showed that virtual worlds facilitated a high level of engagement and the perception of "closeness to classmates during lockdown periods". This aspect was very much appreciated and evaluated as very useful for the student-student and student-teacher social interaction in the difficult lockdown period.

A final test was organized to investigate the acquisition of knowledge on some of the topics presented during the activity, which is also a way to determine if the student was actively following the lesson and taking part to the quizzes, tests or connecting to the links provided to further investigate the proposed themes. The comparison between the final-test results with those from the pre-activity test administered on the same topics (although posing the questions in a different way) it was recognized that all students significantly improved their knowledge about sustainability. In particular, the Screen-Sharing Group obtained a mean score of 61.8% correct answers, whereas better results were obtained by the Virtual World Group (76.4% of the students gave correct answers). The *p value* was less than 0.001, where *p-value*, or probability value, is a number describing how likely it is that a set of data would have occurred by random chance, i.e. that the null hypothesis is true, or no statistical difference between two sets of data.

These results demonstrate that the activities carried out for all the students participating, in both modes where effective in both engaging the students and increase their content knowledge. Moreover, the higher scores obtained by the VW Group, with the students' individual access to the island, indicate the efficacy in using virtual worlds in e-learning teaching, where the path can host laboratory activities, useful in this case of lockdown periods. In normal school time, however, this activity can be proposed to the students as a practical exercise in the computer classroom, as an extra-curricular activity to do at home or even in the frame of a project to include also acquisition of ICT skills.

Table 3: Teachers' satisfaction questionnaire open answers

Question	Answers	%
Do you think activities in virtual worlds helped students feel near their classmates during the lockdown?	Yes	90.9%
	No	9.1%
How was the students' motivation and participation	Not different respect to the normal school activity	9.1%
	Good	27.4%
	Enthusiastic	63,4%
Did you notice a greater interest of students in sustainability topics after the virtual activity?	Yes	54.5%
	No	9.1%
	Not enough time to have feedback	36.4%
Advantages	No advantages	9.1%
	students feel near their classmates	90,9%
	Ideas can be experimented immediately	9.1%
	Meet student's needs / students are protagonist of their learning	18.2%
	Interaction	18.2%
	Approach to science by game	18.2%
	Environment suitable to express creativity and useful as repository	9.1%
Disadvantages	No disadvantages	36,4%
	The need of a desktop or laptop PC	45,4%
	There is the risk that students don't recognize the activity as educational but tend to accomplished mission in a hurry as in a videogame.	9.1%
	The lack of hands-on activities	9.1%

The major challenge in experimenting this activity with students of this age range during the COVID-19 lockdown period was still determined by the large number of pupils forced to use tablets and smartphones instead of the school or home PCs, as these devices are not compatible with Opensimulator. For this reason, the students without the access to the PC were part of the SS Group, although, in some cases, teachers decided *a priori* to make all students participate using only the SS mode, to avoid inequalities among students. The PC unavailability was due also to different reasons such as the sharing of devices among brothers and sisters for online lessons, the hardware requirements of personal computers and the preference of families to buy smartphones and tablets for distance learning. The PC inaccessibility still represents a weak point to take into account when implementing these kinds of activities at home instead of in the school computer rooms.

5. Conclusion

This paper shows how Opensimulator-based virtual worlds can be an effective platform for schools in order to engage students in explorative and collaborative activities, giving them also the perception of "being there and together". During lockdowns, or as a support to the traditional teaching, this method can be used as "lab activity" with interesting and promising results, suitable for any type of subjects and open to interdisciplinary topics. The experimentation carried out on a large number of students and their teachers indicate that there is high interest in using virtual worlds which can help both in increasing the interest in STEM and improve digital and transversal skills.

References

Beccaceci, A., Occhioni, M., Stacchiotti, L. et al. (2021) "Sustainable City Game: a serious game in cardboard and 3D virtual version to engage students in sustainability topics", INTED2021 Proceedings, pp. 4372-4380. ISBN: 978-84-09-27666-0.

Contreras-Mendleta, J.A., Sarango-Lapo, C.P., Jara-Roa, D.I. et al. (2018) "Implementation of Virtual Worlds in distance studies", 13th Iberian Conference on Information Systems and Technologies (CISTI), Spain.

Dede, C., 2009 "Comparing Frameworks for 21st Century Skills", [online], Harvard Graduate School of Education, http://sttechnology.pbworks.com/f/Dede_(2010)_Comparing%20Frameworks%20for%2021st%20Century%20Skills.pdf

Jonassen, D. H. (1999) *Designing constructivist learning environments*. In *Instructional-design theories and models*: Vol. 2. A new paradigm of instructional theory, pp. 215–239, Academic Press.

National Institute for Documentation, Innovation and Educational Research INDIRE, (2020), "Pratiche didattiche durante il lockdown. Report preliminare [online]. https://www.indire.it/wp-content/uploads/2020/07/Pratiche-didattiche-durante-il-lockdown-Report-2.pdf

Occhioni, M. and Paris E. (2021) *Techland, New Educational Paths Focused on Energy Resources and Sustainability Using Virtual Worlds* in *Handbook of Research on Teaching with Virtual Environments and AI*, IGI GLOBAL, Hershey, PA, USA.

Occhioni, M., Beccaceci, A. and Paris E. (2021) "Teaching sustainability topics in virtual worlds. A preliminary Study", 14th Conference of the European Science Education Research Association ESERA

Occhioni, M., Beccaceci, A. and Paris E. (2021) "Teaching sustainability and Agenda 2030 topics in virtual worlds". EDULEARN 2021 Proceedings, pp. 5137-5141, ISBN: 978-84-09-31267-2.

Ranieri, M., (2021) "Country report on the impact of COVID-19 lockdown on schooling in primary and secondary education: Italy" in Carrettero G. et al., What did we learn from schooling practices during the COVID-19 lockdown, EUR 30559 EN, Publications Office of the European Union, Luxembourg.

United Nations, 2015, "Transforming our world: the 2030 Agenda for Sustainable Development". Resolution adopted by the General Assembly on 25 September 2015 -70/1.

Wilson, B. G. (1996) "Constructivist learning environments: Case studies in instructional design", Educational Technology.

Masters Research Papers

Studying the Impact of Gamification on Motivation in Remote Programming Education

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Abstract: With the increasing hybrid blend of face-to-face and remote study in the higher education, finding strategies to keep students motivated when working from home is pertinent. This paper describes gamification in online learning environments, from the viewpoint of individuals undertaking programming education. In this empirical study, both qualitative and quantitative research methods are employed to investigate the hypothesis that gamified motivational methods would increase students' motivation when learning programming remotely at a higher education level. This hypothesis was formed following an observed motivational drop regarding studies during the COVID-19 pandemic, combined with an observed consistency of engagement in ~~the~~ video games ~~industry~~. An initial questionnaire with 90 respondents from multiple backgrounds explores game design elements as a concept and investigates the current or historical motivation of individuals working from home. Conclusions were drawn that participants' motivation working from home were mixed, and that formative feedback and game design elements were perceived to be motivating to a learner, and these results were used to inform the design of two learner-centred virtual learning environments. These virtual learning environments were designed to facilitate programming tasks online in two settings: one being a traditional academic setting with staged communication with a virtual tutor, and the second being a gamified setting, completing missions and gaining rewards in line with a storyline. These programming environments were then used in a practical, yet remote, experiment with 25 participants who were current university students, graduates or recent education-leavers. These experiments gained statistically significant results, showing that the gamified system and specific gamified elements were found to be considerably motivating to the learner. This work therefore makes the following contribution: that gamified elements such as badges, rewards and missions do increase students' motivation when engaging with virtual learning environments for programming. This work is relevant for programming and computing educators, digital education researchers and gamification researchers.

Keywords: gamification, programming, digital education, higher education, virtual learning environment, education

1. Introduction

With the increasingly digital world in which we reside, Computer Science has had, and is having a sustained impact on the world. A High percentage of the population has a personal computer in their pocket, in the form of a mobile telephone. The world's reliance on technology has increased further due to the change to social contact methods as a result of the COVID-19 pandemic. It is therefore clear that as the use of computers increases, the need for programmers will increase. However, that need is not being met (Mims, 2014). There is a substantial divide between the supply and demand of programmers. As motivation correlates with knowledge retention (Naidr *et al.*, 2004), it is hypothesised that an increase in motivation would increase the knowledge retained and hereby the level of proficiency in programming. This paper will investigate online learning and the integration of gamification with learning solutions to address this; with the intention of uncovering methods and testing them to ascertain how students' motivation could be improved when learning programming in a higher education setting. This will then outline recommendations with which educators can design future online programming environments, to maintain high levels of student motivation with future remote or hybrid learning, to increase students' motivation when learning programming; with an aim to address the gaps in programming knowledge amongst graduates.

2. Background

With the significantly higher drop-out rate of Computer Science students in comparison to other subjects at a higher-education level (10.7% vs 5.7%-7.9%) (Lee, 2017; Mantle, 2019; The Telegraph, 2014) and those that do graduate can do so without adequate programming knowledge for the workplace (Mims, 2014). This, in combination with the current online learning culture, is the rationale behind this project. The first element to investigate is that of programming skills and student retention on a programming course. The significantly high drop-out rates could indicate a low motivation in the course overall; which would impact students' motivations in home-learning. Then, it is key to establish methods via which students can complete their work at home, with the same success as found in Chinese educational facilities (Huang *et al.*, 2020). As the increased adoption of

Virtual Learning Environments (VLEs) in the Higher Education landscape to access learning materials and online learning sessions has resulted in students undertaking more work at home.

Another hypothesis is that a lack of formative feedback reduces the motivation students have for learning programming. With the large intakes of students onto Computer Science courses due to increased popularity (Rasheed, 2020), the courses often do not have the time to have copious amounts of classes where the students are physically present. This has led to the adoption of Electronic Learning Portals (ELP) such as Blackboard Learn (Blackboard Inc., 2020). These systems allow students to access their learning materials at home and are used to facilitate online learning sessions (such as Blackboard Collaborate). Although these are vitally important to the university learning environment as, with the number of students who have other time commitments rising (Lowe and Gayle, 2007; Richardson, Evans and Gbadamosi, 2014); doing work at home can reduce the students' motivations to do coursework.

As this study focusses on the motivations of students when working from home, it is important to consider the successes of remote learning environments. Two examples of popular online learning resources are Codecademy. (Codecademy, 2020) and Khan Academy (Khan Academy, 2020). Where Khan Academy offers online resources to assist in teaching many academic subjects, Codecademy focusses on programming specifically and offers programming courses of multiple languages. The learning experience when using these two systems differs, with Khan Academy offering what may feel to be a one to one learning experience (Thompson, 2011) and Codecademy offers a fun and engaging learning experience with gamified elements such as rewards, badges and achievement recognition (Pritchard and Vasiga, 2013).

Studies have evaluated the successes of Codecademy and Khan Academy, highlighting the key features that these systems have. When comparing cost vs reward, these systems are frontrunners. Mainly because they are both free and you can become skilled in a matter of weeks or months (Mims, 2014). Secondly, for Codecademy specifically, the gamified elements have a massive motivational boost.

In addition to the more in-depth contextual understanding gamification can give to the student (Quinn, 2014), users of Codecademy pride the system on its continued engagement. Gamification, is described by Mårell-Olsson as a teaching approach aiming to 'increase student motivation and engagement' (Mårell-Olsson, 2021) and users have identified that they found unlocking avatars to be extremely motivating, with users noting that although the gamified elements weren't why they were drawn to the system, it is why they kept using it (van Roy, Deterding and Zaman, 2018). Other researchers describe the gamified elements as being addictive, due to their fun and engaging nature (Pritchard and Vasiga, 2013). Some highlight that these systems (unlike university courses) embrace the enrolment of women to the system and retain their interest levels whilst studying the course (Perkel, 2015). These elements have then been used in further experiments seen in literature. Iosup and Epema's study, brought the gamification element away from online and remote study and into the classroom, giving us a valuable insight into how gamification could be integrated into a physical learning environment (Iosup and Epema, 2014).

The main aspect to draw from Iosup and Epema's study, is the exceedingly positive impact that gamification had on the students. Although top students choose to learn for learning's sake, gamification elements caused an increase in attainment levels, student participation and student satisfaction across the board (Iosup and Epema, 2014). These were detailed in the study by means of testimonials from the students. The study also highlighted the bias that students can feel when given points by the teacher (Iosup and Epema, 2014), which became an issue when employing this strategy the a physical learning environment scope of their study. What Iosup and Epema show is, however, that gamification does have a place in the higher education system, with the limitation that their study was undertaken in a physical classroom environment.

Further literature has begun to delve into the complex topic that is gamification in learning. However, it does not investigate gamification in practice, moreover, reviewing literature regarding gamification concepts and their *possible* uses in a learning environment. The most common including Badges, Avatars, Points Levels (Dicheva *et al.*, 2015).

When evaluating the points above, it is clear that there are issues in the current Computer Science Higher Education. This study will investigate in the coming sections, what impact gamification could have on learning Programming. It will take note from the literature reviewed above on shortcomings of gamified and academic learning methods and will try to emphasise those that have succeeded in experimentation and in business. This study will try and fill the gap between the cited literature. To investigate the impact of gamification elements in a VLE on student motivation when learning programming with both an explanatory questionnaire, and a practical experiment. They will provide data to be evaluated in later sections to investigate the hypothesis that gamification will assist students with their motivation to learn programming.

3. Experiment methodology

Two elements were incorporated into the experimental methodology of this study. The former was an exploratory questionnaire, and the latter was an experiment testing two systems. One following the traditional academic settings, the other including a range of gamified elements. Both systems were guided by the literature review above and the gamified system would be designed using the data obtained from the exploratory questionnaire.

3.1 Exploratory questionnaire design

The questionnaire, delivered through Google Forms, was designed with the following goals:

- To obtain background knowledge to see whether participants were more attracted to the idea of academic learning environments or gamified learning environments.
- To see which elements of each learning style would be considered useful to take forward into the experimental system.
- To see what access to technology different participants, have at this current time, to allow for the experimental system to be designed with a wide range of technologies in mind.
- To obtain data on participants' feelings regarding working from home. As a large part of this study revolves around the point that the work undertaken is work on an online learning environment, obtaining data pertaining to overall motivation when working from home is therefore important.

To allow for remote participation in this questionnaire, the questionnaire was posted onto social media platforms. This allowed for a large range of data to be gained, from varying age groups. It was also shared with university-based society and groups to obtain the views of university-age students. Questions pertaining to missions, ranking, achievements and personalised competition were in the style of a Likert scale, from 0-10.

3.2 Exploratory questionnaire results

With 90 responses, the questionnaire gained results from ages 18-40. It clearly showed a generational difference between those that did or did not find gamification motivating. Respondents who were over 30 years of age were more motivated to improve their own rank as a reward for their own work whereas under 30s were more motivated by the instant gratification provided by receiving achievements and rewards for their work. Respondents overall were motivated when achieving grades in their prior classroom-based education and as documented extensively in literature, formative feedback remained a frontrunner in strategies that had previously motivated respondents.

When exploring the data pertaining to working remotely, there were mixed reactions when asked about their motivation when working from home. Additionally, in over 25% of cases, individuals working from home had to obtain new technologies to allow them to do so, however almost all participants owned a smartphone, with most also owning a laptop or tablet.

3.3 Experimental system design

Following the exploratory questionnaire, two systems were designed with the purpose of allowing the participants to compare one to another. The first included many gamified elements with missions, goals and rewards alongside a storyline to provide a game-like experience. The second system was designed to provide a more academic experience, using regular, simulated formative feedback and a clear indication of the student's grade as opposed to points and a score. To prevent experimental bias, the system delivery was designed to be randomised. Screenshots of both systems can be seen in figure 1.

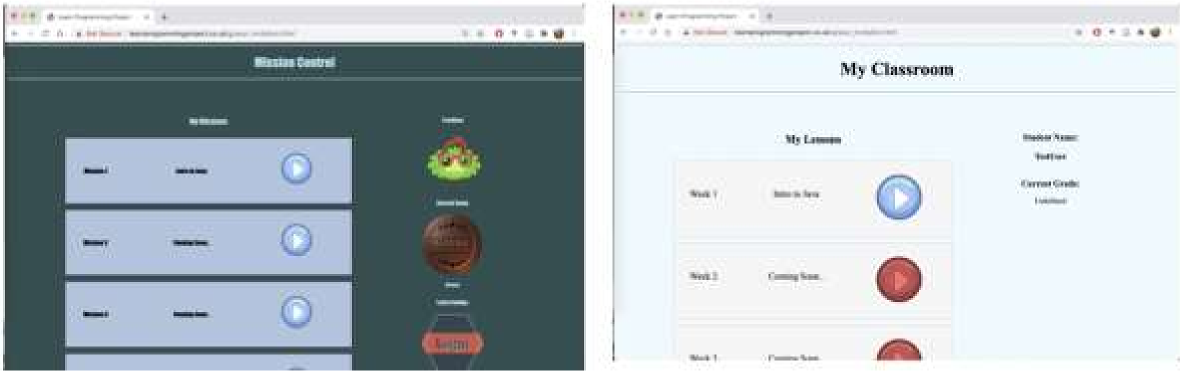

Figure 1: (Left) A screenshot of the gamified system's homepage. (Right) A screenshot of the academic system.

The gamified elements of missions, a storyline, rewards and individual ranking were established from the data evaluated in section 3.2, in combination with the literature evaluated in section 2. The academic environment was built with regular formative feedback and academic grading at its core. These elements are ingrained throughout both systems. Due to the number of questionnaire participants who had to invest in new technologies whilst owning a mobile phone, this experimental system was also designed to run on a mobile, allowing more participants to access the system with ease.

This system was designed to address a short programming curriculum plan using Java, as Java was the introductory programming language at the university at the host institution. Tasks were incorporated in the system, designed as mini-assessments in context, the importance of which can be seen in Yadev's works (Yadav *et al.*, 2016). The tasks that the participants were offered can be seen in figure 2. Tasks A and B were compulsory and tasks C and D were optional. This is with the intention of measuring participants' engagement as the number of completed tasks would be assessed as part of the experiment. The system would mark the students' work instantly, providing the instant formative feedback or reward to allow the participant to experience all elements of the system during the experiment.

Task No.	Gamified task	Academic task	Learning Aim
A	Recruit Allies by writing the codeword: SQUIRREL to the console	Write Hello World to the console	To understand that System.out.print() outputs to the console.
B	Complete a function that can be used to convey the codeword.	Complete a function that outputs to the console.	To understand how functions work and the use of variables, and the view of a class structure.
C	Complete a function to get the codeword.	Complete a function that gets a variable's value.	To understand the use of get functions within a class.
D	Complete a function to set the codeword.	Complete a function to set a variable's value.	To understand the use of set functions within a class.

Figure 2: A table containing the tasks that participants would be able to complete

In addition to the number of tasks completed, the time the user spent on each system was measured, again to determine engagement. Furthermore, post-task questions were posed to the participants use of each system. These questions explored the following areas:

Background knowledge: Similar to the exploratory questionnaire, the background knowledge section covers areas such as previously obtained qualifications, previous programming knowledge and video game knowledge.

Task questions: These questions depend on each learning environment. For the gamified learning environment, the questions explore the motivational value of the badges, rewards and ranking system. For the academic learning environment, the questions explore the motivational value of the simulated tutor feedback and grade attainment. In both sets of questions, the progress the participant made through the tasks is checked, as this could be indicative to the engagement the system provides; and the questions ask users' views on each individual learning environment.

Comparison questions: These questions explore the users' opinions on the two different learning environments, finding out which elements they find more motivating. It will also explore the ease with which the users are able to interact with the system. This section will also investigate the participants' motivation when learning previously in both classroom environments and home learning environments as this was an area of further exploration noted in the first questionnaire.

3.4 Experimental system results

The experiment described above was completed by 25 participants across four different demographics based upon highest qualification level as follows: GCSE (2), A-Level (8), Bachelor's Degree (9), Master's Degree (6). Participants were asked whether they were studying/had studied/intended to study Computer Science, of which 21 of the participants shared. There were no external incentives given to take part as to not influence the outcome. The experiment was undertaken with students who were either recent graduates or current university students, suggesting that findings closely matched the opinions of current students. Therefore, this group can be seen as representative of individuals who would use this system in the future.

The results show that the gamified learning environment was preferred in comparison to the academic learning environment with 17 participants selecting the gamified version, 4 showing equal preference and 4 preferring the academic learning environment.

When investigating the qualitative feedback on individual elements of each system (ranking system, badges and overall motivation for the gamified system; tutor feedback, grade attainment and undertaking tasks for the academic system), the three gamified elements were more motivating to the participants than the academic elements, with badges and rewards having the most motivation. This was determined with scores that users gave regarding how motivating they found the system, conveyed on a Lycett scale and can be seen in Figure 3.

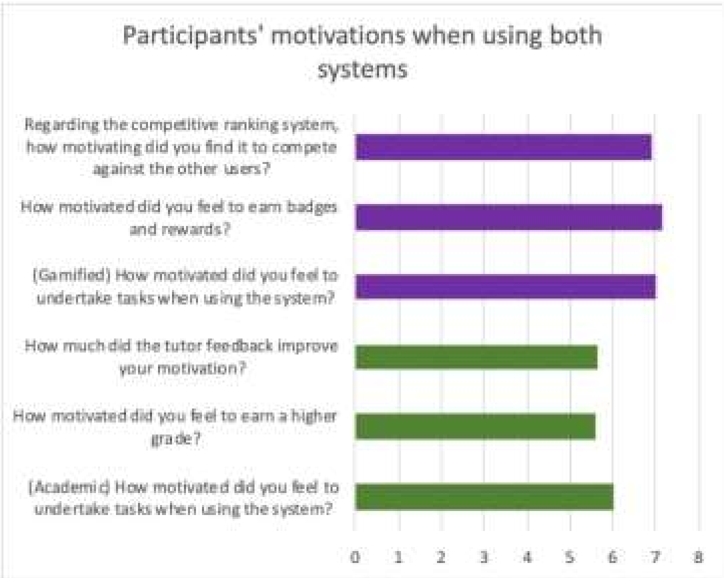

Figure 3: A bar chart showing participants' motivation in relation to elements of each of system

A two-way ANOVA was run on the 25 participants to examine the effects of the gamified and academic environments on participants' motivation when using the completing the tasks. There was a significant interaction between the effects of incorporating gamified and academic environments on motivation ($\rho = .015$). This was then followed up with two a paired T-tests with a 99% confidence interval. The first explored the overall motivation when each system, obtaining a result of $\rho = .006$ and the second compared the means of all three questions (two for features and one for overall motivation seen in Figure 3) obtaining a result of $\rho = .003$. This shows that the null hypothesis can be rejected and that the type of learning environment and features incorporated into these environments make a clear difference to students' motivation as reflected in Figure 4.

When investigating the amount of time spent in each system, participants spent more time on the gamified system again reflecting on its engagement. However, one element that was not as popular in the gamified system, was the competitive ranking system. There were mixed scores regarding motivation in a competitive ranking scenario, and it obtained a mean motivation score of 6.92. P8's feedback detailed that they felt "*that the leaderboard should be an opt-into scenario as some who may use the system may have anxiety about their* *performance being compared"*. When comparing this against the wider mental health profile of the UK, making design decisions that have positive mental health implications should be prioritized.

Qualification Level	Gamification Motivation Mean	Academic Motivation Mean	Preference
Masters	6.66	6	Equal
Bachelors	7.33	6.22	Gamified
A-Levels/Equivalent	6.75	5.5	Gamified
GCSE/Equivalent	7.5	7	Gamified

Figure 4: Table showing the correlation between different qualifications and their respective motivation and preference

4. Discussion

The main finding to discuss as a result of this study is the clear motivational impact that the gamified elements had on engagement during introductory programming tasks. This can be shown by the evidence gained in both the exploratory questionnaire and the experiment. This work builds on the work of Domínguez et al. (Domínguez *et al.*, 2013) and does show the benefit of gamification and reinforces the findings of Iosup and Epema's study (Iosup and Epema, 2014) outside of the physical classroom.

One element which is present in the gamified system, was the use of competitive ranking against peers during learning. This received mixed feedback in both the questionnaire and in the experiment and suggests future implementation of this element should be undertaken with caution and an opt-in approach could be used. It is clear from this study as it was the participants' most important measure of learning as shown in the experimental questionnaire results.

4.1 Limitations

The conclusions drawn from this study have to be considered with the following limitations. Due to when the project was undertaken, the individuals (most of whom had previous programming knowledge) there was no additional learning materials. This system is designed to be used alongside a course, so although feedback shows that more in-depth descriptions are needed, in practice, students would have access to slides and other resources provided by the tutor. This is the same case for tutor feedback in the system itself. Due to the nature of the experiment conditions, the feedback given was standard, and did not change based upon the student. This would not give a full impression of built-in tutor feedback to the participant and should be included in further study.

5. Conclusions

The difficulties in student retention and engagement in Computer Science higher education have been investigated for several years. As yet no 'magic bullet' has been discovered. This study focused on gamification and the impact of integrating gamified elements into programming environments for students' motivation when learning programming. The results show that this is the case, and that the integration of gamified elements do have a positive impact on students' motivation. Previous work was uncertain in this matter and our study seems to reinforce that given many computer science students play digital games, it seems natural that they respond to familiar motivating factors in the learning place.

In a world which seems to have been accelerated by the pandemic towards more in-place or in-home learning. We need to acknowledge that students' time for learning is in competition with more distracting forces in the home, forces which are designed to be far more compelling. Remote education offers many distinct advantages including flexibility and scalability. Education about computer science must adapt to students' social and cultural aspects and their learning contexts. This is necessary for the ongoing success of this discipline.

6. Future work

To provide detailed feedback for the staff to go alongside environments such as this, future study could include investigating recording and visualisation methods to assist tutors in observing where students are struggling, how often students had to repeat a task and where their efforts can be focussed in the classroom.

As part of this future study, involving existing programming tutors in the design of the system, producing it in a user-centred manner, would increase the usability of the system and would ensure that the system met the needs of the tutor. Additional investigations include assessing the long-term benefits to student attainment with use of a system such as this and would the increased motivation cause higher grades over time?

Although gamification has been shown to not have cognitive impacts on students' work (Domínguez *et al.*, 2013) it has been shown to have impacts on the update and student retention of subjects that were previously struggling with attendance rates (Rohrbach, 2018). When considering research relating to this system specifically, reviewing the system further with students in a participatory design methodology to investigate additional elements that may benefit the system could be a further area of future study.

References

Blackboard Inc. (2020) *Blackboard Learn*, *Blackboard.com*. Available at: https://www.blackboard.com/teaching-learning/learning-management/blackboard-learn (Accessed: 12 July 2020).

Codecademy (2020) *Learn to Code - for Free*, *Codecademy*. Available at: https://www.codecademy.com/ (Accessed: 12 July 2020).

Dicheva, D. *et al.* (2015) 'Gamification in Education: A Systematic Mapping Study', *Journal of Educational Technology & Society*, 18(3), pp. 75–88.

Domínguez, A. *et al.* (2013) 'Gamifying learning experiences: Practical implications and outcomes', *Computers & Education*, 63, pp. 380–392. doi: 10.1016/j.compedu.2012.12.020.

Huang, R. H. *et al.* (2020) 'Handbook on Facilitating Flexible Learning During Educational Disruption: The Chinese Experience in Maintaining Undisrupted Learning in the Covid-19 Outbreak'. Smart Learning Institute of Beijing Normal University.

Iosup, A. and Epema, D. (2014) 'An experience report on using gamification in technical higher education', in *Proceedings of the 45th ACM technical symposium on Computer science education - SIGCSE '14. the 45th ACM technical symposium*, Atlanta, Georgia, USA: ACM Press, pp. 27–32. doi: 10.1145/2538862.2538899.

Khan Academy (2020) *Khan Academy | Free Online Courses, Lessons & Practice*, *Khan Academy*. Available at: https://www.khanacademy.org/ (Accessed: 12 July 2020).

Lee, G. (2017) *Which universities have the highest first year dropout rates?*, *Channel 4 News*. Available at: https://www.channel4.com/news/factcheck/which-universities-have-the-highest-first-year-dropout-rates (Accessed: 12 July 2020).

Lowe, J. and Gayle, V. (2007) 'Exploring the work/life/study balance: the experience of higher education students in a Scottish further education college', *Journal of Further and Higher Education*, 31(3), pp. 225–238. doi: 10.1080/03098770701424942.

Mantle, R. (2019) *Non-continuation summary: UK Performance Indicators 2017/18 | HESA*, *The Higher Education Statistics Agency*. Available at: https://www.hesa.ac.uk/news/07-03-2019/non-continuation-summary (Accessed: 12 July 2020).

Mårell-Olsson, E. (2021) 'Using gamification as an online teaching strategy to develop students' 21st century skills', *Interaction Design & Architecture(s)*, 47(Winter 2020-21), p. 25.

Mims, C. (2014) *Computer Programming Is a Trade; Let's Act Like It*, *The Wall Street Journal*. Available at: http://gnoinc.org/wp-content/uploads/Computer-Programming-Is-a-Trade-Lets-Act-Like-It-WSJ.pdf (Accessed: 5 May 2019).

Naidr, J. P. *et al.* (2004) 'Long-Term Retention of Knowledge After a Distance Course in Medical Informatics at Charles University Prague', *Teaching and Learning in Medicine*, 16(3), pp. 255–259. doi: 10.1207/s15328015tlm1603_6.

Perkel, J. M. (2015) 'Pick up Python: A powerful programming language with huge community support.', Toolbox, p. 2.

Pritchard, D. and Vasiga, T. (2013) 'CS circles: an in-browser python course for beginners', in *Proceeding of the 44th ACM technical symposium on Computer science education - SIGCSE '13*. *Proceeding of the 44th ACM technical symposium*, Denver, Colorado, USA: ACM Press, p. 591. doi: 10.1145/2445196.2445370.

Quinn, C. (2014) 'Gaming Learning', in Sutton, B. and Basiel, A. (eds) *Teaching and Learning Online: New Models of Learning for a Connected World*. New York, NY, USA: Routledge, pp. 227–242.

Rasheed, R. (2020) *Top ten most popular courses in the UK*, *Complete University Guide*. Available at: https://www.thecompleteuniversityguide.co.uk/student-advice/what-to-study/top-ten-most-popular-courses-in-the-uk (Accessed: 12 July 2020).

Richardson, M., Evans, C. and Gbadamosi, G. (2014) 'The work–study nexus: the challenges of balancing full-time business degree study with a part-time job', *Research in Post-Compulsory Education*, 19(3), pp. 302–309. doi: 10.1080/13596748.2014.920582.

Rohrbach, J. (2018) *Council Post: How New Technologies Are Changing Language Learning, For Better And Worse*, *Forbes*. Available at: https://www.forbes.com/sites/forbesnycouncil/2018/05/10/how-new-technologies-are-changing-language-learning-for-better-and-worse/ (Accessed: 13 July 2020).

van Roy, R., Deterding, S. and Zaman, B. (2018) 'Uses and Gratifications of Initiating Use of Gamified Learning Platforms', in *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems*. *CHI '18: CHI Conference on Human Factors in Computing Systems*, Montreal QC Canada: ACM, pp. 1–6. doi: 10.1145/3170427.3188458.
The Telegraph (2014) *University degree subjects with the highest dropout rates - Telegraph*, *The Telegraph*. Available at: https://www.telegraph.co.uk/education/educationpicturegalleries/11002595/University-degree-subjects-with-the-highest-dropout-rates.html (Accessed: 12 July 2020).
Thompson, C. (2011) *How Khan Academy Is Changing the Rules of Education*, *Wired*. Available at: https://www.wired.com/2011/07/ff_khan/ (Accessed: 30 June 2020).
Yadav, A. *et al.* (2016) 'Expanding computer science education in schools: understanding teacher experiences and challenges', *Computer Science Education*, 26(4), pp. 235–254. doi: 10.1080/08993408.2016.1257418.

Data-Driven Understanding of Computational Thinking Assessment: A Systematic Literature Review

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DOI: 10.34190/EEL.21.115

Abstract: A movement to include problem-solving and computer science in k-12 education has sparked significant interest in introducing computational thinking (CT). CT education is mainly defined as teaching and learning problem-solving skills. CT is considered a 21-century skill, and like other essential skills aiming to educate students as efficient members of the technology-dependent society, CT learning and assessment are associated with the use of technology-enhanced learning methods and environments. Although most researchers categorize CT skills into three groups, including CT concepts, practices, and perspectives, there is no consensus view regarding CT assessment methods to evaluate these three CT skill categories. Addressing this gap, we explored key topics in the computational thinking assessment (CTA) literature using a data-driven approach for topic modeling. We analyzed 395 articles in CTA literature and identified 11 research topics of CTA. We also performed a network analysis to explore the key links between CTA's identified topics. Based on the results from topic modeling, we presented CTA methods and categorized the assessment tools based on their assessment strategy and the types of CT skills they aim to evaluate. Also, the paper analyzes the identified assessment methods based on the purpose of assessment and the different types of insights they provide for the evaluation of CT skills. The paper discusses the advantages of new forms of CTA through technology compared to traditional assessment methods and provides recommendations for further studies.

Keywords: computational thinking (CT), assessment, topic modelling, machine learning, data-driven, new media

1. Introduction

The development of new technologies and the emergence of student-centered learning theories have changed the learning environments and educational purposes in recent years. Nowadays, along with the new opportunities that technology-enhanced learning environments provide for students' learning, students are required to learn new forms of skills named new media skills. New media skills are the kind of skills required to prepare students as a member of technology-dependent society (Jenkins, 2006). Computational thinking (CT), as an essential 21st-century topic, is considered one of the daily life skills rather than a set of skills used by computer programming specialists (Wing 2006; Labusch, 2018). Based on this belief, computational thinking has become a crucial skill that future generations must develop (De-Marcos et al., 2014).

Since 2006, when Wing used the term computational thinking for the first time, scholars have emphasized the need for teaching CT skills at an early age (Papavlasopoulou et al., 2018). However, even with this burgeoning interest, there is a lack of shared understanding of how CT skills can be developed and assessed. Compared to traditional educational skills, CT skills are mainly associated with cognitive and problem-solving abilities and aim to be thought through technologically enhanced environments. The differences of CT learning with traditional education require new methods to assess students' skill acquisition in CT. This study aims to explore CTA literature to address the following questions: a) What topics have been studied in CTA, and what research themes influence CTA? b) What are the assessment methods and tools in CTA, and how can they be improved using the new learning concepts through new media?

2. Literature review

2.1 Computational thinking

Various studies in the literature provide different definitions for CT. Some studies define CT as a cognitive process, while others highlight it as a problem-solving approach (Zhang and Nouri, 2019). CT literature indicates that the definitions differ based on the goals, skills, and context of implementing CT (Tang et al., 2020). Drawing from programming and computing concepts, many researchers defined CT as the process of programming, designing for usability, improving computational concepts, computational problem-solving, and system thinking. On the other hand, the definitions that emerged from CT's non-programming activities focus on CT's operational and real-life applications. The following two paragraphs provide an overview of the formation of CT definition over time.

CT was not a topic of interest until Wing (2006) introduced it as the approach to "solving problems, designing systems, and understanding human behavior, by drawing on the concepts fundamental to computer science" (p. 33). Also, she stated that computational thinking is about conceptualization, not programming. Later, Guzdial (2008) mentioned CT as a problem-solving process that focuses on abstraction, evaluation, modeling, and automation. With the rise in the importance of CT, the International Society for Technology in Education (ISTE) and the Computer Science Teacher Association (CSTA) defined CT as a problem-solving process that includes the following as its primary characteristics: formulating problems, logical thinking, representing data through abstractions, simulation, automating solutions through algorithmic thinking, and identifying, evaluating, and implementing possible solutions.

All the above definitions are common in that none of them explicitly mentions programming languages for CT acquisition. However, this is not a universal belief about CT. Brennan & Resnick (2012) stated that programming is essential in CT education. Their proposed theoretical framework presented three dimensions including, computational concepts (programming terms of sequences, loops, events, parallelism, conditionals, operators, and data flow), computational practices (iteration, debugging, and abstraction), and computational perspectives (expressing, questioning, and connecting). Another CT framework classifies CT into four dimensions: data practice, modeling and simulation, problem-solving, and system thinking (Weintrop et al., 2016). Since there is no unified CT definition, its definition changes depending on the context and tool (Kirwan et al., 2018). This study uses the CT dimensions presented by Brennan & Resnick (2012).

2.2 Computational thinking assessment

The diversity in CT definition indicates that it is impossible to limit CTA to one of the programming or non-programming constructs. As a result, the same as CT definition, the CTA tools and techniques must differ based on CT's various implementations. Also, the discussions surrounding CT definitions indicate the complex structure of CT (Allsop, 2019). So, it is not practical to restrict CTA to programming constructs as the CT process also involves practices and perspectives. Exploring CTA literature, we can find a wide range of different assessment techniques and methods, including qualitative, quantitative, and mixed-method approaches (Weese, 2016).

3. Method

Given the diversity in CTA, we relied on an unsupervised machine learning approach to develop CTA topics from the literature. Unsupervised machine learning is a technique to discover latent dataset categories (Deveaud et al., 2014). The steps of the conducted systematic literature review are discussed in the following.

3.1 Data collection

We obtained peer-reviewed conference and journal publications in CTA from five databases, including ACM, IEEE, Scopus, Web of Science, and ScienceDirect, as shown in Table 1. The data source included titles, abstracts, and keywords of research items in CTA literature. Referring to Wing's (2006) study as the starting point for the CT studies, we retrieved all related publications since 2006. The query used for data collection was {Topic: ("computational thinking" AND (measur* OR assess* OR evaluat* OR "learning analytics" OR "data mining")}. The word "Topic" in the search query refers to the articles' titles, abstracts, and keywords.

Table 1: Overview of data collection and data selection

Data Source	Number of Search results	Number of Selected research items
ACM	218	112
Web of Science	534	192
IEEE	153	59
Scopus	422	174
ScienceDirect	40	33
Total	1,367	570

3.2 Data selection

Two researchers manually checked the search results regarding their relevance to the CTA field. Also, we excluded the literature review papers as they include a wide range of various concepts. Table 1 shows the number of selected documents from the scientific databases.

3.3 Data preprocessing

Preprocessing of data refers to the process of identifying a collection of meaningful data items and word-features. This collection is called core vector scape (CVS). Our original collected data included 570 documents with a total of 5,462 word-features. Aiming to find a homogenous CVS, we performed the following preprocessing tasks: duplicate removal, outlier removal, stop word elimination, lowercasing, special character removal, n-gram processing, lemmatization, and normalization based on CT context to standardize the different word forms. Finally, we used the *Sklearn* python package to identify relevant word-features. During that process, the following groups of words were deleted: words appeared less than two times in the dataset, significantly high-frequency CT-related words, high-frequency words commonly used in scientific contexts, document-related words such as acronyms, and general English words. This process led to the selection of a CSV with 395 research documents and 356 word-features.

3.4 Data analysis

We performed Latent Dirichlet Allocation (LDA) from python's Gensim package to find the hidden topics in the CVS. Although LDA is an unsupervised machine learning technique, it must be given the number of topics as a parameter. Four metrics, including Arun2010, CaoJuan2009, Deveaud2014, and Griffiths2004 (Cao et al., 2009; Deveaud et al., 2014), were used to identify the number of topics. This analysis led to the selection of 11 topics as the optimal number of clusters for topic modeling and network analysis.

4. Findings

This section presents the results from topic modeling and network analysis.

4.1 Computational thinking assessment topics

The following paragraphs of this section present a description of each of the 11 identified topics of CTA. The sample studies mentioned for each topic are among the ten top documents of each topic. In Figure 1., which represents these 11 research topics, a binary adjacency matrix visualizes the topics. The black cells of the matrix show similarity between the two corresponding documents, and the borders represent the topics of documents. Each cluster's size is associated with the number of documents within that cluster, and the density of clusters shows the homogeneity of the associated topics. For interpreting and naming the obtained topics, we considered both the size and homogeneity of the topics.

Topic 1, named "Teacher development", addresses studies related to enhancing and evaluating teaching concepts in CT, including CT curriculum, pedagogy (Kang et al., 2018), and teacher development in both CT knowledge and teaching skills. The methods for the assessment of teachers' knowledge include surveys, self-assessment (Kang et al., 2018), and evaluation of self-efficacy and attitude toward coding and teaching CT (Rich et al., 2020).

Topic 2, named "Problem-Solving Skills", refers to concepts from complex problem-solving skills. Studies in this topic mainly include two types of assessment: First, tools to measure cognitive abilities required for reasoning and problem-solving (Román-González et al., 2017); Second, methods to evaluate the impact of programming on cognitive development (Park et al., 2015). Cognitive development is significant as it can promote students' problem-solving abilities. Problem-solving competencies are among 21st-century skills and refer to cognitive-related skills such as programming and mathematical thinking. Measuring cognitive skills can reveal students' capabilities for acquiring CT skills. Also, this topic addresses the measurement of intelligence and psychometric (Hubwieser and Mühling, 2015) aspects related to learning CT. The main computational assessment tools in the studies of this topic are statistical methods.

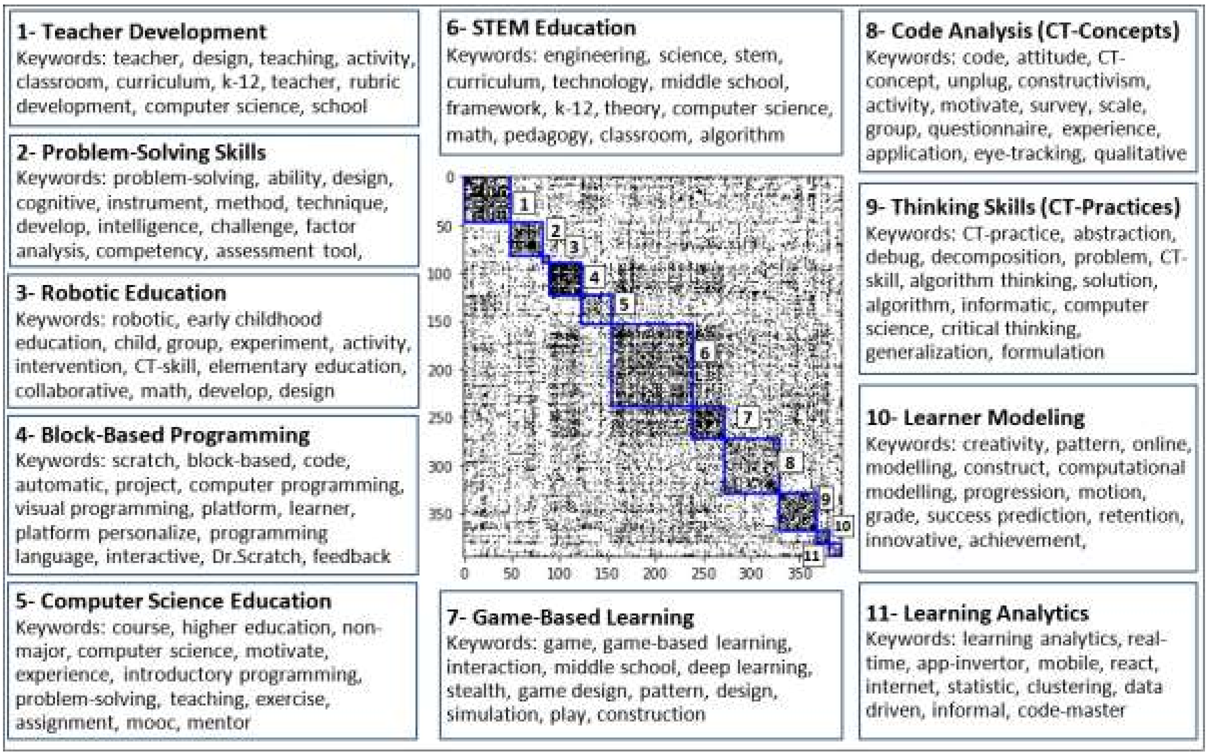

Figure 1: Identified research topics for CTA

Topic 3, named "Robotic Education", mainly addresses CT learning for early childhood and elementary level students. This topic includes both unplugged (Miller *et al.*, 2019) and plugged-in (Kong, Chiu, and Lai, 2018) activities in k-12 education. Robot programming can be used in various educational levels, such as maze-solving robot programming for high schoolers (Fronza, Ioini, and Corral, 2017) and tangible robot programming for kindergarteners (Roussou and Rangoussi, 2020). Collaborative learning and teacher intervention are among the main concept related to assessment in the studies of this topic.

Topic 4, named "Block-Based Programming", addresses CTA in Scratch programming. Scratch is a popular block-based programming software developed to promote CT knowledge in elementary and middle-grade learners (Brennan, Chung, and Hawson, 2011). This topic addresses Dr.Scratch as an automatic web-based tool for assessing Scratch projects and SAT as a modern scratch project analysis tool (Chang et al., 2018). These assessment tools mainly evaluate students' skills in the CT concepts dimension.

Topic 5 is named "Computer Science Education", refers to assessing problem-solving skills in university-level programming courses. The studies included in this topic use a wide range of qualitative, quantitative, and mixed-method approaches for CT evaluation (Romero et al., 2017; Weese, 2016).

Topic 6 is named "STEM Education" and is related to developing and improving the CT curriculum and pedagogy to integrate CT in STEM education. The CTA methods and techniques in this cluster include rubric-based assessment (Bortz et al., 2019), summative assessment such as national exams (Zur-Bargury et al., 2013), formative assessment (Hadad Roxana and Thomas, 2019), and self-assessment of students. Except for CT concepts and practices, some studies of this topic evaluate the skills in the CT perspective dimension.

Topic 7, named "Game-Based learning", addresses CT development through playing (Hooshyar *et al.*, 2021) and game construction (Jenson and Droumeva, 2016). This topic includes different assessment methods, such as evaluating learners' reflection interviews (Litts, Lewis and Mortensen, 2019), analyzing students' game development artifacts based on programming constructs (Werner, Denner and Campe, 2015), measuring students' motivation during playing games, and the use of machine learning and deep-learning techniques (Min *et al.*, 2019) to predict students' CT learning.

Topic 8, named "Code Analysis", mainly refers to assessing CT concepts using different code evaluation methods. For example, eye-tracking is a recent technique for analyzing students' coding activities (Papavlasopoulou et al., 2020). This topic also includes evaluating students' attitudes during and after coding activities. Except for computational methods, some studies used qualitative analysis, such as interviews (Benvenuti, Chioccariello and Giammoro, 2018) and pre/post-test analysis of students' coding skills (Arfé et al., 2020).

Topic 9, named "Thinking Skills", mainly refers to evaluating CT practices, such as abstract thinking and decomposition (Djambong Takam and Freiman, 2018; Sondakh, Osman, & Zainudin, 2020).

Topic 10, named "Learner Modeling", refers to modeling and predicting students' CT learning, creativity, innovative thinking, attitude, and success rate using computational methods (Rao et al., 2018).

Topic 11 is named "Learning Analytics" and refers to automatic or real-time methods of evaluating students' CT skills. This topic addresses the use of statistics, data-mining (Souza et al., 2019), machine-learning (Jeon et al., 2018), and learning analytics (Grover *et al.*, 2017).

4.2 Network and factor analysis

Figure 2. shows a network of the 11 identified topics. The nodes represent the corresponding topics in Figure 1. Each node is connected to at least three most similar nodes based on topic keywords.

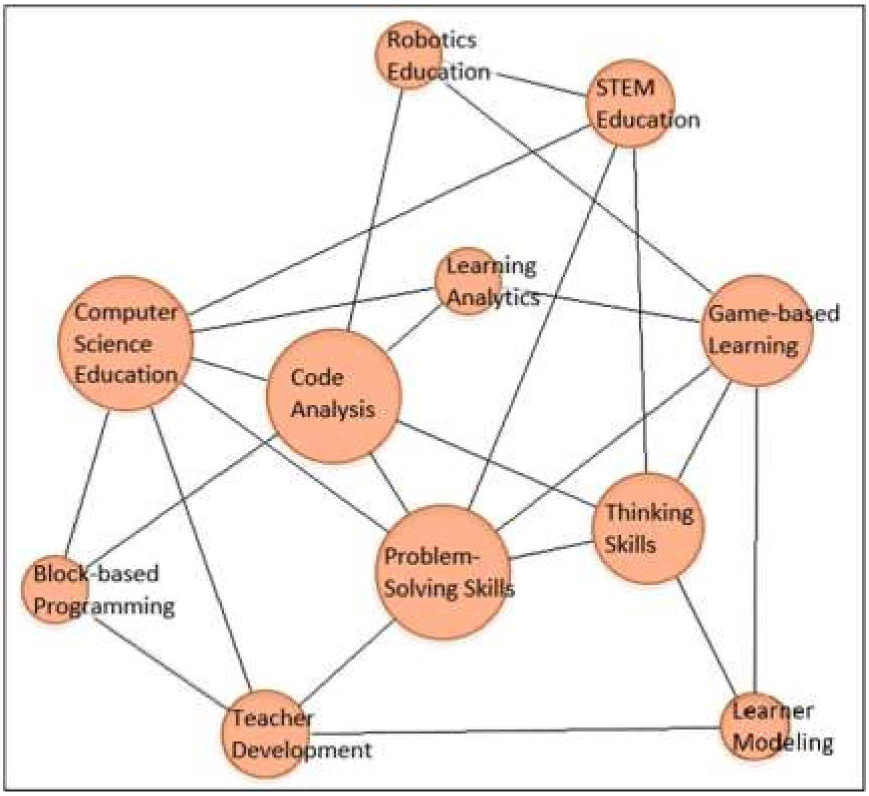

Figure 2: Network of research topics

5. Discussion

Addressing the first research question, we identified 11 topics in the result section and presented a network of topics based on common top keywords of topics. In Figure 2, the larger network nodes represent the topics with higher similarity to the other topics. Also, the size of nodes is associated with their related topics' frequency in the CTA literature.

Based on the network analysis results, "Computer Science Education" is one of the main topics in CTA. Different studies utilized assessment methods from computer science, such as "Code Analysis", to assess CT artifacts. The development of Coding skills in CT aims to enhance students' "Problem-Solving" and "Thinking Skills" through learning environments suitable for CT education. "Game-based Learning", "STEM Education", and "Robotics Education" are three technology-enhanced educational environments for CT education. However, regarding the use of technology and new media, we must be aware that new media does not necessarily mean new learning/assessment (Cope and Kalantzis, 2013). Although digital media through games, coding, and robotics education can provide a flexible and exciting learning environment for CT learners, as long as the computational assessment is only a digitized form of traditional assessment, CTA will not help students perform better through the use of technology. As a result, the studies related to "learning analytics" and "computational modeling" in the CTA field should provide those forms of insights and information that can not be obtained without computational methods. For reporting assessment results, learning analytics dashboards are another tool that can improve CT assessment by assisting teachers to achieve a better understanding of students' learning. Finally, the studies related to the "Teacher Development" topic address enhancing teachers' knowledge of CT, developing skills required for teaching and assessing students' CT learning, and measuring teachers' attitudes toward CT. Teacher development is mainly related to educating teachers in coding, block-based programming, and robotics, as these areas are the most common learning environments for formal CT education in schools.

Responding to the second research question, in the following, we discussed some of the key CTA tools and methods mentioned in the identified topics. We mainly focus on formative assessment, which refers to dynamic or ongoing assessment. The formative assessment strategy is widely used in CTA studies, while summative assessment, which aims to evaluate learners' content knowledge at the end of a course or each lesson, has been mentioned in limited CTA studies.

Different studies have utilized computational methods to assess CT. Srinivas et al. (2018) used Scratch logs to measure CT concepts and practices. Montaño et al. (2019) analyzed students' performance in gamified CT environments by analyzing game logs. However, the literature indicates that automatic assessment methods focus on the level of code complexity, not the meaning (Hoover et al., 2016). As a result, the automated methods are suitable to measure technical mastery, not creativity, which is a skill in the highest cognitive levels. Based on Dewey's theory of creativity, creativity should be measured by the usefulness of a solution, its value, and originality (Mihai, 2016). In recent years, through qualitative methods and learner modeling, the attempts to measure higher cognitive levels of CT skills are rising, and authors are becoming more interested in adopting multiple evaluation approaches to address all CT skills (Allsop, 2019). Based on the topic modeling results, we can imply that even though there are fewer studies for assessing CT perspectives dimension, most of these studies have been conducted in recent years, and this research area is growing.

Some of the automated formative CTA tools are as follows. Dr.Scratch is a tool for automatic assessment of students' codes, and Foundations for Advancing Computational Thinking (FACT) has multiple-choice, low-stakes, and high-frequency quizzes that measure students' understanding of computational concepts and gives hints for further enhancement (Grover, Pea, and Cooper, 2015). Another tool for the automated assessment of Scratch codes is the Functional Understanding Navigator! or FUN! tool (Brasiel Sarah and Close, 2017). Also, some of these tools, such as Real-Time Evaluation and Assessment of Computational Thinking (REACT), provide real-time assessment of students' CT projects (Basawapatna et al., 2015). All of these tools focus on the assessment of CT concepts and CT practices.

Except for the abovementioned tools, Some CTA studies focus on evaluating and activating prior knowledge or utilizing pre-tests to measure students' attitudes and interests. CT literature indicates that prior knowledge is a strong predictor of CT learning outcomes (Grover, Pea, and Cooper, 2015). Self-assessment is another evaluation strategy in CTA literature. Self-assessment can improve students' cognitive development and make them more responsible in their learning process (Shepard, 2000). For example, The #5c21 model uses self-assessment of learners as a measurement strategy (Romero, Lepage, and Lille, 2017). The same as self-assessment, peer assessment is used in CTA to give students the agency of their learning process and motivate them. Portelance et al. (2015) analyzed recorded videos from the peers' artifact-based interviews to evaluate students' CT skills in the perspective dimension, including reusing, expressing, and connecting. Peer assessment can help students learn from each other, question themselves and their peers, discuss their code, and find a solution. Both self-assessment and peer-assessment activities let teachers ignore students' mistakes and involve students in their learning (Shepard, 2000).

6. Conclusion

This study identified eleven topics in CTA literature from 2006 to 2021 and used a network of topics to explore the topic connections. Also, assessment tools and methods for CT were discussed. CT is a skill among 21-century skills required for students to perform as efficient members of the technology-based society. CT education uses different technology-enhanced learning environments to improve students' problem-solving skills and to assess their CT skills using automated or human-based evaluation methods. However, the use of technology as new media or assessment tool does not guarantee new forms of learning. In some computational assessment practices, the rush to adapt to technology-enhanced learning can develop old ways of assessment using new technologies. For CTA to assess required 21-century skills, the assessment methods should focus on student-centered learning theories by providing insights that are not accessible using traditional assessment. Automated analysis of students' codes and CT artifacts, student modeling based on learner behavior, using data analytics techniques and dashboards to create user-friendly reports, personalization of learning process and assessments based on students' interest, behavior, and academic differences are among the benefits that computational analyses methods can bring to the CTA field. In the future, extensive use of advanced computational methods such as image processing, face and gesture detection, and wearable sensors can improve CTA and decrease the need for human-based qualitative assessment methods for evaluating CT at higher cognitive levels.

References

Allsop, Y. (2019) 'Assessing computational thinking process using a multiple evaluation approach', International Journal of Child-Computer Interaction. Vol. 19, pp. 30–55. doi: 10.1016/j.ijcci.2018.10.004.

Arfé, B., Vardanega, T. and Ronconi, L. (2020) 'The effects of coding on children's planning and inhibition skills', Computers & Education, 148, p. 103807. doi: https://doi.org/10.1016/j.compedu.2020.103807.

Benvenuti, M., Chioccariello, A. and Giammoro, G. (2018) 'Programming to learn in Italian primary school', in Cutts, Q and Brinda, T (ed.) Proceedings of the 14th Workshop in Primary and Secondary Computing Education (WIPSCE). doi: 10.1145/3361721.3361732.

Bortz, W. W. et al. (2019) 'Missing in Measurement: Why Identifying Learning in Integrated Domains Is So Hard', Journal of Science Education and Technology. doi: 10.1007/s10956-019-09805-8.

Brasiel Sarahand Close, K. and J. S. and L. K. and J. P. and M. T. (2017) 'Measuring Computational Thinking Development with the FUN! Tool', in Rich Peter J.and Hodges, C. B. (ed.) Emerging Research, Practice, and Policy on Computational Thinking. Cham: Springer International Publishing, pp. 327–347. doi: 10.1007/978-3-319-52691-1_20.

Brennan, K., Chung, M. and Hawson, J. (2011) Scratch Curriculum Guide Draft, Harvard Graduate School of Education. Available at: http://scratched.gse.harvard.edu/resources/scratch-curriculum-guide-draft (Accessed: 3 July 2021).

Brennan, K. and Resnick, M. (2012) 'New frameworks for studying and assessing the development of computational thinking', in American Educational Research Association. Vancouver, Canada, pp. 135–160. doi: 10.1007/978-3-319-64051-8_9.

Cao, J. et al. (2009) 'A density-based method for adaptive LDA model selection', Neurocomputing, Vol. 72, No. 7, pp. 1775–1781. doi: https://doi.org/10.1016/j.neucom.2008.06.011.

Chang, Z. et al. (2018) 'Scratch Analysis Tool(SAT): A Modern Scratch Project Analysis Tool based on ANTLR to Assess Computational Thinking Skills', in 2018 14th International Wireless Communications Mobile Computing Conference (IWCMC), pp. 950–955.

Cope, B. and Kalantzis, M. (2013) 'New Media, New Learning and New Assessments', E-Learning and Digital Media. SAGE Publications, Vol. 10, No. 4, pp. 328–331. doi: 10.2304/elea.2013.10.4.328.

De-Marcos, L. et al. (2014) 'An empirical study comparing gamification and social networking on e-learning', Computers and Education.

Deveaud, R., SanJuan, E. and Bellot, P. (2014) 'Accurate and effective Latent Concept Modeling for ad hoc information retrieval', Document Numerique, Vol. 17, No. 1, pp. 61–84. doi: 10.3166/dn.17.1.61-84.

Djambong Takamand Freiman, V. and G. S. and P. M. and C. M. (2018) 'Measurement of Computational Thinking in K-12 Education: The Need for Innovative Practices', in Sampson Demetriosand Ifenthaler, D. and S. J. M. and I. P. (ed.) Digital Technologies: Sustainable Innovations for Improving Teaching and Learning. Cham: Springer International Publishing, pp. 193–222. doi: 10.1007/978-3-319-73417-0_12.

Fronza, I., Ioini, N. El and Corral, L. (2017) 'Teaching Computational Thinking Using Agile Software Engineering Methods: A Framework for Middle Schools', ACM Trans. Comput. Educ. New York, NY, USA: ACM, Vol. 17, No. 4, pp. 19:1–19:28. doi: 10.1145/3055258.

Grover, S. et al. (2017) 'A Framework for Using Hypothesis-Driven Approaches to Support Data-Driven Learning Analytics in Measuring Computational Thinking in Block-Based Programming Environments', ACM Trans. Comput. Educ. New York, NY, USA: ACM, Vol. 17, No. 3, pp. 14:1–14:25.

Grover, S., Pea, R. and Cooper, S. (2015) 'Designing for deeper learning in a blended computer science course for middle school students', Computer Science Education. Routledge, Vol. 25, No. 2, pp. 199–237. doi: 10.1080/08993408.2015.1033142.

Guzdial, M. (2008) 'Education paving the way for computational thinking', Communications of The ACM, Vol. 51, No. 8, pp. 25–27. doi: https://doi.org/10.1145/1378704.1378713.

Hadad Roxanaand Thomas, K. and K. M. and Y. Y. (2019) 'Practicing Formative Assessment for Computational Thinking in Making Environments', Journal of Science Education and Technology. doi: 10.1007/s10956-019-09796-6.

Hooshyar, D. et al. (2021) 'An adaptive educational computer game: Effects on students' knowledge and learning attitude in computational thinking', Computers in Human Behavior, Vol. 114, p. 106575. doi: https://doi.org/10.1016/j.chb.2020.106575.

Hubwieser, P. and Mühling, A. (2015) 'Investigating the Psychometric Structure of Bebras Contest: Towards Mesuring Computational Thinking Skills', in 2015 International Conference on Learning and Teaching in Computing and Engineering, pp. 62–69.

Jenkins, H. (2006) 'Confronting the Challenges of Participatory Culture: Media Education for the 21st Century. An Occasional Paper on Digital Media and Learning.', John D. and Catherine T. MacArthur Foundation, Vol. 2, No. 2, pp. 97–113.

Jenson, J. and Droumeva, M. (2016) 'Exploring Media Literacy and Computational Thinking: A Game Maker Curriculum Study', Electronic Journal of e-Learning, Vol. 14, No. 2, pp. 111–121.

Jeon, H., Oh, H. and Lee, J. (2018) 'Machine Learning based Fast Reading Algorithm for Future ICT based Education', in 2018 International Conference on Information and Communication technology Convergence. New York, NY, USA, pp. 771–775.

Kang, E. J. S., Donovan, C. and McCarthy, M. J. (2018) 'Exploring Elementary Teachers' Pedagogical Content Knowledge and Confidence in Implementing the NGSS Science and Engineering Practices', JOURNAL OF SCIENCE TEACHER EDUCATION, Vol. 29, No. 1, pp. 9–29. doi: 10.1080/1046560X.2017.1415616.

Kirwan, C., Costello, E. and Donlon, E. (2018) 'Computational thinking and online learning: A systematic literature review', in Proceedings of the European Conference on e-Learning, ECEL, pp. 650–657.

Kong, S.-C., Chiu, M. M. and Lai, M. (2018) 'A study of primary school students' interest, collaboration attitude, and programming empowerment in computational thinking education', Computers & Education. Pergamon, Vol. 127, pp. 178–189. doi: 10.1016/J.COMPEDU.2018.08.026.

Labusch, A. (2018) 'Fostering Computational Thinking through Problem-Solving at School', in Proceedings of the 2018 ACM Conference on International Computing Education Research. New York, NY, USA: Association for Computing Machinery (ICER '18), pp. 276–277.

Litts, B. K., Lewis, W. E. and Mortensen, C. K. (2019) 'Engaging youth in computational thinking practices through designing place-based mobile games about local issues', Interactive Learning Environments. doi: 10.1080/10494820.2019.1674883.

Miller, B. et al. (2019) 'Unplugged Robotics to Increase K-12 Students' Engineering Interest and Attitudes', in Proceedings - Frontiers in Education Conference, FIE. Institute of Electrical and Electronics Engineers Inc. doi: 10.1109/FIE.2018.8658959.

Min, W. et al. (2019) 'DeepStealth: Game-Based Learning Stealth Assessment with Deep Neural Networks', IEEE Transactions on Learning Technologies, p. 1. doi: 10.1109/TLT.2019.2922356.

Papavlasopoulou, S., Giannakos, M. N. and Jaccheri, L. (2018) 'Discovering children's competencies in coding through the analysis of Scratch projects', in 2018 IEEE Global Engineering Education Conference, pp. 1127–1133. doi: 10.1109/EDUCON.2018.8363356.

Papavlasopoulou, S., Sharma, K. and Giannakos, M. N. (2020) 'Coding activities for children: Coupling eye-tracking with qualitative data to investigate gender differences', Computers in Human Behavior, 105, p. 105939. doi: https://doi.org/10.1016/j.chb.2019.03.003.

Park, S.-Y., Song, K.-S. and Kim, S.-H. (2015) 'Cognitive load changes in pre-service teachers with Computational Thinking education', International Journal of Software Engineering and its Applications. Science and Engineering Research Support Society, Vol. 9, No. 10, pp. 169–178. doi: 10.14257/ijseia.2015.9.10.17.

Rao, R. J. et al. (2018) 'Assessing Learning Behavior and Cognitive Bias from Web Logs', in 2018 IEEE Frontiers in Education Conference (FIE), Vol. 1, pp. 1-5.

Rich, P. J., Larsen, R. A. and Mason, S. L. (2020) 'Measuring teacher beliefs about coding and computational thinking', Journal of Research on Technology in Education. Taylor and Francis Inc. doi: 10.1080/15391523.2020.1771232.

Román-González, M., Pérez-González, J.-C. and Jiménez-Fernández, C. (2017) 'Which cognitive abilities underlie computational thinking? Criterion validity of the Computational Thinking Test', Computers in Human Behavior. Pergamon, 72, pp. 678–691. doi: 10.1016/J.CHB.2016.08.047.

Romero, M., Lepage, A. and Lille, B. (2017) 'Computational thinking development through creative programming in higher education', International Journal of Educational Technology in Higher Education, Vol. 14, No. 42, p. 15. doi: 10.1186/s41239-017-0080-z.

Roussou, E. and Rangoussi, M. (2020) 'On the use of robotics for the development of computational thinking in kindergarten: Educational intervention and evaluation', Advances in Intelligent Systems and Computing. Edited by K. G. B. R. O. D. Merdan M. Lepuschitz W. Springer Verlag, 1023, pp. 31–44. doi: 10.1007/978-3-030-26945-6_3.

Shepard, L. A. (2000) 'The Role of Assessment in a Learning Culture', Educational Researcher, Vol. 29, No. 7, pp. 4–14. doi: 10.3102/0013189X029007004.

Sondakh, D. E., Osman, K. and Zainudin, S. (2020) 'A proposal for holistic assessment of computational thinking for undergraduate: Content validity', European Journal of Educational Research. Eurasian Society of Educational Research, Vol. 9, No. 1, pp. 33–50.

Souza, A. A. de et al. (2019) 'Data Mining Framework to Analyze the Evolution of Computational Thinking Skills in Game Building Workshops', IEEE Access, 7, pp. 82848–82866. doi: 10.1109/ACCESS.2019.2924343.

Tang, X. et al. (2020) 'Assessing computational thinking: A systematic review of empirical studies', Computers and Education. Elsevier Ltd, 148(January), p. 103798. doi: 10.1016/j.compedu.2019.103798.

Weese, J. L. (2016) 'Mixed Methods for the Assessment and Incorporation of Computational Thinking in K-12 and Higher Education', in Proceedings of the 2016 ACM Conference on International Computing Education Research. New York, NY, USA: ACM (ICER '16), pp. 279–280. doi: 10.1145/2960310.2960347.

Weintrop, D. et al. (2016) 'Defining Computational Thinking for Mathematics and Science Classrooms', Journal of Science Education and Technology, Vol. 25, No. 1, pp. 127–147.

Werner, L., Denner, J. and Campe, S. (2015) 'Children Programming Games: A Strategy for Measuring Computational Learning', ACM Transactions on Computing Education, Vol. 14, No. 4. doi: 10.1145/2677091.

Wing, J. M. (2006) 'Computational Thinking', Communications of the ACM, Vol. 49, No. 3, pp. 33–35.

Zhang, L. and Nouri, J. (2019) 'A systematic review of learning computational thinking through Scratch in K-9', Computers & Education. Elsevier, 141, Vol. 141, p. 103607. doi: 10.1016/j.compedu.2019.103607.

Zur-Bargury, I., Pârv, B. and Lanzberg, D. (2013) 'A Nationwide Exam as a Tool for Improving a New Curriculum', in Proceedings of the 18th ACM Conference on Innovation and Technology in Computer Science Education. New York, NY, USA: Association for Computing Machinery (ITiCSE '13), pp. 267–272. doi: 10.1145/2462476.2462479.

Work in Progress Papers

Exploring the Most Effective Modality to Present Online Material to Language Students

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DOI: 10.34190/EEL.21.090

Abstract: This study seeks to identify the most effective way to present online content to language learners with the aim of maximising learning benefits and engagement. As teachers are the gatekeepers of content, we believe it is fundamental to understand how they, as well as learners, perceive the different modalities in which it is presented. This paper will present the preliminary results from a pilot study with learners of Spanish as a Foreign Language (FL) in Hong Kong and trainee teachers in Spain. The project has developed a FL online course to test different ways of presenting information to learners using a combination of modalities. The focus of the course is the marker "se", a specific linguistic unit that is seldom taught explicitly in the classroom but that occurs frequently in both the written and spoken language, and is critical to the production and comprehension of nuanced Spanish. Our preliminary results suggest that trainee teachers prefer the video modality but consider the audio modality a novel way of presenting content. The textual modality, however, is considered as the most traditional and "boring" to learners. This is confirmed by the results from the Hong Kong learners who indicate that the audio modality was more rewarding and appealing than the textual one (the results from the video had not been received at the time of writing). These results are encouraging as they suggest an alignment of trainee teachers' perceptions and actual learner engagement despite the cultural differences between the two groups.

Keywords: online content, teaching modality, teacher perception, learner engagement, input modalities, Foreign Language teaching

1. Introduction

Cultural diversity and technological breakthroughs in the past few decades have changed our communication and, consequently, foreign language learning/teaching (Tzirides 2020). What used to be considered an effective setting for teaching is now being questioned, as "learners nowadays live in fast paced, constantly changing times and they have developed different needs comparing to the past." (Tzirides 2020, p. 141). Even before the COVID-19 global pandemic, the advances in technology have been offering many opportunities to be used in the communicative classroom. What COVID-19 did was accelerate the need to adapt teaching, as formal foreign language teaching in educational institutions has been particularly hit by the situation. More and more of our teaching is transferred online, and it is essential that we understand how our audience prefers to learn. Some individuals prefer texts, others audio and yet others choose images or videos.

Despite having a body of research that shows no significant relation between learning styles and student performance (Coffiel, Moseley, Hall and Ecclestone 2004; Price 2004 cited in Hassan et al. 2019), learner engagement and performance do seem to be correlated (Askari, Makvandi and Neisi 2020; Ladd and Dinella 2009), explaining why pedagogues do take them into account when developing teaching materials. Learning preferences by modality, and by extension teaching preferences, seem to be strongly linked to the style of teaching experienced in earlier years. However, the discussion so far has mostly centred on these as individual learners' learning styles rather than situational cultural or educational preferences moulded by previous experiences (Lopez-Ozieblo 2018). Considering that many FL teachers might not share a cultural affiliation with their learners, in the vein of teacher cognition studies (Borg 2003), it is valuable to investigate teachers' beliefs and preferences in terms of the various modalities content can be presented in and how this matches learners' levels of engagement.

Learning requires engagement with the content being learnt. In this pilot study we sought to investigate the level of learner engagement achieved by each of the three modalities used to present content to learners, and also trainee teachers' expectations of those levels of engagement.

2. Background

Existing studies based on virtual learning do not provide conclusive results as to the most beneficial modality in which to present content (Macedonia and Klimesch 2014). These studies highlight the cognitive load imposed on learners, which varies with the content presented but also with how that content is presented. So far, existing studies have led to contradictory conclusions. Schnotz, Boeckheler and Grzondziel (1999) report learners experience cognitive overload when presented with certain types of animated input while Mayer and Moreno (2003) report an easing of cognitive load with narrated animation. Further research on cognitive load has been called for by a number of researchers (Brüncken, Plass and Leutner 2003; Paas, Tuovinen, Tabbers and Van Gerven 2003). Mayer and Moreno (2003) noted that it is difficult to evaluate the levels of cognitive load imposed by the various instructional materials available to learners, partly because this might depend on individual experiences (Lopez-Ozieblo 2018).

Those learner differences affect learners' levels of engagement. Schaufeli and colleagues define engagement as: "a positive, fulfilling, work-related state of mind that is characterized by vigor, dedication, and absorption" (Schaufeli, Salanova, González-Romá and Bakker 2002, p. 74). Engagement is linked to academic achievement (Askari, Makvandi and Neisi 2020; Park 2003) and thought to be the integration of behavioural, cognitive, emotional and agentic components (Christenson, Reschly and Wylie 2011; Fredericks, Blumenfeld and Paris 2004; Reeve and Tseng 2011; Schaufeli et al. 2002). Behavioural engagement refers to personality traits such as effort, vigour and persistence. Cognitive engagement is related to the management and use of learning strategies. Emotional engagement refers to the emotional reactions to the learning process, such as enthusiasm, boredom, pride and challenge. Agentic engagement, a newer component proposed by Reeve and Tseng (2011), refers to learner's motivation both intrinsic and extrinsic.

A number of studies have linked levels of engagement to modality-based learning preferences (Halif et al. 2020; Hashim, Aris and Chan 2019; Stan and Plăiaşu 2018), suggesting that how content is presented affects engagement levels. However, the pedagogic recommendations are usually to present materials in a variety of modalities (Ko and Rossen 2010). Preparing online audio-visual materials is very time consuming and worth exploring their benefits versus less elaborate materials. With this study, we sought to explore the levels of learner engagement with three different input modalities as well as the expectations of future teachers about those levels to inform a subsequent study that will correlate levels of engagement with learning benefits.

2.1 Measuring engagement

O'Brien, Cairns and Hall (2018) indicate that the level of engagement of online course users depends on a number of factors including the level of challenge to learners, the aesthetic and sensory appeal of the content, feedback, interactivity and perceived level of control, among others. In order to calculate users' level of engagement, O'Brien and her colleagues developed a self-reporting tool, the *User Engagement Scale* (UES), which has subsequently been adopted in over 40 studies (O'Brien et al. 2018). The UES asks the user some simple questions about their difficulties in completing the activity, as well as questions on their interest in and perception of the experience, to evaluate their level of engagement. The UES was adapted for the purposes of this study (see Appendices).

3. Objectives

This pilot project had two objectives: (1) to identify what type of modality Spanish trainee teachers believe will engage language learners when learning content online; (2) to identify what type of modality engages HK Spanish FL learners when learning content online.

4. Methodology

The project has developed a series of online units, focusing on three different modalities: text, audio, and video+audio to present different functions of the marker "se". One of these functions (the middle voice "se" to indicate personal care of one's body) was presented to trainee teachers in the three modalities for analysis. Each trainee teacher, working individually, analysed one modality, using an adapted version of the UES to indicate their perceived level of engagement for learners with that unit/modality. Trainee teachers had to indicate their full or partial agreement or disagreement with a series of statements on a 1 to 4 Likert-type scale (1 = I completely disagree; 2 = I mostly disagree; 3 = I mostly agree; 4 = I completely agree). The statements included: The unit captures the students' attention; it can be confusing for students; it can be tiring for students; it has an attractive format; it can be engaging; it can be gratifying; it can be interesting; it is well sequenced. Later, in groups of 4 to 6, trainee teachers compared the three modalities together and provided their answers in a report.

For the Hong Kong learners of Spanish as a foreign language, three different functions of "se" were presented in three separate units, each following one modality. After completing each unit, participants also completed a version of the UES. Learners had to indicate their full or partial agreement or disagreement with a series of statements on a 1 to 5 Likert-type scale (1 = I completely disagree; 2 = I mostly disagree; 3 = I am not sure; 4 = I mostly agree; 5 = I completely agree). We added the neutral option 3 in order not to force learners to agree or disagree with the statements. The statements included: I was completely engaged by this module; the time I spent doing this module just slipped away; I felt frustrated while doing this module; I found this module confusing; doing this module was taxing; the format of this module is attractive; this module appealed to my senses; this experience was rewarding; I felt interested in this experience; I found the "SE" explanation easy to understand; I found the story easy to understand; I liked the last activity. The responses to the UESs and the trainee teachers' reports were analysed and the findings are presented below.

The content and its sequence were the same in the three modalities. The textual unit did not contain any illustrations to facilitate comprehension. The audio-visual unit minimized the use of text by omitting subtitles, although the instructions in the exercises were given textually. The audio modality contained no related illustrations and also minimized its use of text. For this last modality, instructions were given as text and audio.

4.1 Participants

The participants were 66 trainee teachers in their first year of an undergraduate course on Spanish language and its didactics studying at the University of Alcala, Spain. Their participation was a requirement of the subject and their reports were evaluated. In addition, eight learners of Spanish as a foreign language volunteered to participate (over 20 learners were asked but only 8 had completed at least two units at the time of writing). The proficiency of the learners varied between low to medium A2 (according to the Common European Framework of Reference for Languages). They were all learners of the same higher education institution in Hong Kong.

4.2 Procedure

The units were designed using the software *iSpring* and presented online, each following the same structure: (1) brief administrative introduction, (2) a story (presented as a text, audio or video), (3) questions related to the comprehension of the content of the story, (4) a grammar explanation of the specific function of "se" (presented as a text, audio or video), (5) questions on the function of "se", (6) additional and very brief, grammar explanation on the "se", (7) more exercises on the "se", (8) a final free production exercise (write a text, record an audio or a video) and finally the UES. Written text was included in all modalities as learners at the A2 level are at a low intermediate stage and are still very dependent on written text. The units developed for the trainee teachers can be accessed at: http://www.hispanicstudies.net/hispanicstudies/SEintro.html.

Before starting the units, learners completed a test to evaluate their knowledge of the various functions of the grammatical particle "se" to be covered by the project. After completing all the units, learners will be asked to retake the test and the learnings correlated with their evaluation of the various modalities. In addition, participants were asked to fill in a personal adaptation of the *Learning Style Survey: Assessing Your Own Learning Styles* developed by Cohen, Oxford and Chi (2002), based on Oxford's categorization of learning styles. The results from these two tasks are not covered in this paper.

4.3 Analysis

The trainee teachers were divided into 13 groups of 4 to 6, preassigned by the teacher. A total of 53 valid UES answers and thirteen reports were received. Data from the trainee teachers was analysed using a mixed methods approach. Twenty-two trainee teachers analysed the textual modality, 17 the video and 14 the audio. Not all of the responses had been received from the Hong Kong-based leaners by the time of writing. Thus, we can only report on the preliminary results for the text and audio modalities. Mean values were calculated for each of the statements and compared by modality using a series of ANOVAs. Learner's data was manipulated to eliminate option 3 = I am not sure.

5. Results and discussion

Overall, the results indicate that all trainee teachers agreed fully or partially that the three modalities could be interesting, engaging, attractive in format and content and gratifying to complete. All units were considered to be adequately sequenced. The differences in how the modalities are perceived are generally very small. Figure 1 presents the mean evaluations given by the trainee teachers.

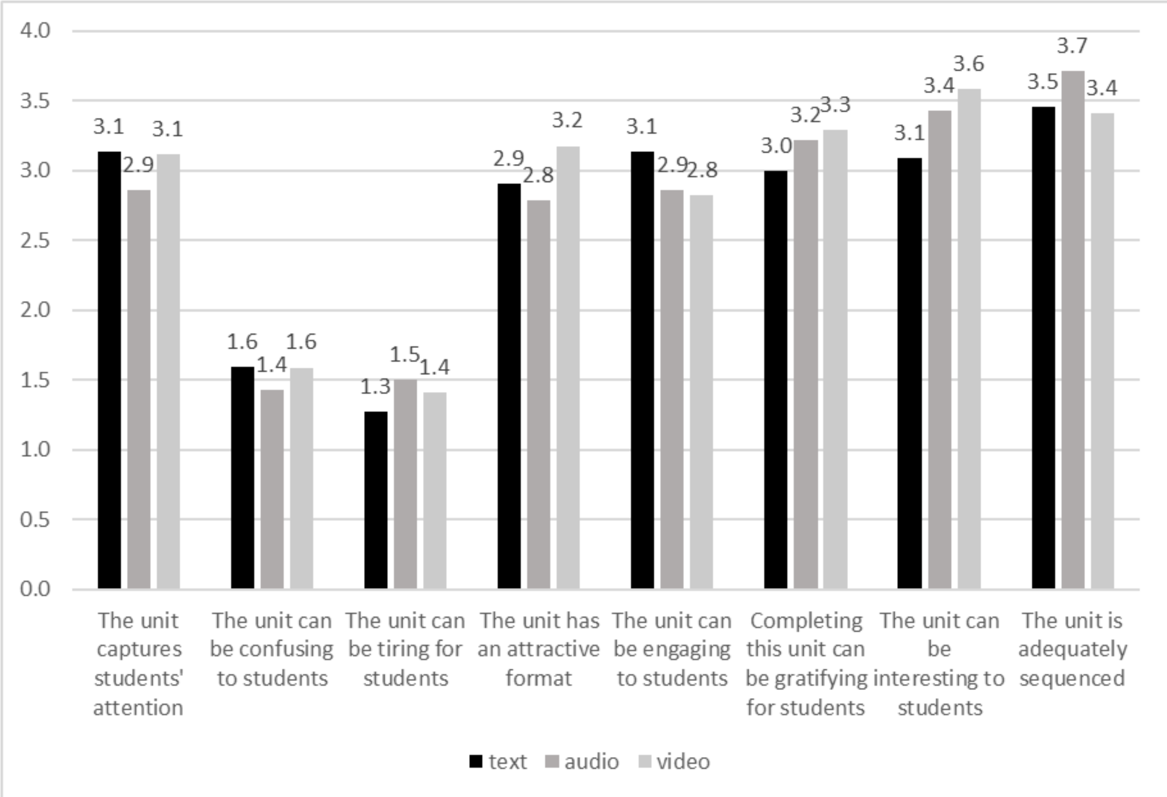

Figure 1: Means of trainee teachers' answers to the UES

The ANOVAs do not indicate any significant differences in the overall perceptions of the three modalities. However, trainee teachers considered the video modality as the most interesting and gratifying one to learners and its format the most engaging. The text was considered the least gratifying and interesting modality but the most engaging and just as likely as the video to capture learners' attention.

The qualitative analysis explained some of the quantitative results, but there were some discrepancies. Despite the data suggesting that the text was likely to be the most engaging modality, it was reported as the least preferred option. Trainee teachers commented on this being the traditional modality to present content to learners in the classroom and that it would lead to low engagement levels. They thought learners might be bored by it, needing to concentrate more than with audio or video modalities. It was considered to be cognitively more challenging and more tiring than the other modalities. Learners with reading difficulties were noted to be disadvantaged by a text-only modality. However, it was also recognized that, aside from the content of the story, it would be easier for learners to note the linguistic elements.

All trainee teachers unanimously agreed on the video modality as the preferred one, as it was felt that it matched how children and youth today interact with the world (mostly through digital audio-visual media). It was believed that this modality facilitates information retention and is engaging. Moreover, it was suggested that subtitles ought to be added to the videos, thus providing the content in three modalities at the same time.

Interestingly, the audio unit was considered a novel task and, for this very reason, it was evaluated as attractive and engaging. It was believed to be more suitable to autonomous learners, although the learning was thought to be more abstract than through the video modality. However, it was not considered suitable at all for deaf learners or those with hearing difficulties. In general, the participants felt that the audio would be easier than the text to follow as it contained prosody, which makes it easier to understand. Nonetheless, and even though the audio could be replayed as often as necessary, it was noted that without a transcript learners might lose the thread of the narration and not be able to get back to it.

The preliminary results of the learners' perceptions (Learners' UES) indicate that there is no significant difference in the evaluation of the two modalities tested so far, text and audio (although the sample is too small to be statistically valid). The main point to note is that learners seemed to find the content easier to understand when presented textually (this will be confirmed once the results of the exercises within each unit have been analysed). Figure 2 presents the summary of the means for the statements evaluated by the learners.

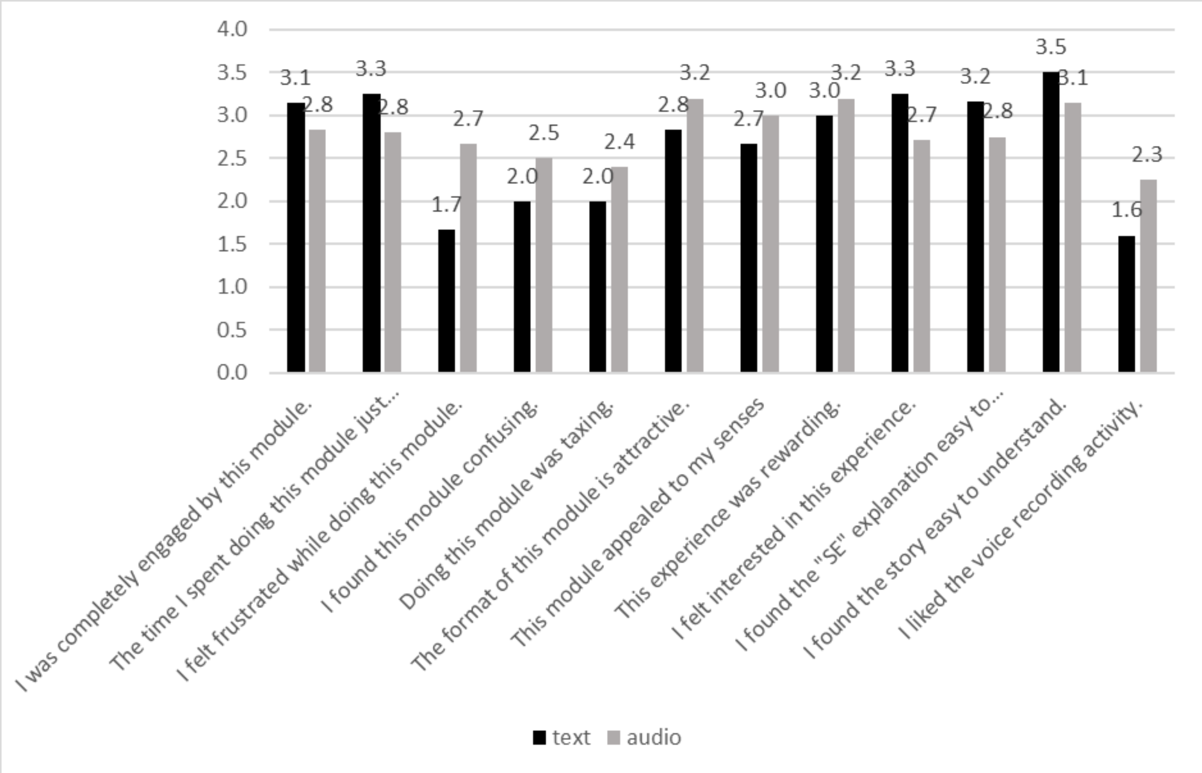

Figure 2: Means of learners' answers to the UES

6. Preliminary conclusions and next steps

When comparing the statements for the two modalities, learners seemed to have experienced more frustration and confusion with the audio modality which they also found more taxing. Interestingly, learners also perceived the audio modality as being more rewarding, more appealing to the senses and more compelling than the textual one. Thus, corroborating some of the observations made by the trainee teachers who felt that the audio modality might be attractive and engaging due to its novelty. An ANOVA test comparing the means of the statements relating to attention, engagement, attractiveness, reward, interest, confusion and tiredness indicated no significant differences between the answers given by trainee teachers and those given by students. Teaching/learning preferences in terms of how content is presented seem to be similar between Spanish trainee teachers and Hong Kong learners of Spanish.

Overall, the suggestion from trainee teachers was to integrate the three modalities within the same unit or to present content in alternating modalities. For learning to take place, content needs to grab learners' attention, this attention needs to be sustained long enough for the content to be processed and integrated with existing knowledge. The modality used to present the content is key to capture learners' attention in the first instance, but an overload of information via too many sensory-motor processing systems might cause a cognitive overload leading to frustration and confusion. Therefore, mixing too many modalities might not facilitate learning. As Miller (2001) notes, learning styles are not a limitation for processing content from various modalities. Individuals process information in their preferred learning style by transferring that information from the original modality into their preferred one.

These preliminary results indicate that both trainee teachers and learners believe that all modalities are equally engaging. The audio modality, not always used to its full potential in the foreign language classroom, should be integrated as much as possible as it engages other senses, rather than just the visual one. This is a positive outcome in which, despite cultural differences, trainee teachers' perceptions correspond to learner's evaluations. In the Hong Kong context, this is specifically relevant as all Spanish teachers in higher education institutions are Spanish native speakers and 90% are Spanish.

Based on these results, this study is being expanded to add more learners of Spanish, in Hong Kong and Spain, who will be completing three content units of the marker "se" each in a different modality. Three groups of learners will be randomly allocated three different sequences of units. Learners' answers to the various exercises will be correlated to their reported levels of engagement and to their learning of the various functions based on the differences between the answers to the "se" pre-test and post-test. Our final results seek to correlate learning benefits to each modality.

Acknowledgements

Thank you to all our participants for volunteering.

This project was funded by the Departmental Learning and Teaching Fund of the Department of English, Hong Kong Polytechnic University. It was supported by the Research Centre for Professional Communication in English (RCPCE) of the Department of English of the Hong Kong Polytechnic University.

References

Askari, M. R., Makvandi, B. and Neisi, A. (2020). "The prediction of Academic performance based on Academic Engagement, Academic Self-efficacy, the Achievement Goals and Perception of School Atmosphere in Gifted Students", *Psychology of Exceptional Individuals*, Vol 9, No. 36, pp 127-148.

Borg, S. (2003) "Teacher cognition in language teaching: A review of research on what language teachers think, know, believe, and do", *Language teaching,* Vol 36, No. 2, pp 81-109.

Brunken, R., Plass, J.L. and Leutner, D. (2003) "Direct measurement of cognitive load in multimedia learning", Educational psychologist, Vol 38, No. 1, pp 53-61.

Christenson, S. L., Reschly, A. L. and Wylie, C. (Eds.). (2012). *Handbook of research on student engagement*. Springer Science and Business Media.

Coffield, F., Moseley, D., Hall, E. and Ecclestone, K. (2004) *Learning styles and pedagogy in post-16 learning: A systematic and critical review.* Learning and Skills Research Centre, London.

Cohen, A.D., Oxford, R.L. and Chi, J.C. (2006) "Learning Style Survey: Assessing Your Own Learning Styles". In M. Paige et al. (Eds): *Maximizing study abroad: a students' guide to strategies for language and culture learning and use* (2nd edition) (pp. 10-19). Center for Advanced Research on Language Acquisition, University of Minnesota.

Fredricks, J. A., Blumenfeld, P. C. and Paris, A. H. (2004). "School Engagement: Potential of the Concept, State of the Evidence", Review of Educational Research, Vol 74, No. 1, pp 59-109.

Halif, M. M., Hassan, N., Sumardi, N. A., Omar, A. S., Ali, S., Aziz, R. A., ... and Salleh, N. F. (2020). "Moderating Effects of Student Motivation on the Relationship between Learning Styles and Student Engagement", *Asian Journal of University Education*, Vol *6, No.* 2, pp 94-103.

Hashim, A. M., Aris, S. R. S. and Chan, Y. F. (2019). "Promoting empathy using design thinking in project-based learning and as a classroom culture", *Asian Journal of University Education*, Vol 15, No.3, pp 14-23.

Hassan, M.A., Habiba U., Majeed F. and Shoaib M. (2019) "Adaptive gamification in e-learning based on students' learning styles", *Interactive Learning Environments*, pp 1-21. DOI: 10.1080/10494820.2019.1588745

Ko, S. and Rossen, S. (2010). Teaching online: A practical guide (3rd ed.). New York: Routledge

Lopez-Ozieblo, R. (2018). "Testing task difficulty evaluating parameters and identifying gestures as a valid indicator", *The Asian EFL Journal,* Vol 20. No. 6, Ch 11.

Macedonia, M. and Klimesch, W. (2014) "Long-Term Effects of Gestures on Memory for Foreign Language Words Trained in the Classroom", *Mind Brain and Education.* Vol 8, No. 2, pp 74-88. DOI:10.1111/mbe.12047

Mayer, R. and Moreno, R. (2003) "Nine Ways to Reduce Cognitive Load in Multimedia Learning", *Educational Psychologist,* Vol 38, No. 1, pp 43-52. DOI: 10.1207/S15326985EP3801_6

Miller, P., 2001. Learning Styles: The Multimedia of the Mind. Research Report.

O'Brien, H. and Cairns, P. and Hall, M. (2018) "A Practical Approach to Measuring User Engagement with the Refined User Engagement Scale (UES) and New UES Short Form", *International Journal of Human-Computer Studies,* Vol 112, pp 28-39. DOI:10.1016/j.ijhcs.2018.01.004

Paas, F., Tuovinen, J., Tabbers, H. and Van Gerven, P. (2003) "Cognitive Load Measurement as a Means to Advance Cognitive Load Theory", *Educational Psychologist* Vol 38, No. 1, pp 63-71. DOI:10.1207/S15326985EP3801_8

Park, C. (2003). "Engaging students in the learning process: The learning journal", Journal of Geography in Higher Education, Vol 27, No. 2, pp 183-199.

Reeve, J. and Tseng, C. M. (2011). “Agency as a fourth aspect of students’ engagement during learning activities”, *Contemporary Educational Psychology*, Vol *36, No.* 4, pp 257-267.

Schaufeli, W. B., Salanova, M., González-Romá, V. and Bakker, A. B. (2002). “The measurement of engagement and burnout: A two sample confirmatory factor analytic approach”, *Journal of Happiness studies*, Vol *3, No.*1, pp 71-92.

Schnotz, W., Bockheler, J., Grzondziel, H., Gartner, I. and Wachter, M. (1998) “Individual and co-operative learning with interactive animated pictures”, *Zeitschrift für Pädagogische Psychologie,* Vol 12, Nos. 2-3, pp 135-145.

Stan, M. and Plăiaşu, A. (2019). “A Study on the relation between learning styles and students’ academic engagement”. In: E. Soare and C. Langa (Eds), The European Proceedings of Social and Behavioural Sciences, EDU WORLD 2018, Vol 67, pp 159-168.

Tzirides, A.O. (2020) “Online Language Learning: Understanding and Supporting the Contemporary Digital Multilingual Learner”. In M. Montebello (Ed.), *Handbook of Research on Digital Learning* (pp. 140-159). IGI Global, PA. DOI:10.4018/978-1-5225-9304-1.ch009

The Review of Dyslexic Humanoid Robotics for Reinforcement Learning

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Abstract: The research focuses on students with Dyslexia in higher education and the support. Additionally, this will include support for their learning for e-learning or face to face lectures. The problem statement for this research is It has been shown that students with Dyslexia benefit from a support system, could the conceptual design of introducing a Humanoid Robot as a support assistant and companion give a personal aspect to the student as well as have an enhanced impact on the student. This could also benefit lecturers who may lack an understanding of Dyslexia and the support it requires. The purpose of this research is to help support students with Dyslexia with their learning using a robot with reinforcement learning techniques. As there are six different types of Dyslexia, research has shown that universities, do not currently have the resources or the support available to help support the students. There is support available however, it is not enough to cater to the six different types of Dyslexia (Zoubrinetzky, Bielle and Valdois, 2014). A robot could be used as a support assistant to help improve the support resources within the university and enable the university to cater to the different types. The key purpose of this paper is to report the review of the conceptual design and preliminary framework with reinforcement learning. The methods and findings of this research will be reviewing current literature surrounding educational robotics and dyslexia, reinforcement learning and e-learning.

Keywords: dyslexia, humanoid robotics, reinforcement learning, learning and teaching, higher education, learning support, e-learning

1. Background and introduction

Educational Robotics is developing and expanding into support systems for higher education students (Rinat, , Yaacov and Goren, 2020). it has changed the way in which educational robots are utilised within education, robots could end up replacing academic helpers as support assistants (Newton, and Newton, , 2019). The number of students with learning difficulties e.g. Dyslexia, Autism, Dyspraxia etc is increasing and research shows that the support with universities is currently lacking and could be improved with an educational robot as a support assistant. Dyslexia is a learning difficulty that primarily affects the skills involved in accurate and fluent word reading and spelling. Dyslexia can be surrounded by confusion and ambiguity which can be anxiety for teachers and parents (Mayo Clinic, 2016). There are a number of core characteristics of dyslexia that are important for identification and assessment, including reading, writing, and spelling difficulties. The research field of dyslexia has many different dimensions. There are research activities in different aspects of neurology/ brain structure; neurological processing; the cerebellum; the visual cortex; and speech and language processing (Montgomery, 2015).

2. Research design and method

This research is work in progress from a PhD study. The methodology will consist of several studies firstly a systematic literature review will be conducted to formulate a design framework (Fig 1). A humanoid robot will be programmed to be a dyslexic support assistant utilising reinforcement learning techniques to reinforce the learning styles for the various types of dyslexia, providing tailored support to students with dyslexia. Study 1 will observe students who have dyslexia in a learning environment to scrutinize how the students engage and react to the support provided by the robot. The research challenge is that students with dyslexia benefit from a support system, the conceptual design of introducing a humanoid robot as a support assistant and companion will give a personal aspect to the student as well as have an enhanced impact on the student. Although the literature review and educational robot using Nao are not new, but it is a new research challenge to integrate reinforcement learning machine learning in addressing students with dyslexia in HE.

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3. Empirical studies for the review of dyslexia, educational robotics and reinforcement learning

3.1 Dyslexia and HE

Dyslexia NOUN

> *"Dyslexia is characterized by an unexpected difficulty in reading in children and adults who otherwise possess the intelligence, motivation, and schooling considered necessary for accurate and fluent reading. Dyslexia is the most commonly studied of the learning disabilities" (Shaywitz, , 1998 pp34).*

The current support systems for students with dyslexia are helpful to an extent, however, due to a contrasting views by people with dyslexia and researchers and practitioners they are also considered not to be helpful (Welsh Government, 2012) . The National Assembly of Wales conducted a project, the Dyslexia Benchmarking project. The aim of the project was to see what support the learning associations across Wales were providing for students with dyslexia, an interview, questionnaires and a literterature review was carried out. The project found that there is support systems in place but due to lack of funding teachers cannot have the training they need (Welsh Government, 2012). The support systems that the learning associations used were, TA's, Specialist dyslexia staff, School Action is a specific programme to help support students with dyslexia

3.2 Types of dyslexia

Dyslexia is a term that can be surrounded by confusion and ambiguity which can be anxiety for teachers and parents. Defining Dyslexia there are a range of definitions that are currently used to describe dyslexia (Mayo Clinic, 2016). The neurological and genetic causes of dyslexia, the characteristic difficulties associated with dyslexia, such as phonological, visual, and auditory processing difficulties, the associated characteristics of dyslexia difficulties relating to memory, time management, processing speed, organization, and sequencing and planning, the need for over-learning and specific teaching approaches (Sharon, 2018). In the last 5 years, there has been advances with research within Dyslexia with six different types being discovered which are, Phonological Dyslexia, Surface Dyslexia, Visual Dyslexia, Primary Dyslexia, Secondary/Developmental Dyslexia, and Trauma Dyslexia. Rachel Zoubrinenetzky (Zoubrinetzky, Bielle and Valdois, 2014) says that there are many characteristics and barriers to learning that can happen with these types of Dyslexia which can affect people in different ways. Phonological Dyslexia causes an extreme difficulty and the ability to manipulate the basic sounds of language, Surface Dyslexia causes people to not be able to recognise a word as a whole due to damage of the left parietal or temporal lobe, Visual Dyslexia causes reading difficulty from either an optical visual problem or visual processing disorders, Primary Dyslexia is the result of a genetically inherited condition, and finally trauma dyslexia occurs after some form of brain trauma or injury to the area of the brain that controls reading and writing. The main barrier to learning that people with these types of Dyslexia experience is difficulty in reading.

Table 1 shows the six different types of dyslexia, treatments and support and assistive technologies

Table 1: Types of dyslexia

Type of Dyslexia	Signs and Symptoms	Treatments and Support	Assistive Technologies
Phonological	Manipulating sounds in head, Rhyming, Blending Sounds	Use pictures say words aloud, use actions say words aloud, smaller chunks, Speech Therapy Techniques, Own voice dictations	Google Read Write is a chrome extension which has proven to help handwriting and allow for more independence for a student.
Surface	Severe difficulty with whole word recognition, Trouble reading words by sight, Slow to read.	Training in the identification and decoding of common letter patterns in irregular words.	Text-to-speech software can help with difficulty of reading words.
Visual	Headaches and eyestrain with reading, text appearing blurred, Text appearing double.	Vision therapy, Treatment with eye muscle exercises.	Scanning software and hand reading pens can help read text that may appear double.
Primary	Problems learning names and sounds of letters, Spelling that is unpredictable, putting letters and figures the wrong way round.	Learn to recognise and use the smallest sounds, understand that letters and strings represent these sounds and words (phonics).	Tablets, smartphones, and Applications can help with spelling issues and the placement of letters and figures.
Secondary/Developmental	Has a poor standard of written work, has poor handwriting, Spells the same word differently in one piece of work.	Direct explicit instruction in phonological processing phonics and reading fluency.	Speech-to-test software can help with the writing difficulties and poor handwriting.
Trauma	Shock, Confusion, Anger, Anxiety, Guilt, Feeling disconnected or numb	Guidance and support, Ongoing evaluation, Adapted learning tools	Handheld microcomputers can help the individual to input, save and retrieve information.

3.3 From dyslexia and conventional machine learning/AI and reinforcement learning

Machine learning can also be used to detect dyslexia early there are three basic machine learning techniques which are, Reinforcement Learning, supervised learning, and unsupervised learning. Reinforcement learning is concerned with intelligent agents ought to take actions in an environment in order to maximize the notion of cumulative reward (Wiering and Otterlo, Van, 2012). Could this reinforcement technique be used on a robot to help support dyslexic students with reinforcement learning, when they do something right then get praised and support from the robot and when they make a mistake the robot will help them to correct it and show them where they went wrong.

There have been many ways and ideas in which people use robots in education which are, telepresence robots, simulators, robot teacher, support assistant etc. Telepresence robots have been used in higher education to help students that cannot come into university due to an illness or injury (Nielsen, Mette *et al.*, 2020). The telepresence robot is a screen attached to the robot to allow the student to be present via a camera from their home, this helps students to not miss out on any of their learning or lecture content (Martell, *et al.*, 2021) . In New York, a second grader with severe, life-threatening allergies was unable to attend school due to his condition. A robot provided a "real school" experience for the boy, allowing the boy to use a video conferencing system, these robots are able to "bring school" to students who cannot be present physically (Herring, 2013).

4. Conceptual framework/ design principles for dyslexic robot with reinforcement learning

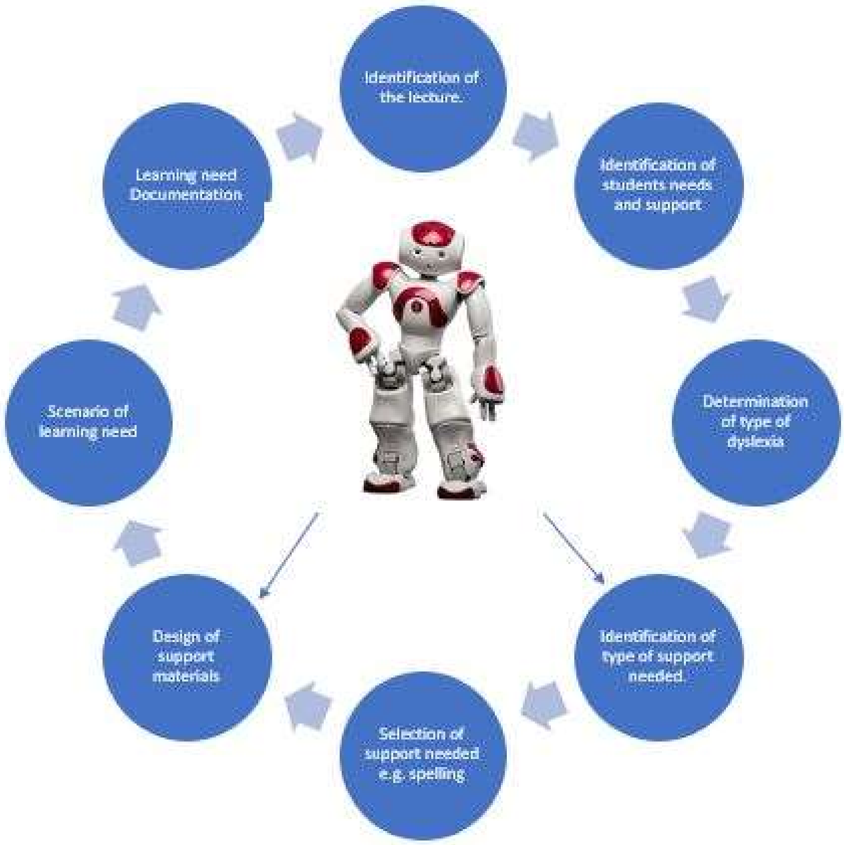

Figure 1: Conceptual framework and design for dyslexic robot

The above figure 1 shows a framework of the design principles that the humanoid robot with reinforcement learning will have. 1. Identification of the lecture, 2. Identification of students needs and support, 3. Determination of type of dyslexia, 4. Identification of type of support needed, 5.Selection of support needed e.g. spelling, 6. Design of support materials, 7. Scenario of learning need, 8. Learning need documentation. Using this conceptual framework combined with reinforcement learning will help the students with dyslexia to be supported with their learning, by the robot using a reward system to help them correct their mistakes and reinforce the correct behaviour to the learning. The robot will be able to access the needs of the student and tailor their needs to the type of dyslexia they have to make sure they are getting the right amount and type of support.

5. Conclusion

As no studies or data has been collected yet this is a possible outcome of the research. Educational robots have been used in Higher Education for teaching but limited. The future work will be a pilot model of a dyslexic robot that is for reinforcement learning and will be used by Dyslexic students or lecturers with primary data collection and validation.

References

Herring, C, S. (2013) 'Telepresence robots for academics', *Proceedings of the American Society for Information Science and Technology*, 50(1), pp. 1–4. Available at: https://asistdl.onlinelibrary.wiley.com/journal/23739231.

Martell, A, K. *et al.* (2021) 'Teachers Willingness to Use a Telepresence Robot for Consultation with Students with Autism Spectrum Disorder', *Contempary School Psychology*, 5(2), pp. 1–2. Available at: https://link-springer-com.ezproxy.cardiffmet.ac.uk/article/10.1007/s40688-021-00359-4.

Mayo Clinic (2016) *Dyslexia*, *Web Page*. Available at: https://www.mayoclinic.org/diseases-conditions/dyslexia/symptoms-causes/syc-20353552#:~:text=Dyslexia is a learning disorder,the brain that process language. (Accessed: 9 November 2020).

Montgomery, D. (2015) *Spelling, Handwriting and Dyslexia: Overcoming Barriers to Learning*. 2nd edn. Available at: https://books.google.co.uk/books?hl=en&lr=&id=i9p9AgAAQBAJ&oi=fnd&pg=PR1&dq=barriers+to+learning+dyslexia&ots=S8fDa6gSmM&sig=cBImyGKyMuwpgZ3st_7ggJeb9PY#v=onepage&q=barriers to learning dyslexia&f=false.

Newton, P, D. and Newton, D, L. (2019) 'Humanoid Robots as Teachers and a Proposed Code of Practice', *The Journal of Education*, 3(5), pp. 1–2. Available at: https://www.frontiersin.org/articles/10.3389/feduc.2019.00125/full.

Nielsen, Mette, W. *et al.* (2020) 'Back to school with telepresence robot technology: A qaulitative pilot study about how telpresence robots help school-aged children and adolescents with cancer to remain socially and academically connected with their school classes during treatment', *Journal of Nursing Open*, 7(4), pp. 1–2. Available at: https://www-proquest-com.ezproxy.cardiffmet.ac.uk/docview/2418124984?accountid=15588&pq-origsite=primo.

Rinat, B, R.-K., Yaacov, K. and Goren, G. (2020) 'Robot-Supported Collaborative Learning (RSCL) Social Robots as Teaching Assistants for Higher Education Small Group Facilitation', *Journal of Front Robot AI*, 5(2), pp. 1–2. Available at: https://www-ncbi-nlm-nih-gov.ezproxy.cardiffmet.ac.uk/pmc/articles/PMC7805738/.

Scaradozzi, D., Screpanti, L. and Cesaretti, L. (2019) 'Towards a Definition of Educational Robotics: A Classification of Tools, Experiences and Assessments', *Smart Learning with Educational Robtics*, 4(5), pp. 63–92. Available at: https://link.springer.com/chapter/10.1007/978-3-030-19913-5_3.

Selwyn, N. (2019) *Should Robots Replace Teachers?: AI and the Future of Education*. 1st edn. Cardiff: Polity Press. Available at: https://www.vlebooks.com/Vleweb/Product/Index/1720864?page=0.

Sharon, D. (2018) 'A documentry analysis of the support services offered to adult learners with dyslexia in higher education', *Journal of Further and Higher Education*, 1(4), pp. 1181–1195. Available at: https://www-tandfonline-com.ezproxy.cardiffmet.ac.uk/doi/full/10.1080/0309877X.2018.1463359.

Shaywitz, E, S. (1998) 'Dyslexia', *The new england journal of medicine*, 2(4), pp. 1–2. Available at: https://www.nejm.org/doi/full/10.1056/nejm199801293380507.

Tselegkardis, S. and Theodosios, S. (2020) 'Simulators in Educational Robotics: A Review', *Journal of Technology Enhanced Education*, 4(6), pp. 1–2. Available at: https://www.mdpi.com/2227-7102/11/1/11/htm.

Wiering, M. and Otterlo, Van, M. (2012) *Reinforcement Learning*. 2nd edn. Edited by M. Wiering and M. Otterlo, Van. Radboud: Springer. Available at: https://link.springer.com/book/10.1007%2F978-3-642-27645-3#editorsandaffiliations.

Zoubrinetzky, R., Bielle, F. and Valdois, S. (2014) 'New Insights on Developmental Dyslexia Subtypes Hetrogeneity of Mixed Reading Profiles', *Journal of Medicine and Health*, 3(5), pp. 1–5. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4053380/.

Scratch Options! Using programming to Approach Social-Emotionally Challenging Situations in Grade 4 Classrooms

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Abstract: Even though fostering computational thinking (CT) and social-emotional skills has been an area of interest in educational research and practice for many years, the simultaneous support of CT and social-emotional skills has not yet been investigated. To address this gap, we developed a workshop to help Grade 4 students work on social-emotionally challenging situations using the Scratch programming language (scratch.mit.edu). Students are encouraged to create interactive stories around problematic situations that might occur in the classroom (e.g., bullying). Then, using cooperative learning methods, they are asked to elaborate different options for reacting to such situations. These options are then programmed by the students using Scratch. We apply a mixed-methods approach to assess (a) the workshop's feasibility, (b) students' acceptance of the concept, (c) the impact on students' CT and (d) the impact on students' problem solving in social-emotionally challenging situations. In this ongoing study, we thus use interviews and questionnaires with teachers and students, classroom observation, think aloud protocols, and screencasts for the students programming with Scratch.

Keywords: computational thinking, social-emotional skills, Scratch, programming, Grades 4 and 5

1. Background

Subject-related learning is not the sole focus of educational discourse. Additionally, the fields of digitalization in learning (European Commission, 2019) and social-emotional learning (Downes & Cefai, 2016) have also become major concerns at the political as well as the school (curricular) level. Both digital and interpersonal skills are now regarded by the EU as key areas in school-based learning and in the preparation of a future workforce.

While there has been exceptional interest in fostering computational thinking (CT) in general educational frameworks (Grover & Pea, 2013), relatively little attention has been placed on the non-cognitive aspects of programming or on its social-emotional potential (Román-González et al., 2018). Even though teachers can apply new forms of co-operation when using digitalized approaches, programming itself is mainly seen as an individual task. This view has recently been challenged by researchers such as Kafai and Burke (2015), who argue for the development of a more social and cooperative approach. Instead of using the term CT, they refer to such an approach as computational participation. In a digitalized world, especially in e-learning, skills of the social-emotional domain, such as communication and collaboration, are crucial.

Our project "Scratch Options!", designed for Grade 4 and 5 students, is intended to aid the merging of CT and social-emotional skills, and to support the development of both areas simultaneously. This target group was selected as, representing a phase of transition, it is believed to be particularly vulnerable, both socially and academically (Mackenzie, McMaugh, & O'Sullivan, 2012). The transition from primary to secondary school takes place in Austria after Grade 4. Merging these areas of interest (CT, social-emotional skills and transition phase) opens up several interesting, but as yet untrodden, paths towards the integration of programming in educational policies targeting the social-emotional learning of students.

2. Aims and research questions

The relevant question here, which has not yet been addressed in educational research, is: Can CT and social skills be fostered simultaneously? Based on our project, we claim that this question may be answered affirmatively. Our assumption is that combining programming with cooperative learning methods when confronting students with common, socially challenging situations, leads to gains in CT as well as in social-emotional skills (at both the individual and classroom level). Discussing and programming the possible behavioural responses (options) in such challenging situations helps students perceive new ways of looking at interpersonal problems. Individual students are thus likely to improve their social-emotional skills, to think more deeply about possible responses in challenging situations, and to gain a broader repertoire of actions for dealing with such situations. We further think that on the classroom level, this approach can have a positive impact on climate and collaboration, and that it may thus serve to improve the students' learning environment.

The project "Scratch Options!" aims at developing a workshop to train students' CT and social-emotional skills by offering them a means of developing behavioural options for social-emotionally challenging situations, options which are based on their own individual experiences. We explore the possibility of creating a viable and participative programming approach for children in Grades 4 and 5 to enable them to address specific challenges experienced in the classroom. This setting requires students to participate in individualized co-creation of situational vignettes describing specific situations and offering behavioural options. As a first step in the project, we developed a workshop for Grade 4 students and pretested it with two students. This was then adapted based on the resulting feedback, and subsequently implemented in a Grade 4 classroom. The main research questions here are whether the workshop fosters (a) individual social-emotional skills, (b) classroom climate, during the challenging period of transition from primary to secondary school, and (c) CT skills. Using student feedback (iteratively), it is intended that the workshop then be adapted for implementation in Grade 5 classrooms.

3. Project description and procedure

3.1 Project phases

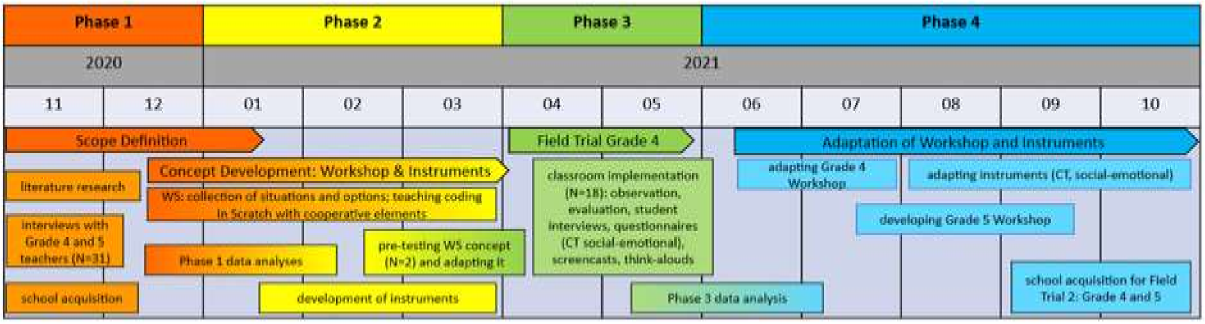

Figure 1: Project phases

The first year of the project consists of four phases. Based on Phase 1 (preparatory phase), in which we identified social-emotionally challenging situations, we developed a workshop plan for Grade 4 classrooms. We also developed instruments for measuring CT and social-emotional skills in this age group (Phase 2). In Phase 3 (currently ongoing), we are now implementing the workshop scheme in a Grade 4 classroom in order to gain insight into which workshop elements are feasible and beneficial for children. This entails use of a mixed-methods approach (see research activities for more detailed information on the instruments and methods used). Based on the data gathered in Phase 3, we then intend (Phase 4) to adapt the instruments and the workshop concept for Grade 4 students and to develop a workshop plan for Grade 5 students too.

3.2 Workshop plan

On Day 1, the whole class works together to identify social-emotionally challenging situations and possible coping strategies. From Day 2 on, the class is divided into groups of 6 to 8 students. Each group takes part in the activities for about two hours per day. Days 2 and 3 mainly focus on familiarizing students with the Scratch programming language. On Days 4 and 5, using Scratch, children work in pairs on solving and programming a social-emotionally challenging situation and on devising suitable behavioural options. Day 5 provides an opportunity for revising the individual projects before presenting them to the group.

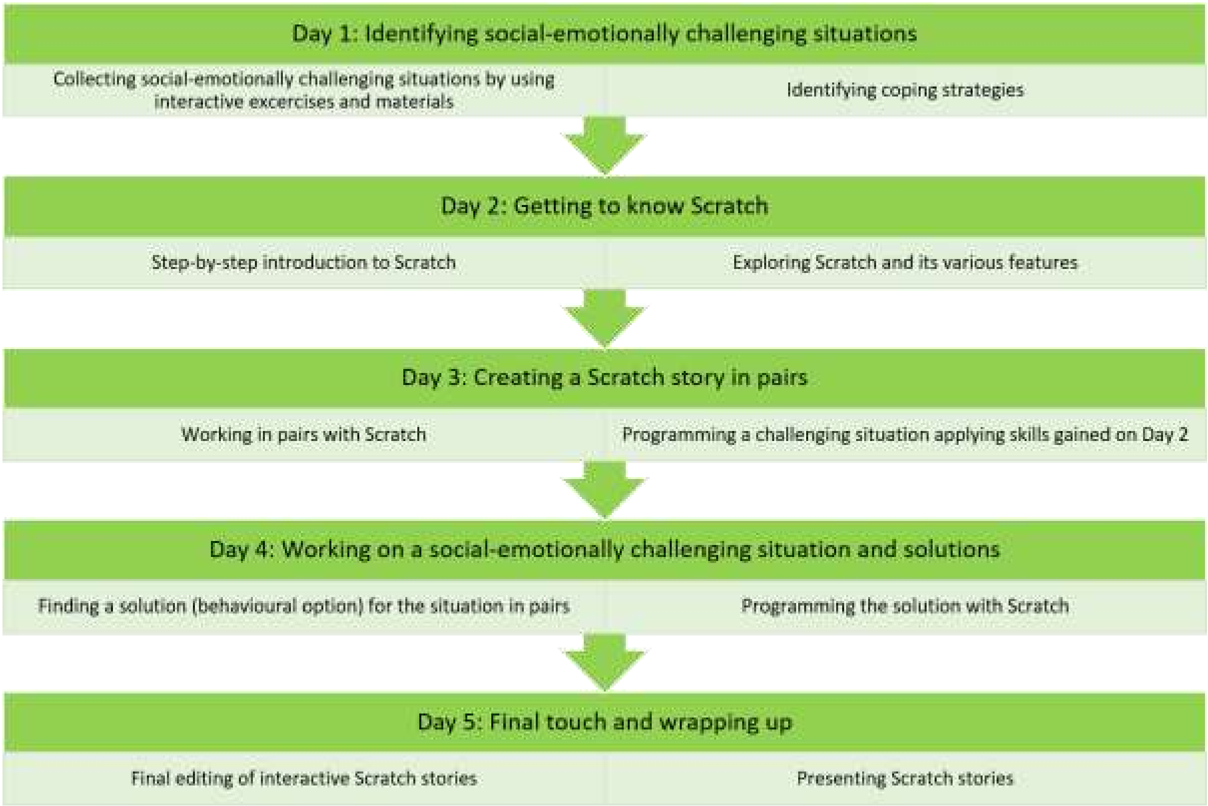

Figure 2: Workshop plan

4. Research activities

We now describe the ongoing research activities in more detail.

4.1 Identifying social-emotionally challenging situations: Day 1

In order to identify relevant social-emotionally challenges, we had to gather sufficient data (teachers' and students' views).

First, we interviewed 31 teachers (Grade 4 and 5) on their experiences and opinions concerning situations that are challenging for this age group (Phase 1). To this end, we developed an interview guide, comprising six sections, addressing social-emotional challenges in different settings/contexts (i.e., classroom, social media, distance learning, transition from primary to secondary school) and the respective coping strategies.

Second, Day 1 of the workshop (5 hours, whole class) was targeted at getting students' opinions and perspectives on this topic. During this first workshop day, the focus is on the identification and discussion of social-emotionally challenging situations in the school context. This is achieved in co-operation with the students. A detailed observation sheet was devised in order to facilitate comprehensive documentation of the first workshop day (dedicated to identifying challenges and behavioural options). The observation sheet was structured in terms of the activities during the workshop and allowed for in-depth documentation of atmosphere, interactions (social: student(s)<->student(s), instructor(s)<->student(s), instructor<->instructor; non-social: student(s)->tools and material), and output from individual and group work. To complement the qualitative evaluation methods, we also developed a questionnaire for collecting student feedback at the end of the first workshop day. The information from the different sources is then clustered and categorized by applying qualitative content analysis in order to define the specific challenges identified. This then provides the basis for further consolidation and application on days 2 to 5.

4.2 Scratching options!: Days 2-5

Days 2 to 5 of the workshop are dedicated to helping students (Grade 4) use Scratch in programming the identified social-emotional challenges and their responses. To gain insights into the workshop's feasibility and adequacy for young students, days 2 to 5 of the workshop are also closely accompanied by research activities. We developed another observation sheet designed to capture possible challenges faced by students when working with Scratch. This covered issues related to the technology, the clarity and feasibility of the tasks, and students' behaviour and expressions while working with Scratch on their own and or in pairs. Two observers accompany the workshop days (to calculate inter-rater correlations). We complement the observation sheet with screencasts of the students' actions while programming with Scratch in order to attain in-depth results from different angles. Selected sequences from these screencasts serve as a basis for prompting retrospective thinking aloud in order to capture students' underlying reasoning. An interview guide was developed to aid collection of information regarding student experiences while working with Scratch and their views on the workshop. The data gathered on days 2 to 5 is then analysed using qualitative content analysis in order to identify possible issues relating to task difficulty, student boredom or frustration, etc.

5. Expected outputs, results and outlook

Based on the information gathered in Phases 1 to 3 (currently ongoing), the workshop is to be adapted (in Phase 4) for wider application in Grade 4. Additionally, a workshop plan is to be developed for use in Grade 5 in order to shed further light on the later part of the transition phase. These adapted workshops will then be implemented in a larger study comprising various classrooms and a control group so that the impact of the workshop on social-emotional and CT skills, as well as our assumption that these two skills can be fostered simultaneously, may both be thoroughly evaluated.

To enhance the long-term viability of the approach, it will not only be developed and implemented in a researcher-led workshop, but also iteratively adapted throughout the study period in order to create a concept that teachers can easily implement in their classrooms. Taking a larger perspective, we also intend (a) to develop suitable teacher training, (b) to develop an instrument using clustered vignettes with behavioural options for measuring social-emotional skills in children aged 9 to 12, (c) to create a platform that enables teachers and students to code individualized interactive stories matching their particular classroom situation, and (d) to provide a pool of different interactive 'challenge' stories with ranked behavioural options for use in European classrooms (a future EU-project).

References

Downes, P. and Cefai, C. (2016) How to Prevent and Tackle Bullying and School Violence: Evidence and Practices for Strategies for Inclusive and Safe Schools, NESET II report, Publications Office of the European Union, Luxembourg.

European Commission (2019) Digital Education at School in Europe. Eurydice Report, Publications Office of the European Union, Luxembourg.

Grover, S. and Pea, R. (2013) "Computational Thinking in K-12: A Review of the State of the Field", Educational Researcher, Vol. 42, No. 1, pp 38–43.

Kafai, Y. and Burke, Qu. (2015) "Constructionist Gaming: Understanding the benefits of Making Games for Learning", Educational Psychologist, Vol. 50, No. 4, pp 313–334.

Mackenzie, E., McMaugh, A. and O'Sullivan, K. (2012) "Perceptions of primary to secondary school transitions: Challenge or threat?", Issues in Educational Research, Vol. 22, No. 3, pp 298–314.

Román-González, M., Pérez-González, J. C., Moreno-León, J. and Robles, G. (2018) "Extending the nomological network of computational thinking with non-cognitive factors." Computers in Human Behavior, doi: 10.1016/j.chb.2017.09.030

Late Submissions

Approaching Instrumental Conflicts During an Assessment Activity with an Interactive Learning Environment

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DOI: 10.34190/EEL.21.077

Abstract: Word processors are still supporting artefacts for the realization of learning activities by allowing higher education students to increase their writing skills. They can be hosted in Interactive Learning Environment (ILE) or desktop based. These artefacts are based on graphical interfaces which forces students to manage instrumental genesis that crosses the effects of didactic, pedagogical and technical artifacts between them, during the learning activity. Our paper investigates the impact of instrumental conflicts on the cognitive load of the students, during an assessment activity with Docyrus, an adaptable ILE. In particular, after a literature review on the instrumental approch and the cognitive load theories applied to the Human Computer Interaction (HCI, the empirical work (N=104) examines how far the customisation of the graphical user interface of an ILE, during the learning activity, influences the final achievment of a quiz. The main goal behind our approach is to understand from the educational engineering point of view, and within the framework of the instrumental approach, the adapted use of these environments with regard to the learning activities to take place there.

Keywords: ILE, interface, cognitive load, instrumental conflict

1. Introduction

Referring to the work of Rabardel (1995) and Marquet (2005 ; 2019), it is now clear that students face instrumental conflicts from didactic, pedagogical, and technical artefacts in their instrumental genesis with the interactive learning environments (ILE) they use. Despite the ever more designated and interactive interfaces, these ILEs are still based on standardized technical and pedagogical engineering principles, which still fail to reduce or circumscribe, the instrumental conflicts that learners face in their learning. Some authors (Hollender et al., 2010) suggest that "the optimization of cognitive load needs to be taken into account in the design of the software used by learners". From the point of view of instrumental genesis (Rabardel, 1995), this paper focusses on the effect of the customization of a graphical user interface, onto the cogntive load. We investigate the impact of the possibility given to the learner to customize the graphical user interface (GUI) of an ILE, during the learning phasis, on the realization of an assessment activity in this same environment at the end of the course. We collect the traces of actions performed by the learner on the interface, in order to measure the effect of the customization on the learner's cognitive load (Sweller, 1994). We then analyse the impact of this cognitive load on the scores obtained in a quiz.

2. Literature review

2.1 Instrumental genesis and instrumental conflict

In the instrumental approach (Rabardel, 1995), the theory of instrumental genesis extends the field of research on the mediating role of tools in human activities. Drawing on constructivist epistemologies, this theory is based on the concept of instrument and the concept of instrumental genesis. The instrument is seen as a mixed entity that is constituted by the artefact, the material or technical part, and the subject's use patterns or behavioural part. According to this theory, an artefact becomes an instrument through transformations that involve the artefact and the user's patterns of use (Overdijk et al, 2012). If the notion of conflict appears, in Piagetian theory, as one of the essential elements in the study of the mechanisms of cognitive development, it is also present in the instrumental approach where, in the content and form of the teaching contents, the didactic and pedagogical artefacts are closely linked during the learning process, requiring the learner to manage to interweave the pedagogical dimension of the knowledge represented with the didactic dimension, the knowledge itself. According to Marquet (2005), e-learning, through the introduction of digital technology (software, learning platforms, ILE) in the learning activity, adds an additional level of appropriation to the didactic and pedagogical artefacts: the technical artefact. The use of the concept of instrumental conflict draws its relevance from the generalisation of the use of digital technologies as learning supports (Marquet, 2019). Indeed, in the case of a computerised pedagogical situation, the computer screens from their graphic interfaces, try to represent, adapt and make accessible, didactic objects initially represented on paper supports. We retain the definition of Marquet (2005 ; 2019) who posits that the "instrumental conflict designates the failure of the instrumental genesis of at least one of the three artefacts at stake in a teaching-learning situation involving an ILE".

2.2 Cognitive laod and Human Computer Interaction (HCI)

One of the major challenges that learners face today in their learning activities is that of being able to perform a familiar task on an interface in a reliable manner (Gajos & Chauncey, 2017). Learning contexts and situations are multiple and complex, contrary to the interfaces that were initially standardised for better adoption of the environments in which they were implemented and for the purpose of ever greater usability (Fleck & Massou, 2021). This unpredictability of Human Computer Interaction makes ILEs complex, especially from the point of view of navigation (Saadé & Otrakji, 2007) introducing, with reference to cognitive load theory (Sweller & Chandler, 1991) and the cognitive theory of multimedia learning (Mayer, 2005) cognitive overload (Chalmers, 2003; Amadieu et al, 2009) and disorientation (Demirbilek, 2004; Xiong, 2017 ; Bayazit et al., 2018; Bhatti et al., 2020). In our study, we consider the extraneous cognitive load, “caused by an inappropriate presentation of the learning material or by requiring students to perform activities that are irrelevant to learning” (Hollender et al., 2010). Learners experience information overload when the effort required to process a task exceeds their processing capacity (Eppler & Mengis, 2004). In ILEs, interface designers seek the best usability of the system by aiming for a minimum number of clicks from the mouse or trackpad used. This often results in a minimum number of screens displayed, each of which contains too much information for them to be suitable for learning due to the lack of progression. This abundance of information can lead the user into a state of cognitive overload (Chen & Chang, 2009; Li, 2017) who in confusion makes unsatisfactory and inappropriate choices.

2.3 Approaching instrumental conflicts with graphical user interfaces

In the literature, a human-computer interface is a means by which people and computers communicate with each other (Bonsiepe, 1990). The user interface (UI) is defined is as “the part of the system that acts as an intermediately between the user and system facilitating the user to interact with the system in an efficient manner”davis (Saha et al., 2015), while the graphical interface characterises a visual operating display that the monitor presents to the computer operator (Harding, 1989). Research has shown that while many interface features are intended to improve the usability (Davis, 1989) and usability of a software (Debue et al., 2013), they do not necessarily reach their goal (Chalmers, 2003). However, despite the implementation of design rules of interfaces available in particular in computer environments supporting learning, researchers have noted conflicts between learning and the completion of the work required (Mikulecky, 1993), "which leads new users to try to skip the training, or to skip certain parts of it, sometimes with disastrous consequences... For the same reason, experienced users are likely to use the procedures they already know, regardless of their effectiveness". As Monique Linard (2001) has clearly stated, in a learning situation, the interface is a device within which the cognitive universe of the designer's representation of the task, the cognitive universe of the designer's graphical and symbolic representations of activities and actions, and the learner's mental representations coexist. We therefore try to answer the following research question: to what extent does the customisation of the graphical interface of an ILE during the learning activity, does impact the results obtained in a Quiz on the same environment at the end of the activity?

3. Methodology

Word processors have been used for a long time to support many learning activities such as writing (Stevens, 1999), second language writing (Li & Cumming, 2001), Spell Checking (Warschauer, 1998), editing (Phinney & Khouri, 1993), Storage (Daiute, 1983). This type of software is still the central application in learning (Zeller & Marquet, 2020b) allowing the realization of memos or reports, after the realization of a strategic intelligence activity. Our study analyses the traces left by the user of a GUI of a specific ILE, Docyrus, which includes several modules: a first one dedicated to the consultation of educational resources thanks to video and a PDF players, a second one being a full word processor, a third one dedicated to the realization of quizzes and a fourth in charge of collecting and analysing learning analytics in real time. We asked students to complete assignments at home. They had to answer a Quiz on Docyrus, after having studied resources, and for the experimental group, after having customized the graphical interface of the environment for better usability. Answering the questions required writing a paragraph of 5 to 10 lines whose content was then semantically analyzed by the software.

4. The survey

4.1 Customisation of the grahical user interface of the ILE and performance on a Quiz

We hypothesize that each switch back and forth between the modules (the PDF, the Word processor and the Quiz modules implemented in Docyrus), is accompanied by a process of appropriation of the interface displaying contextual forms, ribbon, icons and buttons, which puts it prey to instrumental conflicts in its process of instrumentation of didactic, pedagogical and technical artefacts that mobilize a significant cognitive load that reduces the part that can be devoted to the learning itself (Marquet, 2005). Our general assumtion is that there is a correlation between the additional cognitive load mobilised by the learner to personalise the interface of the environment in terms of the amount of actions required to achieve it and both the realization of the quiz. We also hypothesize that the interface personalised by the learner during the activity, allows him/her to adjust all the actions carried out on the interface to answer the Quiz.

4.2 Sample and procedure

Our research was carried out on students enrolled in first and second year in a course in business intelligence and strategic intelligence at the University of Strasbourg. The activity requested to the 104 participants divided into a control and an experimental group, was to read and study methodological content related to data-mining and data curation methods at home. To do this, students had to read PDF documents uploaded in Docyrus. They were asked to go through the resources, taking notes if necessary, and then to take a Quiz at the end of the activity related to the content studied. We draw our attention to five variables : V1_Score : quizz score obtained by the student, V2_Quiz actions_of_navigation : sum of navigation actions performed during the Quiz phase, V3_PDF_actions_of_navigation : sum of navigation actions performed during the PDF reading phase, V4_WP_actions : sum of actions performed on the Word Processor module, V5_GUI_actions : sum of customization actions performed on the interface. The low-level traces that we captured were transformed into high-level traces. Thus, what we call action is the set of events, belonging to the same class of actions, realized jointly in the same temporality scale. For instance, an action carried out on the word processor such as the bolding of a selection of text, can be constituted by ten or so micro-events such as the selection of text, the movement of the mouse towards the formatting icon, the click on the icon and the deselection of the text. We present below the significant results we have obtained.

5. Results

5.1 Performances on Quiz

Variables have been compared with non parametric statistal tests, due to the their non-normal distributions. A first comparison of the averages score obtained at the Quiz (V1), reveals that the experimental group, which was allowed to personalize the graphical interface of the ILE (G1), obtains a higher average score than the control group (G2) (V1: 4.17>3.64), but with no significative effect ($p = .405$). We then measure the sum of customisation actions performed on the interface (V5) for the experimental group. The control group could not customise the GUI. Surprisingly enough, we find that 0 actions were performed by the experimental group who was yet informed and trained to do so. We also compare the average of navigation actions performed for the completion of the Quiz (V2), the average of navigation actions in the PDF resources made available (V3), and the average of actions performed on the word processor (V4). The Mean Rank (Table 1) are systematically higher for the experimental group than for the control group: (V2: 58,87>45,07; V3: 61,53>41,97; V4: 61,15 >42,41). Those differences are all significant V2 ($p = .020$), for variable V3 ($p = .001$) and for variable V4 ($p = .002$).

Table 1: Mann-Withney Test for V2, V3, V4.

	Group	N	Mean Rank	Sum of Ranks
V2_Quiz actions_of_navigation	1	56	58,87	3296,50
	2	48	45,07	2163,50
V3_PDF_actions_of_navigation	1	56	61,53	3445,50
	2	48	41,97	2014,50
V4_WP_actions	1	56	61,15	3424,50
	2	48	42,41	2035,50

	V2	V3	V4
Mann-Whitney U	987,500	838,500	859,500
Z	-2,328	-3,298	-3,160
Asymp. Sig. (2-tailed)	0,020	0,001	0,002

In order to control confounding effects by statistical analysis (Pourhoseingholi *et al.*, 2012), we use a non parametric correlation test (Spearman) as a statistical model to examine the association between multiple covariates and outcomes. For the experimental group G1,we were able to establish one correlation (Table 2) between the variable V2 the variable V4 (Rho = .364; p <.001). We found two correlations for G2 (Table 3) between the variable V2 and the variable V3 (Rho = .457 p <.001), and between the variable V2 and the variable V4 (Rho = .535 p <.001).

Table 2: Correlation between V2 and V3 and V4 variables in the Experimental group

G1		V3_PDF_actions of navigation	V4_WP_actions
V2_Quiz actions_of_navigation	Correlation Coefficient	0,214	0,364** p <.001
	Sig. (2-tailed)	0,113	0,066
	N	56	56

Table 3: Correlation between V2 and V3 and V4 variables in the Control group

G2		V3_PDF_actions of navigation	V4_WP_actions
V2_Quiz actions_of_navigation	Correlation Coefficient	0,457** p <.001	0,535** p <.001
	Sig. (2-tailed)	0,001	0,000
	N	48	48

The non-normal distributions of our variables does not allow us to go further and perform linear regressions to measure linear relationships between our variables.

6. Discussion

Theses results show that if the difference in score is not significant between the experimental group and the control group (V1), the means to achieve it can be significantly differentiated. This is illustrated by the number of navigation actions (V2) during the Quiz, between the different questions, where students of the experimental group return more often to the questions they have already answered. Although the number of navigation actions in the documents (V3) is very close between the two groups, while the number of actions performed on the word processor is again higher for the experimental group (V5). But we note that there are absolutely no action of personalization of the interface which were carried out by the experimental group, in spite of the possibility of doing it and the communication of information and help allowing them to do it very quickly, during the activity, V5 = 0. This finding contradicts our hypothesis that the interface personalised by the learner during the activity, allows him/her to adjust all the actions carried out on the interface to answer the Quiz. These results also contradict those obtained since a study aimed to compare the relative effectiveness of animation- and static picture-based multimedia instruction in invisible infinitesimal phenomena (Yand et al., 2018). We suggest that the instrumental conflicts that students have to deal with from the interface, are tasks of such importance that they leave no room for additional interface customisation activity. The extra activity of the experimental group in terms of actions carried out on the interface in the different modules (Word processor, PDF, Quiz) with no significant difference in the average score obtained in the Quiz, is in line with the results of studies already conducted on the impact of the interface on the cognitive load from the point of view of navigability (Chevallier et al., 2004), where the "ergonomic" version of the same website requires a greater cognitive load than a standard version and often leads to disorientation (Demirbilek, 2004; Xiong, 2017 ***;*** Bayazit et al., 2018; Bhatti et al., 2020). The achievement of a higher average number of navigation actions in the Quiz and of the average number of actions on the word processor for the experimental group, as well as the correlations established between the variables V2_Quiz actions_of_navigation and V4_WP_actions, for each group, suggest the effect of the instrumental conflicts staged from the graphic interface of the learning environment, with more activity observed on adaptable interfaces than on adapted interfaces, and this, even without any customisation action of the adaptable graphic interface.

7. Conclusion

In this study, we evaluate the impact of the interface customisation of the ILE by the learners on the cognitive load. Results reveal that instrumental conflicts increase the cognitive load of the experimental group that had the possibility to customise the interfacte of the ILE. It can be measured by the increasing number of actions on the interface to perform the Quiz with no significant scores differences between the control group and the exprimental group. But they also suggest that these instrumental conflicts are so pervasive that all the students in the experimental group refrain from using any interface customization action during the learning and completion phases of the Quiz, even though they have been prompted and documented to do so with only 2 mouse clicks. However, the limitation of our study is that it only uses desktop computers. Further studies could be based on mobile terminals using an adaptable and *ad hoc* developed ILE.

References

Amadieu, F., Van Gog, T., Paas, F., Tricot, A., & Mariné, C. (2009). Effects of prior knowledge and concept-map structure on disorientation, cognitive load, and learning. *Learning and Instruction*, *19*(5), 376-386.

Bayazit, A., & Bayram, S. (2018). Investigating the relationship between task complexity, cognitive ability and disorientation in hypertext navigation. *Cypriot Journal of Educational Sciences*, *13*(4), 431-443.

Bhatti, N., Ismaili, I. A., Dhomeja, L. D., & McCrickard, D. S. (2020, August). Revealing And Resolving Disorientation In An Online Course Module Of Java Programming. In *2020 15th International Conference on Computer Science & Education (ICCSE)* (pp. 781-786). IEEE.

Bonsiepe, G. (1990). Interface Design language Graphics: Interpretations of Human User Interface. *Visible Language*, *24*(3), 262.

Chalmers, P. A. (2003). The role of cognitive theory in human–computer interface. *Computers in human behavior*, *19*(5), 593-607.

Chen, I., & Chang, C. C. (2009). Cognitive load theory: An empirical study of anxiety and task performance in language learning. In *Electronic Journal of Research in Educational Psychology 7*(2):729-746

Chevalier, A., Kicka, M., & Cegarra, J. (2004). Quels sont les effets de la qualité ergonomique d'un site web et de l'expérience des utilisateurs sur la charge cognitive et le temps de navigation. *Communication presenteeala 10eme JETCSIC, Geneva, Switzerland, June*.

Daiute, C. (1986): Physical and cognitive factors in revising: Insights from studies with computers. Research in the Teaching of English, V. 20, N. 2, P. 141-159.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management science*, *35*(8), 982-1003.

Debue, N., Hellemans, C., & De Leemput, C. V. (2013). Acceptabilité des sites web et ergonomie de l'interface: étude de l'influence de l'utilisabilité objective et de la charge cognitive. *Journal of Human Mediatised Interactions/Revue des Interactions Humaines Médiatisées*, *14*(2).

Demirbilek, M. (2004). *Effects of interface windowing modes and individual differences on disorientation and cognitive load in a hypermedia learning environment*. University of Florida.

Eppler, M. J., & Mengis, J. (2008). The concept of information overload-a review of literature from organization science, accounting, marketing, mis, and related disciplines (2004). *Kommunikationsmanagement im Wandel*, 271-305.

Findlater, L., & McGrenere, J. (2010). Beyond performance: Feature awareness in personalized interfaces. *International Journal of Human-Computer Studies*, *68*(3), 121-137.

Fleck, S., & Massou, L. (2021). Le numérique pour l'apprentissage collaboratif: nouvelles interfaces,

Gajos, K. Z., & Chauncey, K. (2017, March). The influence of personality traits and cognitive load on the use of adaptive user interfaces. In *Proceedings of the 22nd International Conference on Intelligent User Interfaces* (pp. 301-306).

Harding, Bruce A. (1989). *Windows & Icons & Mice, Oh My! The Changing Face of Computing*. Frontiers in Education Conference 1989: 19th Annual:337-342.

Hollender, N., Hofmann, C., Deneke, M., & Schmitz, B. (2010). Integrating cognitive load theory and concepts of human–computer interaction. *Computers in human behavior*, *26*(6), 1278-1288.

Jézégou, A. (2020). La présence à distance en e-Formation. *Médiations et médiatisations-Revue internationale sur le numérique en éducation et communication*, (3), 59-67.

Korbach, A., Brünken, R., & Park, B. (2017). Measurement of cognitive load in multimedia learning: a comparison of different objective measures. *Instructional science*, *45*(4), 515-536.

Li, J. & Cumming, A. (2009): Word processing and second language writing: a longitudinal case study. International Journal of English Studies, V. 1, N. 2, P. 127-152.

Li, C. Y. (2017). Why do online consumers experience information overload? An extension of communication theory. *Journal of Information Science*, *43*(6), 835-851.

Linard, M. (2001). Concevoir des environnements pour apprendre: l'activité humaine, cadre organisateur de l'interactivité technique. *Sciences et techniques éducatives*, *8*(3-4), 211-238.

Marquet, P. (2005, May). Intérêt du concept de conflit instrumental pour la compréhension des usages des EIAH. In *EIAH 2005 (Environnements Informatiques pour l'Apprentissage Humain)* (pp. 383-388). INRP.

Marquet, P. (2019). Le concept de conflit instrumental: rendre opérationnel une démarche d'ingénierie de conception.

Mayer, R. E. (2005). Cognitive theory of multimedia learning. *The Cambridge handbook of multimedia learning*, *41*, 31-48.

Mikulecky, L., & Lloyd, P. (1993). The Impact of Workplace Literacy Programs: A New Model for Evaluating the Impact of Workplace Literacy Programs.

Overdijk, M., Van Diggelen, W., Kirschner, P. A., & Baker, M. (2012). Connecting agents and artefacts in CSCL: Towards a rationale of mutual shaping. *International Journal of Computer-Supported Collaborative Learning*, *7*(2), 193-210.

Phinney, M. and Khouri, S. (1993): Computers, revision, and ESL writers: The role of experience. Journal of Second Language Writing, V.2, N. 3, P. 257-277.

Pourhoseingholi MA, Baghestani AR, Vahedi M. (2012). How to control confounding effects by statistical analysis. *Gastroenterol Hepatol Bed Bench, 5*(2):79-83.

Rabardel, P. (1995). *Les hommes et les technologies; approche cognitive des instruments contemporains* (p. 239). Armand Colin.

Saadé, R. G., & Otrakji, C. A. (2007). First impressions last a lifetime: effect of interface type on disorientation and cognitive load. *Computers in human behavior*, *23*(1), 525-535.

Saha, D., Mandal, A., & Pal, S. (2015). User interface design issues for easy and efficient human computer interaction: an explanatory approach. *International Journal of Computer Sciences and Engineering*, *3*(1), 127-135.

Stevens, V. (1999): Language learning techniques implemented through word processing. Retrieved June 10th, 2011, from: http://www.netword.com/eslhome

Sweller, J., & Chandler, P. (1991). Evidence for cognitive load theory. *Cognition and instruction*, *8*(4), 351-362.

Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. *Learning and instruction*, *4*(4), 295-312.

Warschauer, M. (1998): Computer and language learning: An overview. Language Teaching, V. 31 N. 2, P. 57-71

Xiong, J. (2017). The impact of control belief and learning disorientation on cognitive load: The mediating effect of academic emotions in two types of hypermedia learning environments. *TOJET: The Turkish Online Journal of Educational Technology*, *16*(1).

Yang, C., Jen, C. H., Chang, C. Y., & Yeh, T. K. (2018). Comparison of animation and static-picture based instruction: Effects on performance and cognitive load for learning genetics. *Journal of*

Zeller, A., & Marquet, P. (2020a, June). Impact of GUI personalization of a word processor on a learning activity course. *In 6th International Conference on Higher Education Advances, Valencia*.

Zeller, A.; Marquet, P. (2020b, november). Impact of GUI evaluation of a word processor on the affordance of interactive learning environnements*. Proceedings of the 19th European Conference on e-learning, Berlin, Germany.*