Proceedings of the
17th European Conference on e-Learning

Co-hosted by the University of West Attica, Greece and Hellenic Air Force Academy (HAFA)

1-2 November 2018

Edited by

Prof. Klimis Ntalianis

Prof. Antonios Andreatos

Prof. Cleo Sgouropoulou

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Review Process

Papers submitted to this conference have been double-blind peer reviewed before final acceptance to the conference. Initially, abstracts were reviewed for relevance and accessibility and successful authors were invited to submit full papers. Many thanks to the reviewers who helped ensure the quality of all the submissions.

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Preface

These proceedings represent the work of contributors to the 17th European Conference on e- Learning (ECEL 2018), Co-hosted by: the University of West Attica, Greece and Hellenic Air Force Academy (HAFA) on 1-2 November 2018. The Conference Chair is Prof. Klimis Ntalianis from West Attica University and the Programme Co-Chairs are Prof. Antonios Andreatos from the Hellenic Air Force Academy and Prof Cleo Sgouropoulou from West Attica University.

ECEL is a well-established event on the academic research conference calendar and now in its 17th year the key aim remains the opportunity for participants to share ideas and meet the people who hold them. The scope of papers will ensure an interesting two days. The subjects covered illustrate the wide range of topics that fall into this important and ever-growing area of research. For the 4th year the conference has also played host to the final round of the International e-Learning Excellence Awards.

The opening keynote presentation is given by Prof. Michalis Xenos from the University of Patras who will address the topic of Everything is blended learning. Then an afternoon keynote will be given by Carlos Delgado Kloos from the Universidad Carlos III de Madrid, Spain on the subject Education is too Important to still Teach like we're in the Middle Ages. The second day of the conference will open with an address by Dr.Anastasios (Tassos) Mikropoulos from the The Educational Approaches to Virtual Reality Lab, University of Ioannina, Greece who will talk about the Learning Affordances of Virtual Reality.

With an initial submission of 188 abstracts, after the double blind, peer review process there are 77 Academic research papers, 9 PhD research papers, 1 Masters Research paper and 4 work-in-progress papers published in these Conference Proceedings. These papers represent research from Argentina, Australia, Austria, Bahrain, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Iran, Ireland, Italy, Japan, Kazakhstan, Malaysia, the Netherlands, Nigeria, Norway, the Philippines, Portugal, Russia, Saudi Arabia, Singapore, South Africa, Spain, Sweden, Taiwan, Turkey, the UK, the UAE, Uganda, the USA and Vietnam.

We hope you enjoy the conference.

Prof. Klimis Ntalianis
Prof. Cleo Sgouropoulou
West Attica University, Athens Greece

Prof. Antonios Andreatos
The Hellenic Air Force Academy, Athens Greece

October 2018

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Biographies

Conference and Programme Chairs

Prof Klimis Ntalianis received his diploma and PhD from the Electrical and Computer Engineering Department of the National Technical University of Athens (NTUA) in 1998 and 2003 respectively. Between 2004 and 2006 he has completed two Post-docs in the areas of multimedia protection and emotion analysis. From 1998 till 2009 he was a Senior Researcher at the IVM Lab of NTUA, where he has participated in more than 20 R&D projects under different calls from the General Secretariat of Research and Technology of Greece, the Research Promotion Foundation of Cyprus and the European Union. In parallel and from 2005 till 2011 he has worked as an adjunct lecturer at the University of Peloponnese, the Hellenic Naval Academy, the Hellenic Air Force Academy and the Cyprus University of Technology. From October 2014 he has been Associate Professor at the Athens University of Applied Sciences (TEI of Athens). Klimis has published several articles in International Journals and Conferences. His main research interests include multimedia analysis, social computing and learning with multimedia

Prof Antonios Andreatos is Professor at the Computer Engineering Division of the Hellenic Air Force Academy. He received a Diploma in Electrical Engineering from the University of Patras, an M.S. in Computer Engineering from the University of Massachusetts at Amherst, an M.Ed. in Adult Learning from the Hellenic Open University and a PhD in Computer Engineering from the National Technical University of Athens. Antonios has published numerous papers in various international journals and conference proceedings, and four book chapters. He has also published three books. His educational research interests include: Engineering Education, e-Assessment, Active Learning methods, Learning in Virtual Communities of Practice, Free & Open-Source Software (FOSS) in Education, OER & MOOCs in Education, Social Media in Education, Informal learning in FOSS communities, Didactics of Computer Engineering. He is involved in the scientific committees of many conferences and is a reviewer for several journals.

Prof (Mrs) Cleo Sgouropoulou is a Professor of Learning Technologies at the TEI of Athens, Head of the Department of Informatics and Director of the Institute for Lifelong Education (ILE). Her research interests lie in the fields of design, development and standardisation of Learning Technology and Research Information Systems. Cleo is the Vice-Chair of the European Standardization Committee (CEN) TC 353 "ICT for Learning, Education and Training" and the Head of the Greek delegation to the ISO JTC1 SC36 "Information Technology for Learning, Education and Training". She has participated as an expert in several standardization projects and contributed to the production of related specifications European Norms (ENs) ("EN15982 Metadata for Learning Opportunities", "EN15981 European Learner Mobility Achievement Information"). Cleo has leaded numerous national and European-funded projects related to e-Learning, Open Educational Resources (OER) and Massive Online Open Courses (MOOCs), learning outcomes, competence and skills modelling for strengthening LLL, mobility and training to employment pathways, Open Data and analytics for e-Research.

Keynote Speakers

Carlos Delgado Kloos holds a Ph.D. degree in Computer Science from the Technische Universität München and in Telecommunications Engineering from the Universidad Politécnica de Madrid. He is Full Professor of Telematics Engineering at Universidad Carlos III de Madrid, where he is the Director of the GAST research group, Director of the UNESCO Chair on "Scalable Digital Education for All", and Vice President for Strategy and Digital Education. He is also the Coordinator of the eMadrid research network on Educational Technology in the Region of Madrid. He is the Spanish representative at IFIP TC3 on Education, Senior Member of IEEE, and associate editor of IEEE Transactions on Learning Technologies. His main research interests are in Educational Technology. He has been involved in more than 40 projects with European (Esprit, IST, @LIS, eContentPlus, Erasmus+), national (Spanish Ministry, Region of Madrid) and bilateral (Spanish-German, Spanish-French) funding. He has published over 400 articles in national and international conferences and journals and has further written a book and co-edited over a dozen. He has coordinated several MOOCs (on edX and MiríadaX).

Dr. Anastassios (Tassos) Mikropoulos holds a Ph.D. from the National and Kapodistrian University of Athens (1990). He is a Professor and the Head of the Department of Primary Education the University of Ioannina, as well as the founder and director of the "Educational Approaches to Virtual Reality Technologies laboratory-EARTH lab". Tassos Mikropoulos is the founder and elected chair of the Hellenic Association of ICT in Education. His main research interests are on educational virtual environments and educational neuroscience. Professor Mikropoulos also serves as a consultant for the Greek Ministry of Education and Research in topics such as digital school, educational software, in-service teachers further training.

Michalis Xenos (BSc 1991, PhD 1996) is a Professor at the Department of Computer Engineering and Informatics at the University of Patras. He was the director of the graduate (2013-2016) and the postgraduate (2009-2012) Computer Science courses at the Hellenic Open University. He was member of the European Steering Committee for the OpenUpEdu Group for the European MOOCs and founder and director of the Software Quality Research Group. He is now leading 4 EU funded research projects and he has lead and participated in over 50 research and development projects in the areas of software engineering and educational technologies. His current research interests include Software Quality, Human Computer Interaction, Human Robot Interaction and Educational Technologies. He has authored or co-authored 8 books and over 170 papers in international journals and conferences.

Mini Track Chair

Dr. José Martí-Parreño is Associate Professor at the Universidad Europea de Valencia, Spain. His main research areas include gamification and educational innovation. He was awarded in 2015 with the David A. Wilson Award for Excellence in Teaching and Learning for a research project on gamification. His research on gamification has been published in top journals such as Computers in Human Behavior and Journal of Computer Assisted Learning.

Biographies of Contributing Authors

Lawrence Aikins graduted from University of Maryland with B.Sc. in Information System Manegement and Masters in Cyber-Security at UMBC. He is currently doing his PHD in Information Technology at Towson University. Certifications include Ethical Hacking, Certified Security Analyst, Licensed Penetration Tester, Security+, Microsoft System Administration. His current position as President of LKA Computer Consultants.

Angeliki Alafouzou studied English Language and Literature in the University of Athens. My Master's Degree was taken place in the University of Pireaus and more specifically in the department of Digital Systems. My Master Thesis concerns the construction of a gamified e-course that promotes motivation via the use of ARCS model.

Paulo Alves – Ph.D. in Technology and Information Systems, University of Minho, Portugal, and Master in Multimedia Technology from the University of Porto, Portugal. Is e-learning coordinator and professor at the Polytechnic Institute of Bragança. Is researcher at CeDRI-Research Centre in Digitalization and Intelligent Robotics. The research interests include: e-learning, big data analytics, web development and multimedia.

Ahmed Antwi-Boampong holds an MBA in project management and is currently a Ph.D. Fellow at the Aalborg University, Centre for Communications, Media and Information Technologies. His research focus and interest are in blended learning and how it's utility can be harnessed and applied to higher education in developing countries.

Ema Elena Aveleyra Professor of Mathematics and Physics, Specialist Computer Education. Master of Educational Projects Management. Associate Professor in Physics and Algebra in the University of Buenos Aires. Director of the Educational Technology Center and the Laboratory of Virtual Learning Environments in the School of Engineering-UBA. Author of several works on educational research and ICT in education.

Robert Beauchemin is President and CEO of eConcordia/KnowledgeOne, an award-winning learning solutions company headquartered in Montreal. Through his 30 years of professional experience in information technology, including the management of several large-scale computer learning development projects, he acquired a strategic vision, as well as leadership, negotiation, and change management skills in a multidisciplinary environment.

Anders Henrik Bendsen, VIA University College, Denmark researches in online and blended learning at VIA University College, Bachelor of Education Programme of Teacher Training. I take an interest in learning assisted by digital means, which has taken me from learning for dyslectics into upgrading colleagues in digital networks for classes, and recently into a national MOOC for Teacher Training Colleges.

Marcus Bjelkemyr is head of the masterprogram Innovation and design and lecturer at Maelardalen University . He has a civil engineering degree within Production systems, and wrote his Ph. D. thesis on system-of-systems issues in production, both at the Royal Institute of Technology (KTH)

Konstantinos Bourdas works as a primary school teacher and I have many years of experience in the application of learning technologies to education. My work as a postgraduate student in e-learning, in the Department of Digital Systems, at University of Piraeus, focuses on gamification and how it can be used to foster engagement and motivation.

Pavel Brebera works as Senior Lecturer at the Language Centre of the University of Pardubice, Czech Republic. In his current job, he focuses mainly on teaching English for Specific Purposes, eLearning and mLearning. His other professional activities include, for example, providing in-service teacher training at private language schools.

James Brunton Dr has a BA (Hons) in Applied Psychology from University College Cork and a PhD in Social/Organisational Psychology from Dublin City University (DCU). He is Chair of the DCU Connected BA in Humanities (Psychology Major) programme in Dublin City University. Working within DCU's National Institute for Digital Learning his research interests include the psychology of identity formation, socialisation/induction processes for 'off-campus' higher education students, and digital assessment.

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. Her methodology draws on action and Design-Based-Research approaches in studies of the visual's learning potentials. She has several publications in this field.

Amelia Calonge Professor at University of Alcalá (Spain), leading a multidisciplinary research team working on Geology teaching. Most of her research over the last years has been concentrated in Educational resources and strategies in Secondary and University Teaching. She also has active with other experimental centers as the Centers for Secondary Teacher's Background or GEO-Schools (European Union project supported by the Lifelong Learning Programme). Currently,, she is the Dean of the Faculty of Education since 2013.

Nathalie Cazaux A French native, I have been living in Dublin (Eire) since 1992. I lecture at Third-Level in the Institute of Technology, Blanchardstown. I teach French for Business (Year 1 to Year 4). I am interested in Education and Technology. Currently working on Game-Based Learning and Gamification with a keen interest in UDL too.

Dr. Ivana Cechova is Head of the English Department at The Language Training Centre of the University of Defence, Brno, Czech Republic. She has attended many specialist programs to broaden her professional expertise in Europe, Canada and the United States. In her current research work, she focuses on ICT in teaching languages, E-learning and Blended Learning as well as Applied Linguistics

Paula Charbonneau-Gowdy is Associate Professor and researcher in English as a Foreign Language Teacher Education at the Universidad Andres Bello in Santiago, Chile. She received her PhD in Education from McGill University Canada in 2006. She was formerly Senior Advisor in Learning and Technology to the Government of

Canada. Her research interests lie in the socio-cultural implications of emerging technologies on teaching, learning and learners at all levels of the educational system.

Min-Chi Chung is a graduate student of Graphic Arts and Communications at National Taiwan Normal University. She received bachelor's degree in English education from National Kaohsiung Normal University in 2015. Her main research areas are instructional design in English and elementary mathematic with innovative technology, and help students to learn in meaningful and interesting manner.

Samantha Clarke is a practical developer and researcher of game-based learning and gamification applications primarily focused on the role of games and play in the educational environment. Her research and practice interests are mainly in the area of curiosity, narrative and puzzle led games that include escape rooms, D&D, mystery boxes and choose your own adventure style games.

Eamon Costello Dr. holds a BA (Hons) in English Literature and History, a higher Diploma (Distinction) in Computer Science, an MSc in Software and Information Systems and a Doctorate from Trinity College Dublin. Dr. Costello has extensive experience in teaching and research in digital and open and online learning.

Reet Cronk is originally from Australia and currently chairs the Information Systems Department at Harding University USA. She has a multidisciplinary background of medical technology, molecular genetics and information systems. Her most recent research has been in the evaluation of web 2 technology, gamification, e-learning social and intellectual capital, and knowledge sharing.

Olav Dæhli an associate professor at the University of South-Eastern Norway, Department of Electrical Engineering, IT and Cybernetics. He teaches engineering courses in the field of ICT and automation. His research interests are within computer science, automation, ICT in higher education, e-learning, and entrepreneurship.

Laura Delgaty is a Senior Lecturer in Medical Education at Newcastle University and Deputy Degree Programme Director to the Masters of Medical Education Programme. Her background is as a sports physiotherapist and she is a senior fellow of the Higher Education Academy. Her research interests include technology in learning, medical education, diversity and inclusion and curricular studies.

Souâd Demigha is a Doctor in Computer Science from the University of Paris1-Sorbonne. She is a researcher at CRI (Sorbonne-University) and Lecturer at the University of Paris XI. Her Research deals with: Information Systems, Medical Imaging, eLearning, Knowledge Management, Big Data, Data Mining. She is the author or co-author of 42 international scientific papers.

Martina A. Doolan Dr is a Principal Lecturer in Computer Science at the University of Hertfordshire. Martina was awarded a UK National Teaching Fellow in recognition for her research, teaching and expertise in innovations in technology and learning. Martina's research interests include: social, collaborative/community learning, assessment design and the use of technology.

Jeppe Egendal, VIA University College, Denmark -researches the use digitalization and eLearning in vocational education and bachelor programs. I have a particular interest in vocational teachers' use of digital tools in education and the organizational implementation of digitalization and eLearning in education. Another focus of interest is the use of open source resources in education, e.g. MOOCs in education.

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Digital Transformation of Education in the Kingdom of Saudi Arabia: Deploying a Country-Wide Learning Management System for K-12 Education

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Abstract: In the context of Saudi Arabia Vision 2030, the Ministry of Education launched the Future Gate initiative, aiming to bring about a significant digital transformation for teaching and learning in the K-12 education in the Kingdom of Saudi Arabia. Future Gate is a country-wide, large-scale initiative that offers a Learning Management System (LMS) for all the public middle and secondary schools in Saudi Arabia. In addition to that, Future Gate also sets up the infrastructure needed for the LMS to be adopted within the classroom. The proposed paper outlines the main parts of Future Gate while it also reports on the most important challenges that project implementation was faced with, reflecting on the ways in which they were handled. As Future Gate is an ongoing project, this paper discusses its upcoming phases and attempt to identify future challenges. Overall, this paper aims to serve as a case study for countries that are planning to develop similar initiatives, building upon the lessons learned in the case of Saudi Arabia.

Keywords: schools, K12, learning management system, initiative, Saudi Arabia

1. Introduction

The coordinated use and adoption of new technologies within the classroom worldwide, has been intensified throughout the last decade. In this systematic effort of national educational systems to enhance the educational experience offered to students and teachers alike, various national initiatives have been launched (Watson, 2007; Alazam et al., 2012; Tay et al., 2012; Moodly & Adu, 2014; Voogt et al., 2017). The majority of these initiatives aim to increase access to high-speed internet, devices and/or software in order to improve teaching and learning processes. But the aims of such initiatives and therefore their success, depend on something more than the mere adoption of the technology or the sheer numbers of devices subsidized.

The evaluation of such initiatives throughout the years, has outlined specific challenges which are also documented in relevant case studies (Stack 2008, Unal & Ozturk, 2012; Bennett, 2017). As Groff and Mouza (2008) discuss, there are specific challenges, obstacles and limitations related to the integration of technology in the classroom. The authors break them down in six categories, related to (1) the school, (2) the teacher, (3) the student, (4) the project, (5) technology and (6) research & policy. In order for any technological intervention in the classroom to work, all these factors have to be taken into consideration. In a similar analysis carried out by the Ministry of Education of the United States, in its National Education Technology Plan, (NETP, 2017), the main factors that influence technology adoption were broken into five (5) categories: learning, teaching, leadership, assessment and infrastructure.

Future Gate is a country-wide, large-scale initiative that, upon its completion, will have set up a Learning Management System (LMS) for 25.000 schools, 4.500.000 students and 500.000 teachers in Saudi Arabia. Future Gate started in 2017 and will be completed in 2020, when all students, teachers and schools of the Kingdom of Saudi Arabia will be connected to Future Gate LMS. During this process, a number of challenges is already surfacing, posing threats to project implementation but also opportunities for learning.

This paper will outline the main aspects of Future Gate, discussing key considerations for each one. It will also report on the most important challenges that project implementation was faced with, reflecting on the ways in which they were handled. As Future Gate is an ongoing initiative, this paper will discuss on some preliminary evidence in an effort to identify future challenges. Overall, this paper aims to serve as a case study for countries that are planning to develop similar initiatives, building upon the lessons learned in the case of Saudi Arabia.

2. Future Gate project overview

Future Gate's primary goal is to set up a Learning Management System (LMS) for all the middle and secondary public schools in Saudi Arabia, to support the teaching and learning needs of students and teachers alike. As it is depicted in the following figure, Future Gate will be deployed in three (3) distinct phases, starting from 2017, until 2020.

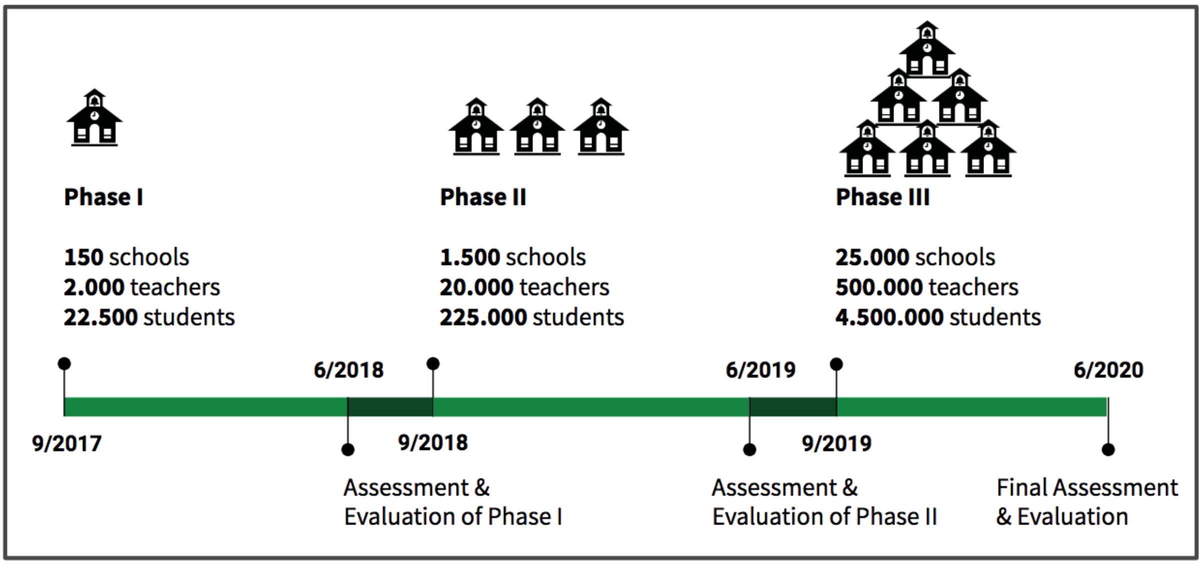

Figure 1: The phases of the Future Gate project

In Phase 1, one hundred and fifty (150) schools started using the LMS, fifty in the Riyadh region, another fifty in Jeddah and fifty in Dammam. In each region, a different LMS was introduced. More specifically, schools in Riyadh used a Moodle implementation, whereas Jeddah used a Classera implementation and finally, Dammam was introduced to the LMS provided by ITWorx. The rationale behind the LMS selection is described in more details, in Chapter 3. In Phase 2, another 1.500 schools will be connected to the LMSs, throughout the school year 2018-2019. Finally, in Phase 3, the remaining schools of the Kingdom will be connected to the Future Gate LMS, raising the total number of connected schools to 25.000.

2.1 Main beneficiaries and functionalities offered

In the core of Future Gate, lie three groups of beneficiaries that will mainly be using the project services, these are the teachers, students and parents. The following table, outlines the functionalities that the LMS will offer to each one of these groups.

Table 1: Main LMS functionalities for each beneficiary

Functionality	Teacher	Student	Parent
Electronic tests	+	+	
Interactive content	+	+	
Weekly plan	+	+	+
Student attendance	+		+
Student behaviour	+	+	+
Communication	+	+	+
Academic calendar	+	+	+
Profile page	+	+	
Lesson preparation	+		
Discussion forums	+	+	
Task list	+	+	
Student reports			+

As it was depicted in Table 1, through the Learning Management System (LMS), students and teachers can get access to interactive content for their courses. The teacher can also upload homework for the students, tests, questions and exercises on the question bank and their quarterly plan. Teachers can also communicate with students and parents. The LMS also allows the teacher to prepare his/her weekly teaching plan. Teachers, students and school management can access the weekly and daily program and schedule virtual classes for students. Last but not least, on the LMS, a competitive point system was deployed, to incentivise students and teachers working with the LMS.

2.2 Challenges

This section will shortly reflect on some of the main challenges that project implementation was faced with, discussing the course of action that was followed in each one. Looking at recent relevant literature, it seems that the challenges that Future Gate is faced with, are quite similar to other initiatives, both on a national level but also on an international one (Bennett, 2017; Schoology 2017):

- *Introduction of LMS in various school topics*: To make sure that the LMS was introduced smoothly in the everyday practices of teachers and students, it was gradually introduced in the different school topics during the first phase of the project. More specifically, during the first three weeks of the first phase, the LMS was used in the topics of Math, Science and English. Following this, during the next three weeks the LMS was introduced in Social Sciences and Arabic. Lastly, after week seven, the LMS was introduced into the remaining topics of the school curriculum.
- *On the ground support to teachers*: To make sure that the teachers were offered all the support they needed in utilizing the LMS, a specialized team was established in each region of the Kingdom. These teams visited the schools where the LMS was deployed and offered assistance and guidance to the teachers in order to work with the LMSs. The existence of these teams, apart from the support to the teachers, also created a feedback channel for the project implementation team, allowing for teachers' input to be taken into consideration during the next phases of the initiative.
- *Training and supporting material*: In conjunction to the face-to-face support, Future Gate also produced a set of activation guides for teachers, students, parents and school personnel in general. These guides referenced in a brief and concise manner, the main functionalities of the LMSs that the school community can use. In this way, it was made clear for all the stakeholders involved which were the ways in which they could take advantage of the LMS to enhance their learning and teaching practices.
- *Monitoring, evaluation and quality assurance*: Throughout the project implementation, a quality assurance plan is being deployed, using tools, methods and specific metrics to monitor the use of the LMSs by the educational community. The actual use of the LMSs was monitored using the free and open-source, Matomo analytics platform[1] (formerly known as PIWIK). Specific Key Performance Indicators (KPIs) were set for the Future Gate outcomes, following international practices. A baseline was established for these KPIs and a benchmark was set based on similar projects and initiatives. The ongoing monitoring and evaluation of these KPIs, ensures that Future Gate is making a real impact on the educational sector altogether.
- *Change management & motivation*: As in other similar educational technology initiatives, the changes brought about from the introduction of the LMS also called for a well-though change management strategy for all the stakeholders involved. More specifically, to address the issue of motivating the teachers and learners to use the LMS that was introduced, the project established a detailed reward and recognition system. Starting from a point system that was incorporated in all LMSs, the teachers and students can collect points by their activities within the LMS. Based on the points collected, teachers and students are selected locally, regionally and then nation-wide, to receive certifications and other prizes, that recognize their leadership and initiative.

3. Learning management systems

Currently, in Future Gate, three (3) different LMSs are being deployed. Three providers were selected, deploying one LMS per region (Riyadh, Jeddah, Dammam) in order to pilot each LMS on a controlled set of schools. The overall aim was to evaluate the use of each LMS during the first stage of the project in order to select one LMS that would be deployed in all the schools of the Kingdom, in the final stage of the project. The three providers that were selected, were Moodle, Classera and ITWorx. Access to all three LMSs was facilitated through Single-Sign-On from the existing national School Information System (SIS) named Noor.

[1] https://matomo.org/

The selection of the three LMS providers was based on a set of one hundred and thirty-nine (139) criteria that were used to evaluate the functionalities offered by the LMSs. The full set of criteria is beyond the scope of this paper, but the generic categories in which these criteria were grouped, are the following:

- 1. Supporting learning objectives and competences
- 2. Support for learner and teacher analytics
- 3. Support for evaluation of all the users' activity in the LMS
- 4. Technical compatibility with other systems
- 5. Technical extensibility, technical documentation and support to the users
- 6. Support of self-development, self-learning and individual learning styles
- 7. Compatibility with existing standards and specifications for e-learning
- 8. Compatibility with latest technologies and software tools for e-learning
- 9. Support of the main functionalities needed by teachers, students and parents
- 10. Security and privacy of data as well as student protection
- 11. Support for learning objects, authoring of content and digital repositories
- 12. Multilinguality support for Arabic language and content

The evaluation criteria for the LMSs were carefully selected to make sure that the LMS selected would serve the needs of the educational community with respect to the latest developments in educational technologies. In addition to that, the ability of the LMS to cover local needs with respect to student privacy and data security was also a fundamental concern. Lastly, the ability of the LMS to offer insights related to teacher and student usage and performance with the system, was a hard requirement so that the Future Gate implementation team could assess and evaluate the impact of the LMS on teaching and learning.

4. Infrastructure

4.1 Broadband connectivity

Saudi Arabia has a great number of schools, varying greatly in size, scattered across a vast area. For these schools, internet connectivity has been an issue, manifested in the form low internet speeds or limited access. For the schools of Saudi Arabia to be able to take advantage of the services offered through the Future Gate LMS, broadband connectivity was also a prerequisite.

To this direction, Future Gate coordinates the creation of a solid infrastructure for the broadband connectivity of all the middle and secondary public schools. More specifically, for the first period of the project, all the participating schools (150) were connected to 10Gbps internet and were equipped with wireless access points throughout the school building. For the next phases of the initiative, all the remaining schools will be gradually connected through a similar infrastructure to high-speed internet.

4.2 Interactive projectors and teacher laptops

To allow for the seamless integration of the LMSs within the classrooms, the Future Gate project will gradually equip the schools in Saudi Arabia with interactive projectors. To allow the teachers to take advantage of the projectors installed inside the classrooms, a total of 2.000 laptops were purchased and donated to teachers during the first stage of Future Gate. Related to the interactive projectors, after the completion of the first stage of Future Gate, 20% of the schools participating have an interactive projector installed.

4.3 1-to-1 laptop

One of the major obstacles for the LMS use, as it was identified through the students' needs assessment, was the availability of a personal computer. The availability of a personal computer for every student would contribute to overcoming this obstacle and ensure the use of the LMS by the students, both at home but also in the school.

To this direction, Future Gate has carried out an initial study, assessing the short and long-term impact of such an initiative as well as its financial aspects. Through this study it was made clear that the direct and indirect benefits to the economy of Saudi Arabia, out-weight the initial investment needed to launch this initiative as well as the yearly costs that come into place. Therefore, it is expected that during the second stage of the project (school year 2018-2019), the 1-to-1 laptop initiative will be launched as well.

5. Preliminary results

5.1 Key performance indicators

As it was mentioned in paragraph 2.1, continuous monitoring and evaluation lies in the heart of Future Gate. In this context, a set of KPIs has been defined and is being continuously compared to international benchmarks to ensure that the project is in line with its expected results. In the following table, a subset of these KPIs is presented, along with their benchmark and their first measurement that will be used as a baseline for Future Gate for future comparison. Each benchmark was retrieved from various sources such as research papers, national surveys and international reports (UNESCO, 2009; EC, 2013; OECD, 2015; Kampylis et al., 2015). For KPIs 6 to 14, data collection was carried out through a questionnaire that was delivered to the teachers electronically, communicated through a text message on their phones and was completed by approximately three hundred (300) teachers.

Table 2: Future Gate KPIs and benchmarks

No	KPI	Method of measurement	Baseline	Benchmark
1	Teachers that use LMS to create assignments	Usage data from LMS, surveys and questionnaires	18.4%	20%
2	Teachers' Use of ICT in more than 25% of the lessons		40%	32%
3	Teachers that use LMS to create e-content		15.4%	16%
4	Teachers that use LMS for the preparation of weekly plan		16.2%	11%
5	Teachers that use LMS for the preparation of the course		24.1%	29%
6	Teachers that see low bandwidth as an inhibitor for ICT use	Questionnaire	24.6%	21%
7	Teachers that see devices as an inhibitor for ICT use		32.6%	34%
8	Teachers' experience in using computers for teaching		(<1y): 4% (1-3y): 18% (4-6y): 21% (>6y) 57%	8.8% 14.1% 14% 52.9%
9	Teachers with more than 6 days on ICT related training		20%	61%
10	Teachers reporting having spent no time on ICT related training		48%	5%
11	Teachers' Confidence in their ICT Skills		3.5/4	3/4
12	General attitude of Teachers towards ICT in teaching and learning		3.3/4	3.4/4
13	Teachers that think that ICT improves overall performance of students		77.5%	68%
14	Negative views on the use of ICT in Teaching		15.6%	5%

As it can be concluded from the previous table, for this subset of KPIs, the Future Gate baseline is close to the international benchmarks identified, either being slightly lower or slightly higher. As a starting point, the baselines identified and their comparison to international benchmarks is sufficient. As it can be seen in the KPIs, this subset focuses exclusively on the teachers, so another set of KPIs focusing on students is being measured and will be analyzed at a later stage of Future Gate.

Related to the actual numbers in the aforementioned table, it can be noted that the use of the LMS is close to the international benchmarks, but the aspiration of the project is that these numbers will improve over time.

Also, one critical aspect of the KPIs, is related to teachers' training which is significantly low compared to international benchmarks. More specifically, only 20% of teachers have had more than six (6) days on ICT-related training whereas almost half of the teachers that were questioned (48%), had no ICT training whatsoever.

Last but not least, compared to international benchmarks, it was noted that the Saudi teachers were more negative towards the use of ICT in teaching than their colleagues worldwide. This fact has to be taken into account in all the processes and campaigns related to change management so that the benefits of introducing the LMS into the classroom are made clearer to the teachers.

5.2 Usage statistics

5.2.1 Devices, visit frequency, duration and time of day

Throughout the first period of Future Gate, data from all the LMSs have been collected as part of the monitoring process. This data included but were not limited to: visits, unique visitors, duration of visits, actions per visit, bounces and page views. In greater depth, data such as visits per day, per visit duration and per number of pages were collected and analyzed. In this paper we chose to present a subset of this data, mainly the ones that offer rich insights on the use of the LMS by students and teachers.

Table 3: Device types per visits

No	Device Type	% of Visits
1	Desktop	52.21%
2	Smartphone	33.59%
3	Tablet	10.07%
4	Phablet	3.67%

Although it was expected that most of the visits in all three LMSs would originate from desktop computers, it was noteworthy that a large part of the visits, came from smartphones. This fact indicates the need for the LMSs to be designed in a mobile-friendly manner, so that the users can take advantage of the same functionalities of the desktop version in their mobile, table or phablet, that accounted for almost 48% of the visit sources for the LMSs. In the following table, the total number of visits to the LMSs is grouped based on the duration of the visit.

Table 4 offers two interesting findings. First of all, the high percentage of visits with short duration, which was 22% for the period of reference. This was attributed to the fact that within the schools, once the students received their log in credentials, most of the teachers had the students test them out within the classroom, logging in and out in a short period of time so that the next student could also test their credentials. This aside, the 27.94% of the visits that lasted from fifteen minutes and more was really encouraging for the use of the LMS. To further examine this finding, in Table 5 the pages per visit are being analyzed.

Table 4: Visits per visit duration

Duration	% of Visits
0-10s	22.72%
11-30s	3.93%
31-60s	4.53%
1-2 min	6.70%
2-4 min	9.23%
4-7 min	9.58%
7-10 min	6.93%
10-15 min	8.46%
15-30 min	15.11%
30+ min	12.83%

Table 5: Visits per number of pages

No of Pages	% of Visits
1 page	21.56%
2 pages	11.54%
3 pages	9.10%
4 pages	6.67%
5 pages	5.56%

No of Pages	% of Visits
6-7 pages	8.15%
8-10 pages	8.41%
11-14 pages	7.34%
15-20 pages	6.77%
21+ pages	14.72%

Related to Table 5, despite the large number of visits that concern one or two pages (33%), almost 38% of the visits concern eight or more pages which shows that even at such an early stage of the project, the LMSs are being used by teachers and students alike. To validate this notion, the monthly number of visits per visitor is examined in Table 6.

Table 6: Visits per number of visits

No of Visits	% of Visits	No of Visits (cont.)	% of Visits
1 visit	13.28%	8 visits	3.29%
2 visits	8.30%	9-14 visits	14.61%
3 visits	6.47%	15-25 visits	14.84%
4 visits	5.37%	26-50 visits	13.31%
5 visits	4.65%	51-100 visits	6.42%
6 visits	4.08%	101-200 visits	1.63%
7 visits	3.64%	201+ visits	0.14%

Looking at Table 6, it is evident that a significant percentage of students and/or teachers visit the LMSs quite frequently over the course of a month. More specifically, almost 36% of the users visit the LMS fifteen or more times during a month. This finding validates our notion that at such an early stage of the Future Gate project, the educational community is quite engaged in the project, actively using the services offered, incorporating the LMS in its everyday learning and teaching practices. Of course, more in-depth analysis will be needed to make stronger claims related to the use of the LMS.

Lastly, the time of day and the actual day when the LMSs are used has been a solid indicator of LMS usage. More specifically, the following tables show the time of day when the logins to the LMSs took place, over the period at hand, as well as the percentage of visits for each day of the week.

Table 7: Visits per time of day

Time of day	% of Visits	Time of day (cont.)	% of Visits
Midnight	2.12%	Noon	2.78%
1:00	0.95%	13:00	4.36%
2:00	0.57%	14:00	8.12%
3:00	0.45%	15:00	8.21%
4:00	0.50%	16:00	7.60%
5:00	1.25%	17:00	8.41%
6:00	1.86%	18:00	9.59%
7:00	1.53%	19:00	9.24%
8:00	1.85%	20:00	8.79%
9:00	2.02%	21:00	6.87%
10:00	2.44%	22:00	4.93%
11:00	2.56%	23:00	3.03%

Table 7 indicates that most of the visits to the LMS take place post-school, that is after 14:00. After 21:00 at night, the percentages decline, which was also expected. For the time being, in-school use is quite low, which shows that students are not logging in the LMS from their classroom, where evidence suggests that teachers are usually logged in, using the LMS through a projector.

Table 8: Visits per day

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
% of Visits	17.86%	18.86%	16.99%	9.88%	8.54%	12.41%	15.46%

Table 8 indicates that the use of the LMSs is more intense on Monday, Tuesday and Wednesday. Taking into account that the weekend in Saudi Arabia is Friday and Saturday, the low percentages on Thursday and Friday are explained, as the students don't have to study for the following day. As it can be seen in the table, from Saturday the percentage of visits rises again, peaking around Tuesday, in the middle of the school week.

5.2.2 LMS usage data

This paragraph offers some initial quantitative results from the actual use of the LMSs in all three regions, for the total of the 150 schools of the first phase. As it was already mentioned, in this phase, approximately 2.000 teachers and 22.500 students were introduced to the Future Gate LMS. These 22.500 teachers, have been responsible for the use of the LMS as this is detailed in Table 9.

Table 9: LMS usage data

Item	Dammam	Jeddah	Riyadh	Total	Per teacher
Lessons prepared	29.517	43.630	25.946	99.093	~50
Tasks & activities prepared	154.328	40.451	27.316	222.095	~111
Interactive content created/uploaded	121.480	58.234	15.357	195.071	~98
Discussion threads created	23.114	4.143	9.268	36.525	~18
Virtual classes organized	711	1.461	159	2.331	~1.2

The results of Table 9 show that the use of the LMSs in the three regions is quite different. This phenomenon can be attributed to the differences between the user interface of each LMS. When all schools are connected on the same LMS, these numbers will be examined again. Overall, taking into account that almost 90% of teachers are actively using the LMS, it seems that teachers are indeed using the LMS to prepare for their lesson, to create tasks and activities for their students and to upload or create new content from scratch. In a next analysis, the authors will also look at the usage data from the side of the students to see if the activities/lessons/content created by teachers is being utilized by the students as well.

6. Conclusions and future work

The present paper has briefly outlined the Future Gate project, offering an overview of the different activities that are being supported through it. The main limitation of this paper lies with the fact that the quantitative results and findings reported, are preliminary. Nevertheless, the authors feel that the presentation of these findings is important, as it sets a baseline which can be used to measure future progress. Some of the major lessons learned by Future Gate so far, include the following:

- The attitude of the teachers towards digital learning are overwhelmingly positive as it comes out from the use of the systems but also from the surveys carried out,
- The challenges Future Gate is faced with, are more or less similar to the ones faced by other initiatives worldwide. The magnitude of the project adds to the complexity of the challenges but their origins are more or less similar,
- Support to all the stakeholders of such initiatives is of paramount importance for their success. Either through a dedicated team of people, or through supporting material, support has to be provided at all times to make the transition to digital easier,
- Motivating teachers is a critical aspect for any similar initiative. Setting up a reward system, or offering incentives for the incorporation of the new technologies in teaching, has proven to be a successful strategy for Future Gate so far, allowing for the creation of a group of “champion” teachers that are leading the use of the LMS in their classroom, acting as ambassadors of the initiative, within the entire community.

Future work will look at the data that will come out from the next phase of the project to compare and contrast the progress made. Further work will also attempt to build upon the findings of this paper to examine the impact of the Future Gate project on the teaching and learning altogether, through a more in-depth analysis of related KPIs.

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Gamified Project Based Learning Environment for Motivation Improvement

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Abstract: Gamification constitutes a new methodology in instructional design that gains more and more attention in education field. Many systems utilize gamification techniques for the purposes of different fields, such as marketing, education and computer science (Werbach & Hunter, 2012). Gamification increases the levels of engagement of users (Lamprinou, 2015; Alafouzou, 2017). Consequently, gamified learning systems promote motivation improvement both in learning and training. However, developing a gamified learning system requires a background of a theory of Motivation, based on which the levels of engagement and motivation can be measured. This theoretical research proposes an enhancement of ARCS model (Keller, 1979) in a gamified learning environment using the characteristics of Project Based Learning. The ARCS model of motivation combines four theories; Bandura's Theory of Self-Efficacy, Berlyne's Theory of Curiosity and Arousal, Maslow's Needs Hierarchy and Rotter's Locus of Control and consists of four core components; Attention, Relevance, Confidence and Satisfaction (Keller, 1983). The approach of Project Based Learning is very strong match with the ARCS Model, as this model can be used with many models of instructional design (Keller, 1987a, 1999, 2000a; Keller & Suzuki, 2004). Project based learning is a teaching methodology that promotes authentic learning experiences through real world problem solving and investigation. Having learners create projects allows them to engage in more active learning rather than absorbing material in an isolated learning environment. Besides, the eight characteristics of Project Based Learning (PBL) play a complementary role to the ARCS motivational model, since each component links to each characteristic of PBL. Having developed two gamified learning management systems (LMS) for the purposes of adult and primary education, the next step is to improve them with the contribution of the characteristics of Project Based Learning to the Arcs model's components integrated in the gamified online learning environment. The PBL characteristics consist of authenticity and relevance, freedom of choice, self-reflection, public presentation, 21st century skills and problem solving, which are perfectly aligned with the motivational model of Keller and promotes each component of the model.

Keywords: gamification, project based learning, ARCS model, motivation theories, learning management systems, LMS

1. Introduction

Learning is a goal driven social activity that depends on motivational factors and experience and leads to long-term changes in behaviour potential. Motivating learners in continuous and enjoyable studying is considered as a crucial part in learning process and in distance learning. Consequently, designers should take into consideration the accomplishment of an effective instructional design, in order an enhancement of cognitive processing and encouragement of positive engagement to be achieved.

Additionally, learners of 21st century are characterized as "digital natives" due to their great familiarity with new technologies. As a result, educators should find new ways in order to satisfy learners' higher requirements and different attitudes and to motivate them in the learning process. Moreover, it is observed that learners nowadays face learning process as another acquisition rather than its real substance, in other words they develop a "consumer" attitude towards learning content (Williams & Williams, 2011). This phenomenon has its roots on the educational system that aims in the increase of extrinsic motivation instead of intrinsic motivation. So, the question that derives from all the above is in which way learners will be motivated and engaged in the learning process.

Gamification as a new and innovative term in education is used as a tool for improvement of engagement, increase of motivation, reinforcement of active learning, enhancement of creativity and finally it provides guidance to desired learning behaviours. As a result, many studies have focused on the integration of Gamification in motivational models or learning theories in order to be more efficient the learning process. Such an example is ARCS model of motivational instructional design that was created by John Keller (1979) in his effort to explain motivation. ARCS model is also described as a problem-solving model as it helps designers to identify and solve motivational problems related to the appeal of instruction (Dichev, Dicheva, Angelova, Agre, 2013).

This article aims to indicate an instructional design based on Project Based Learning (PBL) which complements the ARCS model of motivational design and the use of gamified elements for the improvement of learners' motivation. The rest of the paper is structured as followed: Section 2 contains the theoretical background. Section 3 concerns the instructional design and the customization of the Moodle educational platform. Finally, Section 4 refers to the discussion and future work.

2. Theoretical background

This section of paper presents the concepts of ARCS model of motivational design, Gamification and Project Based Learning (PBL) as far as the correlation among these concepts.

2.1 ARCS motivational model

ARCS model of motivational design was developed by John Keller and is based on social learning theories and humanist psychology (Jacobson and Xu, 2004). This model is used by many of the educational technologists as it has a great impact in the field of computer-based instruction (McMahon, 2014). This model consists of four factors and each factor consists of three essential strategies components for motivating instruction.

Table 1: ARCS motivational model

Factor	Strategy	Description
Attention: the stimulation and preservation of interest and curiosity of the learners at the beginning and during the learning process.	**(A1) – Perceptual Arousal**	*Gain and Maintain Initial Interest* by the use of emotional elements, surprising, paradoxical, or uncertain events in instruction.
	(A2) – Inquiry Arousal	*Increase of Interest* by use of problem-solving activities, questioning and a sense of mystery.
	(A3) – Variability	*Maintain Students' Interest* by using a variety of teaching methods and tools in instruction (video, presentations, group activities, animations, game) for a change of pace.
Relevance: the association of educational content with the needs, the goals, the interests, and the learning preferences of learners.	**(R1) – Goal Orientation**	*Utility of Instruction* by connecting educational material with students' actual needs.
	(R2) – Motive Matching	*Using of teaching strategies* that involve the learners' choices about strategies of learning.
	(R3) – Familiarity	*Connection to what one already believes and understands.* The use of concrete language, examples or concepts that are related to the learner's experience and values.
Confidence: the percentage of effort and motivation in order the goals to be achieved.	**(C1) – Learning Requirements**	Cultivation of *Success Expectations* in the form of clear objectives by presenting clearly the instructions and the evaluation criteria.
	(C2) – Success Opportunities	*Establishment of the learner's* belief that can achieve the accomplishment of activities by providing decreasing scaffolding and challenging levels for the consolidation of confidence.
	(C3) – Personal Control	*Support of Success Attributions* by providing feedback and opportunities for control over the learning with choices of content, objectives and activities.
Satisfaction: the positive feelings that are created by the sense of success, the praise or simply the entertainment.	**(S1) – Positive Consequences**	*Provision of feedback and rewarding outcomes* for the enhancement of learners' performance with the use of both intrinsic and extrinsic reward that will sustain the desired behavior.
	(S2) – Natural Consequences	*Reinforcement of intrinsic satisfaction* with the use of games, projects, collaborative activities and via the application of new knowledge in the learning process.
	(S3) – Equity	*Maintenance of consistent standards and fair treatment* by predetermined evaluation criteria and equity of rewards during the task accomplishment.

The above table (Table 1) describes the strategies that are suggested by John Keller for the increase of motivation in both traditional and web-based learning. In this paper we will refer to the correlation of these strategies with the PBL model and with the gamified elements.

2.2 Gamification

The term of Gamification was first announced in 2008 (Deterding, Dixon, Khaled & Nacke, 2011). From then until now it is greatly used in marketing and enterprises as it keeps users engaged with the products and motivates them to perform certain behaviours. However, Gamification is still new in the domain of education but it seems to be preferred as it is an innovative way for instructors to correlate learners' needs and educational objectives. In general, Gamification refers to the use of technology and game practices in non-gaming contexts in order to increase users' motivation, stimulate engagement and influence behaviors in performing a task or achieving a goal via game-like systems. Despite, since 2008, the term of Gamification has been broadened by others authors as follows.

- The process of using game thinking and game mechanics to solve problems (Deterding, et. el, 2011).
- The use of game mechanics, dynamics and frameworks to promote desired behaviors (Lee & Hammer, 2011).
- Gamification is the use of game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning and solve problems (Kapp, 2012).

Nevertheless, the most common term of Gamification is defined by Werbach and Hunter (2012). According to them, Gamification is defined as "the use of game elements and game-design techniques in non-game contexts".

According to this definition of Gamification, game elements are divided into game components, game dynamics and game mechanics. Game Dynamics are the most abstract game elements that construct the whole game. They are the hidden structure that make games coherent and they are more related to training process' objectives and to identification of behaviours. Game Mechanics are the basic process or the rules that promote participation and action. In other words, they are the means by which Game Dynamics are fulfilled. Finally, Game Components refer to more specific characteristics of games that are used in order to support Game Dynamics and Game Mechanics. More specifically, Game Components promote the achievement of Game Mechanics that cause the fulfillment of Game Dynamics. However, there are connections between all the Game Elements. The table (Table 2) below depicts the correlation between the gamified elements with the core components of ARCS model of motivational design.

Table 2: Matching of game elements with core components of ARCS model

	Game Components	**Game Mechanisms**	**Game Dynamics**	**ARCS Model**
Game Elements	Avatar		Narrative/ Scenario	(A3) – Variability
				(C1) – Learning Requirements
				(S2) – Natural Consequences
	Levels	Competition	Progress	(A2) – Inquiry Arousal
				(C2) – Success Opportunities
				(S3) – Equity
	Leaderboards		Relationships	(C2) – Success Opportunities
				(S1) – Positive Consequences
				(S3) – Equity
	Teams	Cooperation		(A2) – Inquiry Arousal
				(R2) – Motive Matching
				(R3) – Familiarity
				(C1) – Learning Requirements
				(S2) – Natural Consequences
	Badges	Rewards		(S3) – Equity
	Points			(A1) – Perceptual Arousal
				(C2) – Success Opportunities
				(S1) – Positive Consequences
	Collections			(A1) – Perceptual Arousal
				(S1) – Positive Consequences
		Challenges		(A2) – Inquiry Arousal
				(C1) – Learning Requirements
				(S2) – Natural Consequences
		Feedback		(C3) – Personal Control
				(S1) – Positive Consequences
	Content Unlocking		Constraints	(A1) – Perceptual Arousal

This table represents the associations between the gamified elements that are used in the gamified system with the core components of ARCS model. Based on the aforementioned, Gamification Elements include characteristics of the ARCS model, which promote an engage and interactive learning scenario. Besides, Game Components such as Leaderboards, Levels, Avatars and teams that promote Cooperation, Awards, Points, Badges and Relationships attract learners' attention and help them to have control of their learning, leading them to progression. In the next chapter, we will indicate the association between the core components of ARCS model with the phases of PBL model, the combination of whom cause the effectiveness of the instructional design.

2.3 Project Based Learning (PBL)

Project-based learning is an instructional method centered on the learner. Project-based learning allows in-depth investigation of a topic worth learning more about (Harris & Katz, 2001). The project-based learning approach creates a "constructivist" learning environment in which students construct their own knowledge. Whereas in the "old school" model the teacher was the task master, and in the "new school" model the teacher becomes the facilitator (Thomas, 2000).

According to literature review, Projects include scaffolding activities that engage learners and make sense to them. Definitions of "project-based instruction" include features relating to the use of an authentic ("driving") question, a community of inquiry, and the use of cognitive (technology-based) tools (Krajcik, Blumenfeld, Marx, & Soloway, 1994; Marx, Blumenfeld, Krajcik, Blunk, Crawford, Kelly, & Meyer, 1994).

This instructional method promotes five important principles for the learning process:

- 1. PBL projects are central, not peripheral to the curriculum.
- 2. PBL projects are focused on questions or problems that "drive" students to encounter (and struggle with) the central concepts and principles of a discipline.
- 3. Projects involve students in a constructive investigation.
- 4. Projects are student-driven to some significant degree. PBL projects are not, in the main, teacher-led, scripted, or packaged.
- 5. Projects are realistic, not school-like.

Several PBL courses reported in the literature aim to give students a taste of future work through immersion in an actual professional context (Danford, 2006; Meehan and Thomas, 2006), enhancing their skills and employability. The fact that student can make a choice in project-based learning increases levels of motivation (Blumenfeld et al., 1991; Kahn and O'Rourke, 2004), while the use of problems with relevance to the students' interests and experience is also seen as intrinsically motivational (Kahn & O'Rourke, 2004; Graaf & Kolmos, 2007). Consequently, in this theoretical study we present the PBL's characteristics into eight essentials which summarize the benefits and approaches of this instructional model. According to John Larmer and Dr. John Mergendoller from the Buck Institute for Education (2010) have identified the following eight key components that should exist in all projects.

Figure 1: PBL essential elements retrieved from http://www.bie.org/

The PBL Essential Elements integrates many aspects of ARCS Model and Gamification, as these theoretical backgrounds promote constructivism in the learning process and each ARCS component links to the characteristics of PBL, as shown below.

3. Method

This paper aims to indicate an instructional design based on the ARCS model strategies and the PBL model characteristics for the improvement of learners' motivation in a gamified e-course. In Higher education students have low motivation levels, as the learning process is not linked with the market needs and they do not receive practical knowledge which helps them for their future career (Osheim, D., E, 2013). Besides, this research proposes an enhancement in the gamification framework based on ARCS model, in order to motivate learners in Higher Education and engage them into the gamified learning process. Moreover, in this section will be presented the customization of the Moodle educational platform as a crucial part of the instructional design according to the association among gamified elements, ARCS strategies and PBL phases.

3.1 Instructional design

The purpose of this theoretical research is to enhance the four categories of Keller's ARCS model (Attention-Relevance-Confidence- Satisfaction) developing a gamified project based learning framework suitable for each subject in Higher Education. The PBL characteristics consist of authenticity and relevance, freedom of choice, self-reflection, public presentation, 21st century skills and problem solving, which are perfectly aligned with the motivational model of Keller and promotes each component of the model. The eight characteristics of Project Based Learning (PBL) play a complementary role to the ARCS motivational model, since each component links to characteristic of PBL.

Table 3: Course design

SCSS	PBL	ARCS factor	ARCS Techniques
Search	**Significant Content**	(A1) – Perceptual Arousal	Use of emotional elements and audiovisual media.
		(A2) – Inquiry Arousal	Set of a problem solving activity.
		(R1) – Goal Orientation	Describe the value of the connection of educational material with students' actual needs.
		(R2) – Motive Matching	Involve the learners' choices about strategies of learning.
		(R3) – Familiarity	Use of concrete language, examples or concepts that are related to the learner's experience and values.
		(C1) – Learning Requirements	Provide clear objectives by presenting clearly the instructions and the evaluation criteria.
		(C2) – Success Opportunities	Define peer-to-peer interaction and decreasing scaffolding and challenging levels.
		(C3) – Personal Control	Provide control over the learning with choices of content, objectives and activities.
	Need to Know	(A1) – Perceptual Arousal	Use of emotional elements and audiovisual media.
		(A2) – Inquiry Arousal	Set of a problem solving activity.
		(A3) – Variability	Use a variety of teaching methods and tools in instruction.
	Driving Question	(A2) – Inquiry Arousal	Set of a problem solving activity.
		(R1) – Goal Orientation	Describe the value of the connection of educational material with students' actual needs.
		(R2) – Motive Matching	Provide opportunities for collaborative interaction.
		(C1) – Learning Requirements	Highlight previous knowledge.
Solve	**Student Voice and Choice**	(C1) – Learning Requirements	Define clearly the process (type, duration, content) and the evaluation criteria.
		(C2) – Success Opportunities	Define peer-to-peer interaction and decreasing scaffolding and challenging levels.
		(C3) – Personal Control	Provide control over the learning with choices of content, objectives and activities.
	21st Century Skills	(A2) – Inquiry Arousal	Set of a problem solving activity.
		(R1) – Goal Orientation	Relate the educational material with students' actual future needs and interests.
		(C2) – Success Opportunities	Define peer-to-peer interaction and decreasing scaffolding and challenging levels.

SCSS	PBL	ARCS factor	ARCS Techniques
Create	**Inquiry and Innovation**	(A2) – Inquiry Arousal	Set of a problem solving activity.
		(R2) – Motive Matching	Involve the learners' choices about strategies of learning.
		(C3) – Personal Control	Provide control over the learning with choices of content, objectives and activities.
	Feedback and Revision	(C1) – Learning Requirements	Provide clear objectives by presenting clearly the instructions and the evaluation criteria
		(S1) – Positive Consequences	Provide feedback and external rewards.
		(S2) – Natural Consequences	Provide opportunities of sharing knowledge with peers and unpredictable rewards.
		(S3) – Equity	Evaluate with predetermined evaluation criteria and equity of rewards during the task accomplishment.
Share	**Publicly Presented Product**	(A3) – Variability	Use a variety of teaching methods and tools in instruction.
		(S1) – Positive Consequences	Provide positive feedback, external rewards and self-assessment methods.
		(S2) – Natural Consequences	Provide opportunities of sharing knowledge with peers.
		(S3) – Equity	Evaluate with predetermined evaluation criteria and equity of rewards during the task accomplishment.

The table above (Table 3) describes the incorporation of the ARCS model strategies and techniques into the characteristics of PBL which follows the steps of course design for the improvement of learners' motivation. Though the PBL model also leads the educators and instructional designers to divide the learning process into different phases. According to Krajcik and Blumenfeld (2006), there are five key features in PBL that are used as a helpful starting point in order PBL to be approached in a constructivist manner, which are the following:

- Identify
- Investigate
- Explore
- Utilise
- Develop

Consequently, based on the PBL phases we can design the online course integrating gamified elements on our LMS. In the following section, we present the design framework in order to create a gamification system on Moodle**.**

3.2 Moodle customization

Moodle is one of the most well- known educational platforms that provides many opportunities of variability on content creation and promotes gamification, active learning and collaboration. For the needs of the instructional design that promotes motivation, we use a variety of Moodle activities, resources and plugins which satisfy the ARCS model techniques, the PBL characteristics so as the gamified elements of the gamified e-course. Besides, MOODLE is capable to support PBL up to certain level, in an on-line scenario a dedicated module with group formation, permissions in intra and inter-group, resource sharing, synchronous communication and assessment of progress of the group and individuals.

Table 4: Moodle characteristics

	PBL	Moodle Characteristics	ARCS factor	Gamified Elements
Significant Content	**Inquiry and Innovation**	**Group**	(A3), (R2), (C2), (S2)	**Group**: The creation of groups promotes the game mechanism of cooperation External Tool: The use of avatars that promote the scenario.
		SCORM Packages	(A1), (A3), (C1)	
		Glossary	(A3), (R2), (R3), (C1), (C2), (S1), (S2), (S3)	
		External Tool	(A1), (A3), (R1), (C1), (S3)	
		Forum / Chat	(A2), (A3), (S1)	
	Driving Question	Choice	(A3), (R2), (C3)	**Wiki:** This activity promotes cooperation.
		Lesson	(A3), (R3), (C3)	
		Wiki	(A3), (R2), (R3), (C1), (C2), (S1), (S2), (S3)	

<table>
<tr><th></th><th>PBL</th><th>Moodle Characteristics</th><th>ARCS factor</th><th>Gamified Elements</th></tr>
<tr><td rowspan="5"></td><td rowspan="5">Publicly Presented Product</td><td>Survey</td><td>(A2), (R1), (R2)</td><td rowspan="5">Certification: It promotes learners' satisfaction and works as a reward for what they have achieved.</td></tr>
<tr><td>Peer Assement</td><td>(R2), (C2), (S1), (S2)</td></tr>
<tr><td>Rubrics</td><td>(A2), (R1), (R2)</td></tr>
<tr><td>Assignments</td><td>(A2), (R3), (S3)</td></tr>
<tr><td>Certification</td><td>(S2), (S3)</td></tr>
<tr><td rowspan="15">21st Century Skills</td><td rowspan="3">Student Voice and Choice</td><td>Choice</td><td>(A3), (R2), (C3)</td><td rowspan="3">Workshop: This activity promotes cooperation and provide the opportunity of self-evaluation.</td></tr>
<tr><td>Workshop</td><td>(A3), (R2), (R3), (C1), (C2), (S1), (S2), (S3)</td></tr>
<tr><td>Forum/ Chat</td><td>(A2), (A3), (S1)</td></tr>
<tr><td rowspan="4">Need to know</td><td>Glossary</td><td>(A3), (R2), (R3), (C1), (C2), (S1), (S2), (S3)</td><td rowspan="4">Progress Bar: Helps learners to follow their learning path.</td></tr>
<tr><td>External Tool</td><td>(A1), (A3), (R1), (C1), (S3)</td></tr>
<tr><td>Database</td><td>(A2), (A3), (R2), (R3), (C2)</td></tr>
<tr><td>Progress Bar</td><td>(C1)</td></tr>
<tr><td rowspan="6">Feedback and Revision</td><td>Ranking Board</td><td>(A1), (C3), (S1), (S2), (S3)</td><td rowspan="6">Ranking Board/ Level up: These plugins provide the opportunity of classification.
Feedback: Game mechanism
Quiz: They have the form of challenges.
Badges: A game component that promotes external motivation.</td></tr>
<tr><td>Level up</td><td>(A1), (C1), (C2), (C3), (S3)</td></tr>
<tr><td>Feedback</td><td>(C1), (S1), (S2)</td></tr>
<tr><td>Quiz</td><td>(A3), (S1), (S3)</td></tr>
<tr><td>Badges</td><td>(S1), (S2)</td></tr>
<tr><td></td><td></td></tr>
</table>

According to the above table (Table 4), we link the eight essentials of PBL with ARCS elements and Moodle Activities, where we can use them in order to gamify an online Moodle course. Consequently, Moodle sets parameters to integrate Game Components, such as quiz result tables, ranking block, content unlocking, progress bars, badges, and levels, with which we can design a gamified course. Moreover, narrative and storytelling through authentic environments, such as problem solving, immerse learners in a gamified LMS, which contains a lot of video game traits, that they already know, but at the same time, that happens inside the boundaries of a non-gaming context ultimately leading to the active engagement of the learners in the learning process and the increase of their motivational levels (Lamprinou & Paraskeva, 2015).

4. Conclusion and future work

The enhancement of ARCS model increases the motivation level of learners, since Project Based Learning (PBL) and Gamification foster self-regulated learning and can promote pupils' conceptual knowledge within a systematic process of documenting and reflecting on learning (Barak, 2012). Gamification engages learners in the learning process through gameful activities and interactivity among learners that drive their motivation to a higher level.

Consequently, after the designing of two gamified systems based on ARCS model and PBL, it is observed that learners cooperate and take part even in optional activities, since they are members of a team and try their best to create and share their projects in order to acquire social improvement. Meaningful inquiry engages learner's mind. Besides, there are major characteristics of project learning: 1) self-responsibility for thinking and learning; 2) awareness of social responsibility; 3) thinking and acting from the scientific perspective but in a practical application; 4) relating both group process and product with professional practice (Kleijer, Kuiper, De Wit and Wouters-Koster, 1981).

However, Gamification does not promote only extrinsic motivation, but based on ARCS model the proposed instructional design aims to offer a combination of the two for a better combination. Therefore, Gamification makes education more fun and engaging, without undermining its credibility and helps students gain motivation towards studying, as they are pushed by positive feedback and gamified environment.

In our future work we wish to implement the gamification and PBL elements proposed on an online eLearning course implemented on Moodle (LMS) and follow the enhancement of the ARCS model. It is however intuitive that gamification can improve motivation and engagement of users with such a system.

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Digital Literacy and Undergraduates' Values

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Abstract: Digital literacy has been in the spotlight at all levels of education and society in general. It has been treated and analysed within various dimensions and perspectives, namely dimensions associated with information, communication and technology, and perspectives related to technical and cognitive aspects. However, emphasis has seldom been laid on social values when handling digital literacy and particularly the Internet. It is important that digital literacy is not anchored in technology for the sake of technology only, but in the society's coherent development, which cannot exclude the culture of consolidated social values and the construction of new values which enable the harmonious evolution of society in an era characterised by innovation, interconnection and knowledge. This study, conducted in the academic year of 2016/2017, involved a sample of 724 undergraduates attending two public higher education institutions, a Spanish one and a Portuguese one. Among the results obtained, we highlight that the majority of the undergraduates have been using the Internet for over 10 years and spend more than 30 hours a week searching for information predominantly related to academic life and current affairs. Most of the communications they establish online are with friends, relatives and colleagues. They give more attention to values when communicating online with friends and relatives than when communicating with colleagues. The identification of counter-values is higher in the communications established with colleagues than in those established with friends, and it is also higher in the communication with these latter than in the communication with relatives.

Keywords: digital literacy, internet access, internet values, higher education

1. Introduction

The efficient use of digital technologies has been a concern for society, especially for higher education institutions. Within the context of such institutions, where digital technologies are intensively used for a variety of purposes, it is a constant challenge for teachers and researchers to understand the kind of use undergraduates make of these technologies and the importance they give to social values when using them. Among the various digital technologies which could have been emphasised, the focus of this research work has been laid on the use of the Internet and on the values and counter-values associated with it.

This is a mixed methodology study which comprises both qualitative and quantitative aspects. The data was obtained by questionnaire in the academic year of 2016/2017 from a sample of undergraduates attending two different higher education institutions, a Portuguese one and a Spanish one. The main aims of the study are: identify the undergraduates' level of digital literacy; determine the undergraduates' perceptions regarding the use of social values and counter-values when communicating online.

The level of digital literacy is assessed based on the answers given to questions related to the use of the Internet, namely the frequency of use and the type of information searched for online. The data regarding the undergraduates' perception of the use of values and counter-values when communicating online was obtained from the answers given to questions related to the attention given to values and counter-values when communicating with colleagues, friends and relatives.

This paper is developed considering the following main topics: Literacy and values on the Internet, where we focus on digital literacy and on social values on the Internet; Methodology, where we present a brief characterisation of the study as well as of the sample involved; Results, where we present both the data and its interpretation regarding the undergraduates' digital literacy and their perception of the attention given to social values and counter-values when communicating online; Conclusions, with a synthesis of the main results. The paper ends with the bibliographic references which constitute the basis of the scientific grounding of this study.

2. Digital literacy and values on the internet

2.1 Digital literacy

Digital literacy represents a current topic of major interest and cannot be dissociated from the Internet nor from its various connected digital technologies since as stated by Dias (2017, p.7), «With the digital technologies, we build the new settings and methods for interacting and communicating in virtual communities and the reasoning for pedagogic innovation and scenarios of change.»

The main mission of higher education is to prepare undergraduates for the future. Digital literacy refers not only to ensuring that students can use the most recent technologies but also to developing their skills to select the right tools within a given context, deepen their learning outcomes and get involved in creative problem solving (Ventimiglia &, Pullman, 2016).

Appel (2012) defined digital literacy as the capacity to find and analyse information using computers and the web. JISC (2014) put forward a broader definition of digital literacy which includes the capacities that an individual has to live, learn and work in a digital society. According to Reedy and Goodfellow (2012), digital literacy includes not only the capacity to search for and use information but also the communication, collaboration, teamwork, social conscientiousness within a digital environment, the understanding of electronic security and the creation of new information. Digital literacy is a comprehensive and complex concept which involves multiple elements or requirements and combines multiple dimensions, namely technical, psychological and interpersonal (Alexander, Becker, Cummins & Giesinger, 2017).

In association with digital literacy appeared the term digital competence, this latter more focused on the application of knowledge. Hatlevik and Christophersen (2013) adopted the term digital competence to describe the acquisition and processing of digital information and the capacity to produce digital information.

Vuorikari, Puni, Carretero and Brande (2016) highlight that according to the European Digital Competence Framework for Citizens, digital competence is the efficient use of information technologies for work, leisure, learning and communication. It includes the use of computers to recover, access, store, produce, present, and exchange information as well as to communicate and participate in collaborative networks via the Internet.

Ting (2015) related digital literacy to the student's autonomy by observing that digital native students search the Web resources autonomously outside the school to build their own digital literacy, they interact and learn with colleagues and access and share Web learning resources which are useful to school subjects, thus contributing to the improvement of their own autonomy and learning.

Also, most of students' acquisition of digital skills visibly occurs outside the school due to their need to communicate and learn. For example, they interact with friends using social networks and search for useful information to solve a given problem (Ng, 2012).

It is expected that a basic level of digital skills will be crucial for the vast majority of jobs in the future and that the need for higher levels of digital skills will increase (Berger & Frey, 2016; Rouse, 2016).

Since digital literacy helps leverage students' deeper learning outcomes, it can provide more fruitful careers. Higher education institutions must continuously think about the application of technologies in a number of ways in order to create learning environments which provide students with opportunities to develop their digital skills and enable them to achieve their goals in an increasingly more digital economy (Alexander, Becker & Cummins, 2016).

When students reach higher education, they already have a certain level of digital literacy, since they are acquainted with some digital tools and know how to use them. However, in most cases, they still lack the necessary skills to apply their digital literacy to the learning context.

Whenever the use of the Internet and of various digital tools implies some interaction with other people, social values become prominent, namely the values and counter-values adopted by students when communicating with friends, colleagues and relatives.

2.2 Social values on the Internet

The current process of globalisation in society is giving birth to new forms of interpersonal relations, inclusively leading to social fragmentation and an increase of the differences among countries.

It is common to hear that we are living a crisis of values (Minguez, 2012), that the society we live in has lost social and moral values and that these are not integrated in the relations of democratic and civic participation (Torrego, & Martínez, 2014). All this represents the dynamics providing the framework for social change and its relevance to the social structure and cultural patterns of each society. Hence, culture becomes the means towards a global understanding of knowledge, moral capacities and other individual capacities representing substantial elements in the various cultural societies. According to UNESCO (2015) and to Martinez-Martin, Puig_Rovira and Trilla (2009), this is the context in which the person has to face and adapt to their own moral experiences and the daily resolution of conflicts of interest.

There is an increasing need for studies focused on the individual for a deeper understanding of the individual use of ICT in the presence of different cultures. Although the Internet is global, its users work individually and are affected by different cultural values (Bagchi, Kirs, & Choden, 2015).

People in any country are likely to have contrasting perspectives on the Internet. There is evidence of this in the daily conversations as well as in debates about issues such as online content and privacy regulation. It does not necessarily mean that some people are right and others are wrong, but that groups of individuals are likely to have different values, attitudes and beliefs regarding the Internet, or in other words that online debates may be shaped by different Internet cultures (Dutton, & Blank, 2014).

According to López, Carpintero, Del Campo, Lázaro and Soriano (2010), values are ideas or convictions that individuals are able to assess and interpret as valid, thus providing them meaning and guidance. It is observable that values are considered essential in people's everyday life, something which is desired and appreciated and therefore, guides and favours coherent and responsible actions. Moral values are evident in society and in citizenship and materialise into ideas about the world, the models and the practices which guide the shaping of personal values (Halstead, & Taylor, 1996).

The democratic society and therefore, educational institutions must uphold education as an intentional process based on the person's intellectual development towards the resolution of conflicts (Bernardini, 2010). Hence, education must favour processes of understanding values universally respected and socially shared so that each individual can integrate society both critically and actively (Aretio, Corbella, & Blanco, 2010).

This is why the influence of the media and of the Internet in culture, lifestyles and in the acquisition of values is obvious. It permeates everyday life and therefore, requires some critical analysis which prevents the escalation of problems regarding the interpretation and understanding of messages emitted from those contexts (Buckingham, 2005; Gozálvez, & Contreras, 2014; García-Ruíz, Ramírez, & Rodríguez, 2014). Preparing students for the labour market and training them as active citizens represent two fundamental goals of higher education (Santos, & Lorenzo, 2010). These institutions have a social commitment which goes beyond mere academic training. They are committed to promoting ethical values among their students and to helping them develop as democratic, tolerant and solidary citizens (Martínez & Esteban, 2005).

Nevertheless, the omnipresence of technology and the Internet enables the consumption of certain contents which may influence people's values and attitudes (Castells, 2001). Therefore, it is necessary to gain insight into the type of content, values and attitudes students possess and acquire on the Internet in order to determine, as far as possible, the values which characterise them and, if necessary, include specific training in the academic context that favours the education of democratic, responsible and competent citizens.

3. Methodology

This is a mixed methodology study containing aspects associated with quantitative research and others associated with qualitative research. The data was obtained by conducting a questionnaire containing both open and closed questions. Overall, the answers to the closed questions were treated by using an approach close to that of quantitative studies, since they enable the testing of the relation between variables (Creswell, 2014) as well as the quantification of the variation of a phenomenon or situation (Kumar, 2011). The answers to the open questions were treated qualitatively since as suggested by Amado (2017), the use of open questions about a given topic can be highly useful in qualitative research, enabling respondents' free expression of opinions and since the analysis of the answers given allows the identification of respondents' perceptions, subjective experiences and representations regarding the topic under study.

For the treatment of qualitative data, a content analysis was carried out by following an approach close to that proposed by Bardin (2015), consisting of considering three chronological poles denominated as pre-analysis, exploration of the material and treatment of results, inference and interpretation. According to the author, this approach constitutes a set of communication analysis techniques which uses systematic and objective procedures of description of the messages content.

The study can also be considered exploratory with descriptive characteristics since it can be extended to other institutions and involve a higher number of students.

As previously mentioned, the data supporting this study was obtained by questionnaire in the academic year of 2016/2017, from a sample of 724 undergraduates attending two public higher education institutions, namely a Portuguese one and a Spanish one.

Among the 724 undergraduates, 606 (83.7%) attend the Portuguese institution and 118 (16.3%) attend the Spanish institution; 310 (42.8%) are male and 414 (57.2%) are female. The ages range from 17 to 56 years old, with an age mean of 20, a median and mode of 19 and a standard deviation of 3.2. The sample subjects attend the following bachelor degree courses: Accounting (10.1%), Management (14.6%), Informatics Engineering (11.5%), Sports (13.8), Basic Education (8.0%), Environmental Education (0.8%), Social Education (10.9%), Pre-primary Education (4.6%), Primary Education (11.7%), and Languages for International Relations (14.0%). With regard to the curricular year that the sample subjects attend, 61.9% are in the 1st year, 34.0% are in the 2nd year, and 3.5% are in the 3rd year. A percentage of 0.7% of the students did not indicate the curricular year they attend.

The results of the research are presented in the next section.

4. Results

The results are presented according to the aims defined for this research. Therefore, based on the sample subjects' answers to the questions associated with each aim, the results are presented from two main topics denominated as follows: Undergraduates' digital literacy; Undergraduates' perception of the attention given to social values and counter-values when communicating online.

The topic of digital literacy appears in this research due to a need to substantiate the claim that the students do possess skills to use the Internet, namely as far as communication is concerned, since only the fact that they have digital literacy to communicate enables the further determination of the attention they give to values and counter-values when communicating.

The questions which originated the data under analysis are listed in the presentation of results.

4.1 Undergraduates' digital literacy

The indicators regarding the sample subjects' digital literacy were obtained according to the frequency of Internet use and the kind of information students search for on the Internet.

The frequency of use was associated with the number of years for which the undergraduates have been using the Internet and the number of times they use it per week. From the answers given by the sample subjects to the question 'How many years have you been using the Internet for?', we conclude that the minimum number of years of Internet use is one year and the maximum is 22 years, the mean is 9.6 years, the median and the mode are 10 years, and the standard deviation is 2.6.

In terms of weekly hours, the frequency of use was determined based on the answers to the question 'Approximately how many hours do you use the Internet for per week (7 days)?' The analysis of the answers shows that the minimum number of hours of Internet use is two hours and the maximum is 120 hours, the mean is 31.1 hours, the median 30 hours, the mode is 70 hours and the standard deviation is 26.3.

In order to assess the kind of information the undergraduates search for on the Internet, we analysed the answers given to the question 'What kind of information do you usually search for on the Internet?'

In the treatment of the answers, each kind of information mentioned in the answers given was considered as an analysis unit and each encoded analysis unit was considered as a register unit. Bardin (2015, p. 130) defines the register unit as «a unit of significance to be encoded and which corresponds to the content segment to be considered as a base unit, aiming at categorisation and frequency counting.» In the whole of the answers given by the 724 sample subjects, 1,211 units were identified (expressions that translate the kind of information the subjects search for online). The expressions are highly diversified, which makes it impossible to categorise them in order to make the subjects' answers more easily understandable. Therefore, we only highlight the most representative categories of answers.

The results show that most of the information searched for is academic information (40.3%), followed by information on current affairs (16.6%), sports (6.4%), varied information (5.4%), and entertainment (3.1%). The remaining 28.3% of the expressions identified, that corresponds to 28 categories, were integrated in the other category, each one of which with little representativeness and with a percentage of under 3% (Figure 1).

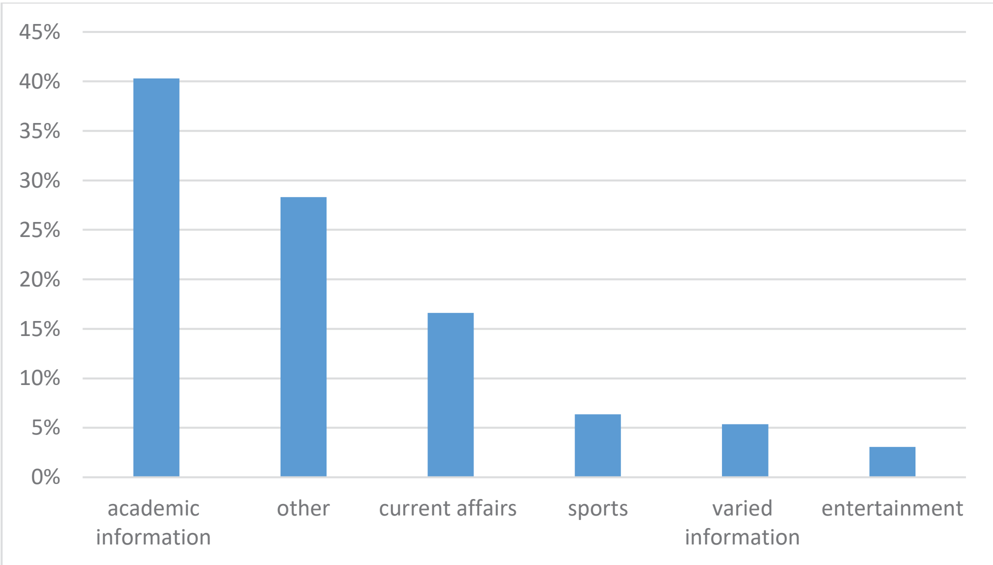

Figure 1: Kind of information that students usually search for on the internet

Among the 28 categories regarding the information searched for online, we highlight the categories concerning information related to the following: general knowledge, films and series, curiosities, doubts, weather forecast, information technology, politics, health, music, the environment, economics, literature, social networks, newspapers, shopping and places to visit.

In a nutshell, given the indicators found, the results show that the majority of the sample subjects frequently deal with the Internet and have been using it for some years. Also, the main information searched for online is related to the sample subjects' academic activity, current affairs and sports.

4.2 Undergraduates' perception of the attention given to social values and counter-values when communicating online

The undergraduates' perceptions regarding social values and counter-values when communicating online becomes more easily understandable when we know who they communicate with online.

In order to identify who the students communicate with online, the sample subjects were asked to answer the following question: 'Who do you usually communicate with online?'

By using each entity indicated by the students as an analysis unit, 820 units (expressions translating who the students communicate with) were identified from the answers given by the 724 sample subjects. The 820 expressions were integrated into four different categories denominated as friends, relatives, colleagues and others. We found that most of the online communications established by students are with friends (72%), followed by relatives (20%) and colleagues (3%). The remaining 5% represent the category others, made up of all the types of communication which could not be integrated in the other designated categories. Some examples of such types of communication are with the boyfriend or girlfriend, teachers and strangers.

In light of these results, it becomes particularly interesting to determine the attention students give to social values when they communicate online with colleagues, friends and relatives.

The indicators regarding the attention undergraduates give to values when communicating online were obtained from the answers given to three questions, one concerning their colleagues, another one concerning their friends and yet another one concerning their relatives, all of which can be synthesised as: 'When you use the Internet to communicate with colleagues/friends/relatives, do you take into account the values of: a) friendship, b) cooperation, c) creativity, d) honesty, e) equality, f) freedom, g) respect, h) responsibility, i) solidarity, and j) others. Which?'

Each respondent's answer admitted for each value the following options: never, few times, many times, and always. In order to facilitate the understanding of the data and compare the attention given by the subjects to social values when communicating with colleagues, friends and relatives, the qualitative data was transformed into quantitative values by means of the following coding: no answer given - 0, never - 1, few times - 2, many times - 3, always - 4. Thus, the classification of the attention given to social values by each one of the sample subjects ranges from 0 to 4, with zero being the minimum score and 4 being the maximum score.

By means of the process described above, it was possible to determine the mean of the scores given to each value and consequently, compare the attention given by the sample subjects to social values when communicating with colleagues, friends and relatives.

After the respective coding and interpretation, the data obtained from the students' answers to the given questions is presented in Figure 2.

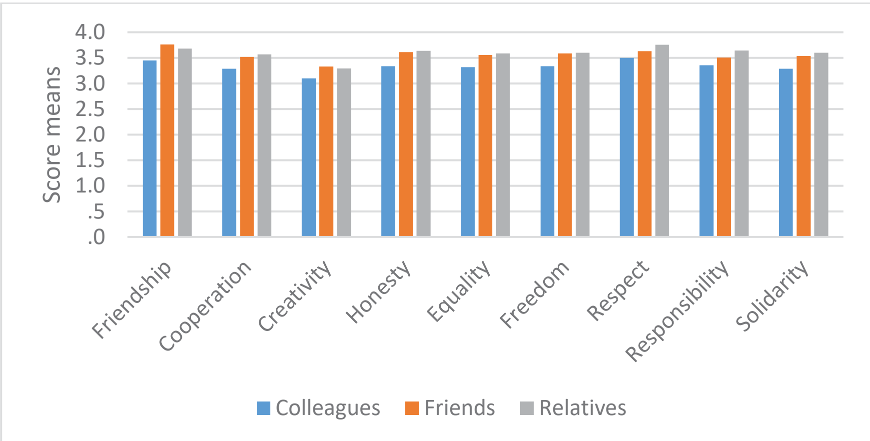

Figure 2: Distribution of the attention given by the undergraduates to social values when communicating online with colleagues, friends and relatives (n=724)

Given that the scale regarding the attention given to social values was defined with scores from zero to four, with 0 representing the minimum value and 4 the maximum value, the observation of Figure 2 enables the conclusion that all the sample subjects give attention to values when communicating with colleagues, friends and relatives either many times or always.

The results show that the undergraduates give more attention to each of the values analysed when they communicate with friends and relatives than when they communicate with colleagues. More attention is given to the value of friendship when communicating with friends than when communicating with family. More attention is given to the values of respect and responsibility when communicating with relatives than when communicating with friends. With very close score means, similar attention is given to the values of cooperation, creativity, honesty, equality, freedom and solidarity when communicating with friends and with family.

By following preconditions and conventions similar to those used to determine the attention given by students to values when communicating online, we sought to obtain indicators regarding the students' perception of the presence of counter-values when communicating online. The indicators about counter-values were obtained from the answers given to three questions, one regarding colleagues, another one regarding friends and one more regarding relatives, translated into the following expression: 'In your online communication with colleagues/friends/relatives, do you identify the counter-values of: a) inequality, b) dishonesty, c) selfishness, d) disrespect, e) insecurity, f) irresponsibility, g) manipulation, h) oppression, i) violence, and j) others. Which?'

The distribution of the means obtained for each of the counter-values analysed according to the conventions defined is presented in Figure 3.

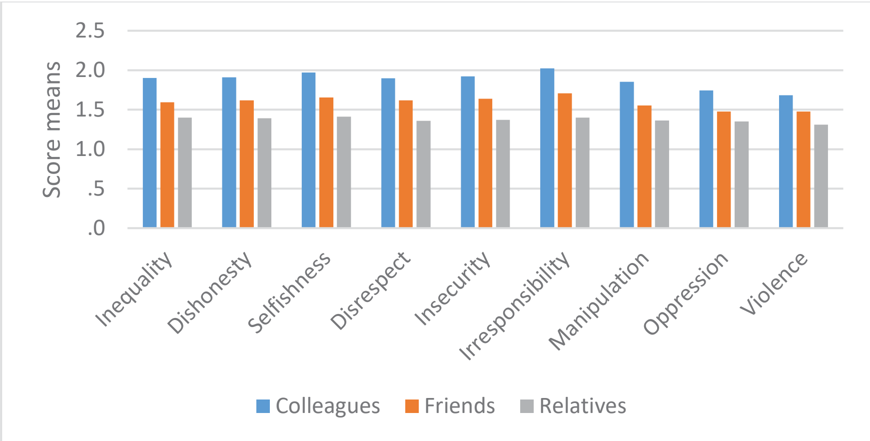

Figure 3: Distribution of the undergraduates' perception of counter-values when communicating online with colleagues, friends and family (n=724)

By observing Figure 3, it is visible that the identification of counter-values when students communicate online is quite frequent. The identification of counter-values is always higher in the communication with colleagues than in that with friends. It is also always higher when students communicate with friends than when they communicate with relatives.

The counter-values analysed were those of inequality, dishonesty, selfishness, disrespect, insecurity, irresponsibility, manipulation, oppression and violence. The most prominent were selfishness and irresponsibility when communicating with colleagues.

5. Conclusions

The main focus of this study was laid on the assessment of aspects regarding undergraduates' digital literacy as well as on the attention they give to social values and counter-values when communicating online. It is a mixed methodology study, assuming approaches from both qualitative and quantitative research. The data analysed was obtained by questionnaire in the academic year of 2016/2017, from a sample of 724 bachelor degree students attending two public higher education institutions, a Portuguese one and a Spanish one.

Among the main conclusions drawn from this study, we highlight the following:

- The number of years of Internet use by the sample subjects varies between one and 22, with a mean of 9 years and a median and mode of 10 years;
- The frequency of Internet use varies between two hours and 120 hours per week (7 days), with a mean of 31 hours, a median of 30 hours and a mode of 70 hours;
- The information that stands out as what the students search for online is academic information (40%), information related to current affairs (17%), information related to sports (6%), varied information (5%), and entertainment (3%). The remaining information searched online (29%) is related to various topics, each of them with little percentage representativeness, translated by expressions associated with general

knowledge, films and series, curiosities, doubts, weather forecast, information technology, politics, health, music, the environment, economics, literature, social networks, newspapers, shopping and places to visit.

- Most of the students' online communications are established with their friends (72%), followed by those established with relatives (20%) and those with colleagues (3%). All the other communications the undergraduates establish online represent 5% of the total of the communications established;
- For each of the social values analysed, the undergraduates give them more attention when communicating online with friends and relatives than when communicating with colleagues. With regard to friends, the value they give most attention to is that of friendship. When communicating with relatives, they give most attention to the values of respect and responsibility. They give similar attention to the values of cooperation, creativity, honesty, equality, freedom and solidarity when communicating with friends and relatives;
- The identification of counter-values when the students communicate online is quite frequent. The identification of counter-values is higher when communicating with colleagues than when communicating with friends and it is also higher in the communication with the latter than in the communication with relatives. The counter-values analysed were those of inequality, dishonesty, selfishness, disrespect, insecurity, irresponsibility, manipulation, oppression and violence, and the most prominent were those of selfishness and irresponsibility when communicating online with colleagues.

Digital literacy constitutes a current topic of major interest and social values constitute a topic which is always present in social interactions. Therefore, the association of topics such as digital literacy, digital competence, digital tools and social values always poses wide challenges in which each contribution only represents a small part of the great deal we need to research and understand.

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Teaching Aspects of Cybersecurity Through a Movie

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Abstract: This paper describes a pioneer effort of displaying a commercial movie in a Cybersecurity course. The purpose of this effort was to check whether the students were able to identify several cybersecurity attacks in practice on the one hand, as well as, to enlighten the human aspects of cybersecurity on the other hand. The results were assessed by a questionnaire plus interviews. The students were able to identify most of the cyber-attacks relating to the technical background given in the course, while they missed some of the frauds committed by the actors, relating to the psycho-social and legal dimensions which are not covered in the syllabus. The students had the opportunity to get some insight about the latter while enjoying the movie. The whole experiment was evaluated positively. In this way, it became clear to the students that cybersecurity has also a psycho-social dimension which should not be underestimated. This study made the following conclusions: (a) Psycho-social and socio-cultural dimensions are missing from the curricula offered to our students. (b) The students watch commercial movies regularly. (c) The use of commercial movies in the learning process was a pleasant way to highlight important aspects psycho-social aspects of cybersecurity. (d) The movie offered an alternative, realistic way to test students' understanding of both technical knowledge and socio-cultural aspects of cybersecurity.

Keywords: network security course, cybersecurity, movie, psycho-social dimension, socio-cultural aspects

1. Introduction

1.1 Video in education

Video transforms the way we teach, learn, study, communicate and work. Utilising the power of video to achieve improved results in education is becoming a basic skill for today's educators. A central pillar in achieving deeper learning effects, video brings significant benefits to educational institutions, especially in distance learning (Kaltura, 2015; Snelson, 2009). The Kaltura report entitled "The state of video in education" (2015) presents the answers of 1,200 respondents (educators, instructional designers, IT professionals, digital media professionals, senior administrators and students) from around the globe. A 93 percent of the respondents believe that video improves the learning experience. A popular reason for this, according to the respondents, is that "Video appeals to those students who are visual and auditory learners. When paired with hands-on activities, videos reach all learning types". The report further states that 84% of the teachers have shown video in the classroom (p.11). Teaching and learning are being enhanced by videos from multiple sources: custom videos created by teachers (93%) and student-generated videos (88%), as well as the more customary free online resources (97%) and licensed content (92%) (Kaltura, 2015). The author of this paper has been using videos in his classes because he believes in the power of the specific medium (Snelson, 2009; Andreatos, 2012). In this work however, we describe the use of a movie as a pleasant and attractive means to introduce students to the social and psychological topics of cybersecurity (Rogers, 2010; McAlaney et al., 2016; Taylor et al., 2017).

1.2 Movies in education

Movies are part of students' everyday experiences. Available in a variety of formats, movies can be easily played using common equipment such as computers. Movies may also prove notable pedagogical tools when properly used in modern learning frameworks. Movies have been used extensively in language courses (Mathis), but rarely in engineering and science courses.

2. Research planning

The research described here was implemented during the 8th (spring) semester of the academic year 2017-2018, in the Network Security course. The movie was displayed on 13 April, 2018, the week right after the Orthodox Easter. This date was selected for two reasons: first, the syllabus coverage was satisfactory at that time, so we could afford a lecture for the movie; second, it was a transactional period from the Easter vacation back to work. Five out of the nine students coming from distant places had a longer period of absence (due to extra time for travelling). Therefore, four students managed to view the movie, covering almost half (44.4%) of the whole population for the given class.

The following criteria were used in the selection:

- a) Relation to the course; presentation of several cases of cyber-attacks.
- b) Limited duration in order to fit the lecture time (estimating also the time to fill in a questionnaire).
- c) Not very violent.
- d) Interesting scenario.

The actors of the selected movie (Hacker, 2016) belong to the same age bracket as the students; moreover, the movie is presented from the viewpoint of the main actor (the hacker), a fact which allows students to identify with the protagonist.

The scenario of the movie starts as follows. Alex Danyliuk with his family immigrate from Eastern Europe to Canada seeking a better life. When his family hits financial trouble, Alex Danyliuk turns to a life of crime and identity theft, with the help of Sye, a street-wise hustler who introduces him to the world of black market trading. Alex meets Kira, a young female hacker, through the web. The three of them form a gang and earn a lot of money. Alex at the same time makes several contacts on the dark web. After some success, he attracts the attention of Z, a mysterious masked figure, who's the head of an organization known as Anonymous, and a number one target by the FBI (Fig. 1). After a meeting, Z hires them to organise an international operation causing financial market chaos, which would profit them substantially. Alex agrees to this, seeing it as an opportunity to revenge the bank that laid off his mother (Hacker - the story, 2016). This movie is rated 6.2 on IMDB.

3. Methodology

3.1 Research instruments

Because the total number of students was small, quantitative, as well as qualitative research (semi-structured interviews) was used (Bricki and Green, 2002; Newman, 2003; Oppenheim, 1992). A questionnaire was given to the students right after the projection (13 April 2018). After that, a discussion was encouraged by the instructor; students had the opportunity to exchange views and opinions, especially on the cyber-attacks and frauds, and learn from each other (collaboratively) and from the instructor (informally). The interviews took place on 7 May, 2018, after the exams, in order to avoid biased answers (Creswell, 2003).

Figure 1: Alex and Kira meet Z

3.2 Research questions

The main research questions of this study are presented in Table 1.

Table 1: Research questions and instruments

No	Research question	Instruments
1	Are the students able to identify in practice the various types of attacks taught in theory and understand the corresponding motivation?	Questionnaire
2	Are the students able to identify in practice common frauds?	Questionnaire
3	The projection of the psycho-social aspects; do the students possess the background necessary?	Questionnaire and Interview
4	The students' opinion on the use of movies in the specific course.	Interview

Most of the research questions appeared on the questionnaire. Some of the research questions were relating to the technical nature of cybersecurity whereas others were relating to the part not covered in the syllabus, i.e., the psycho-social aspect. Next the questions of the questionnaire are presented.

3.2.1 Technical research questions

The students should recognise as many attacks as possible.

- Q1) Which cyber-attacks did you identify in the movie?
- Q2) Do you believe that you learnt useful things about cybersecurity through the movie?

3.2.2 Psycho-social research questions

- Q3) The students were asked to characterise the main protagonist and classify him in one or more categories listed in the (technical) bibliography (Tanenbaum and Wetherall, 2011).
- Q4) Which frauds were committed by the protagonist?
- Q5) The students were asked to identify any relation between the movie and the Psychology class they attended during their 3rd year of studies.

3.2.3 Rating the movie

- Q6) In addition, the students were asked to rate the movie in comparison with the movies which they had watched so far.

3.2.4 Interviews

The interview was semi-structured. There were some open questions concerning the two classes offered by the same instructor (namely Computer Networks II and Network Security). The first set of questions concerned the lectures and the lab exercises; in the second round of questions the students had the opportunity to freely make suggestions for the improvement of the courses. Finally, the third round of the interview was about the movie; the students were asked if they were watching movies regularly, if they had been displayed movies in other courses before and how did they like watching the movie as part of the course. The answers will be presented in the following section.

3.3 Sampling procedure

The class consisted of nine students, eight males and one female, aged 22 years. All students have lived together in the HAFA for 4 consecutive academic years and have followed the same educational and training programme, hence the class was highly homogeneous. Thus a sample consisting of four students (44.4%) was representative and adequate.

3.4 Validity

The students fill in the questionnaire right after watching the movie. Each student was sitting in their own desk and discussion was not allowed. The questionnaire was anonymous and the answers did not count towards the course grade. The instructor supervised the whole process and collected the questionnaires. In order to avoid biased answers, the students who watched the movie were interviewed after the end of the course, several days later, on 5 May, 2018.

4. Research results

4.1 Results from the questionnaire

4.1.1 Technical research questions results

- Q1) From open question Q1 of the questionnaire where the students were asked to identify the cyber-attacks committed by the protagonists, most students were able to identify the most obvious attacks such as social engineering and spear phishing attacks; one of them did not answer. The average student identified 50% of the attacks.

Table 2: Success in identifying cyber-attacks

Student No.	Attacks identified	Success rate
Student 1	No answer	- - -
Student 2	1	25%
Student 3	2	50%
Student 4	3	75%

The results are average, probably because there is a distance from a theoretical definition to real-life action.

- Q2) Do you believe that you learnt useful things about cybersecurity through the movie?

The answer was 'some' (i.e., average); this could be attributed to the fact that the movie was a commercial one (not focusing on cybersecurity) and as such, it included many common frauds not relating to cybersecurity.

4.1.2 Psycho-social research questions results

- Q3) Classify the main protagonist. The results of the questionnaire revealed that the students on average identified correctly (100%) seven out of ten answers.

Table 3: Some people who may cause security problems, and why

Goal	Checked by students	Success rate
To have fun snooping on people's email		100%
To test out someone's security system; steal data	2	50%
To claim to represent all of Europe, not just Andorra		100%
To discover a competitor's strategic marketing plan		100%
To get revenge for being fired	3	75%
To embezzle money from a company	4	100%
To deny a promise made to a customer by email		100%
To steal credit card numbers for sale	4	100%
To learn an enemy's military or industrial secrets		100%
To steal biological warfare secrets	1*	75%

(*) Wrong answer

- Q4) From open question no. 4 of the questionnaire, where the students were asked to identify the frauds committed by the protagonists, the answers varied a lot and only one of the students managed to identify almost all of the frauds (such as identity theft and credit card cloning).

- Q5) The psychology course taken by our students during the 3rd year is about psychology in the workplace and it does not cover the psycho-social aspects of cybersecurity; hence, this movie has introduced this perspective to the students.

From the last two points we may conclude that students awareness on the non-technical dimension of cybersecurity is inadequate; the movie revealed this fact and also gave them an opportunity to think constructively towards this direction.

5. Rating the movie

- Q6) The average rank given by the students was 6.875. It is remarkable that the students were curious to compare their rank to the average IMDB rate (6.2; Hacker - the movie, 2016) which is somewhat higher but still close enough. This fact implies that the students are familiar with the contemporary movie industry.

5.1 Results from the interview

The instructor received critical as well as constructive feedback on matters relating to the courses. Regarding the movie, the results revealed that:

- The students were shown documentaries and video clips in the past, during the War Ethics course, but they liked better watching an entire movie.

- The students are watching movies on a regular basis; hence, it was a good idea for the instructor to use this channel in order to communicate some additional aspects of cybersecurity to the students, due to their familiarity with the medium.

- All students agreed that it was a good idea to watch a movie in the framework of the Network Security course. The students declared that they enjoyed the movie.

5.2 Weaknesses and limitations of this work

Although an adequate sample of the targeted population participated in this study (44.4%), the whole class consisted of only nine students, a fact which constraints the generalisability of the research results (Price and Murnan, 2004; USC Libraries Research Guides, 2018). This is an inherent problem of HAFA's engineering classes. However, due to the high homogeneity of student population attending the specific course, the researcher estimates that the results may hold for the next classes attending the course in the near future.

6. Conclusion

In this paper a pioneer effort of displaying a commercial movie in order to enhance student education on cybersecurity is described. The students had the opportunity to get informed about some of the non-technical aspects of cyber-crime, such as the psycho-social and legal factors. It became clear that a youngster with extra information science skills may become a cyber-criminal under special circumstances and that cybersecurity has also a psycho-social dimension, which should not be underestimated. It is evident that this dimension is beyond the technical background of the course. The experiment was assessed through a questionnaire, as well as, interviews.

The questionnaire was handed to the students right after the movie and it turned out to be an alternative way to test students' understanding of both technical knowledge (attacks) and socio-cultural aspects of cybersecurity.

Research results revealed that psycho-social and socio-cultural dimensions are missing from the curricula offered to our Telecommunications and Electronics Engineering students. To address this problem, the following three measures are proposed: (a) Add a special lecture to the Psychology course of the 3rd year. (b) Add a special lecture about Cyber War Ethics to the War Ethics course of the 2nd year. (c) Use proper videos and video clips in the Cybersecurity course in addition to the technical content.

The instructor plans to re-attempt the experiment with another movie, in a future class. An improved questionnaire, enriched in the psycho-social dimension, will be used.

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The use of web Technologies in Mobile Devices to Support Students Education

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Abstract: The use of communication technologies in the teaching-learning process has increased tremendously. The use of mobile technologies (e.g. smartphones and tablets) has not been an exception and it appears as an innovative tool for both teachers and students. Current higher education students belong to the so-called "native digital generation" that use mobile devices from a very early age. Students, innately, constantly access information through these same devices. In Portugal, in higher education, there is a week timetable where teachers clarify students' doubts, in their offices. These are called office hours. It should be noted that the presence of students in this timetable is optional. Although it turns out that attending office hours is beneficial to them, many students do not take advantage of them. Thus, a question arises: how to encourage students to use office hours for doubts clarification, without the need of student and teacher being simultaneously in the same classroom or teacher's office? A possible solution was considered: the development of a collaborative web platform, to be used in mobile devices, to support tutoring at distance. Thus, it is intended to facilitate the communication between a teacher and his/her students, to clarify doubts through the use of mobile devices, which students use in an informal way in their everyday life. This paper presents an e-learning web platform, developed with the purpose of doubts clarification, at distance, between teacher and students, in a collaborative way, in real time, using mobile devices, enhancing a better teacher-students communication. The web platform was developed allowing the users to share a drawing area, in real time, with other users, using different devices, allowing all connected users to freely draw or use the available tools in this collaborative platform. Basically, when one of the users draws something in the available area, those designs are sent to a server, being then visible by the other user, in real-time. The work accomplished allows concluding that the mobile technology has the potential to increase the accessibility and the communication between teachers and students, increasing students learning. Recommendations, limitations of the present study and suggestions for future research were also made.

Keywords: online educational platforms, higher education, mobile devices, web technologies

1. Introduction

The Europe 2020 strategy aims to support the modernization of European higher education systems, by helping educational institutions to achieve their full potential, as drivers of human capital development and innovation. Thus, the modern knowledge-based economy demands highly qualified graduates, from the higher education institutions. In other words, Europe needs more qualified citizens, having not only knowledge of specific subjects, but also transversal skills such as flexibility, communication and entrepreneurship, so that they may achieve success in the current job market. Higher education institutions play a crucial role in the so-called "Triangle of Knowledge" in which teaching, research and innovation interact with each other. Contemporary societies live in a context of change, which has impacts in higher education, with implications in the organization of the teaching system and in the practice of teaching and learning processes (Cardoso et al, 2008). Some of these changes have been fostered by the Bologna Process, which has been developed in a context of gradual and irreversible economic globalization, and has prompted the construction of a European Higher Education Area, to promote European cohesion. It was assumed that education is for everyone and it should be based on democratic ideals of humanist orientation, anchored in principles of equality, rationality and social justice.

Several studies on educational practices have been developed. Information and Communication Technologies (ICT) have played an important role in teaching and learning practices (Fabian, 2016). It is believed, as mentioned by Coutinho and Alves (2010: 220) that "web-based teaching is a way of renewing teaching practices and that is a challenge for both students and teachers. (...) It makes no sense to continue to ignore the educational potential of the internet, thus we must be all those who want more and better Education, to explore the diversity of opportunities it has to offer and what matters to investigate". In this sense several teaching and learning platforms have been developed and are used in educational practices, in higher education. However, these platforms do not always meet the demands of digital natives. Thus, this paper presents the Higher M@T-EduTutor platform prototype, which allows students to clarify doubts, without the need for teacher and student to be present in the same physical space. Instead they just need to be with their smartphones and tablets, in addition to the traditional computer. Initially, the theoretical framework of the study is introduced. Then, the platform, which was developed according to the ADDIE Instructional Design Model, is presented, followed by the conclusions obtained.

2. ICT and higher education

2.1 The role of ICT in education

Higher Education Institutions have a constant concern, regarding the value of the diploma and the professions of the future, of a digital and flexible world. Employers and society itself require diverse knowledge, skills and attitudes. Thus, it is necessary for students to be able to solve problems, to work with challenges and with diversity, according to the Industry 4.0 paradigm. School cannot ignore this reality or what is happening in the world, but rather has to prepare citizens able to respond to the demands of the world that surrounds them. Moreover, it has to be realized that current students are part of a generation based on Web 2.0 and Web 3.0, since they were born in this technological space and are fully integrated in it. It is not possible to dissociate ICT from today's society. This has seen economic and social changes in the last decades, also driven by a period of enormous technological development. With the growth of ICT, access to information becomes faster and the results obtained are more and more abundant. The introduction of ICT in various sectors of human activity was involuntary. However, in the case of education, it was imposed for a number of reasons, from allowing access to a greater number of citizens, enabling them to live and to work in a technological society, and to promote an up-to-date education supported in the knowledge society needs (Andrade, 2002). According to this author, the introduction of ICT in schools, allows to take to them the changes occurring in society, providing new educational practices (Andrade, 2002). Furthermore, it considers that school education should provide all students the development of a set of learning skills, by enhancing lifelong learning, mediated and supported by the school. This requires a "radical transformation of the educational vision: from a vision focused on teaching environments to the implementation of learning environments, which can be configured with new ideas and strategies, supported by new technologies" (id, id: 82). For Andrade (2002) the new technologies can be an opportunity to change the educational paradigm, at the learning level.

The presence of ICT in educational institutions fosters a process of reengineering the educational models, which benefit from the use of technological resources, which should essentially be a path that facilitates the preparation of students, to be capable of facing social dynamics (Junior, 2009). According to this author "the use of Internet-oriented teaching can be seen as a tool that enables the construction of knowledge, through a contextualized practice that composes a new nature of teaching and learning in school. If the Internet is made up of innumerable elements that reflect the real world, there is no doubt that bringing the world-wide network to the classroom benefits students, insofar as it brings the 'real world' closer to the effective experience of the subjects"(Junior, 2009: 12).

Currently, most students already use many of the resources available on the Web, in an almost spontaneous, informal and natural way. Thus, learning experiences in dynamic and flexible environments using familiar technologies encourage students to build up their knowledge. According to Miranda & Torres (2009: 2): "Teachers have understood that to educate this generation it is necessary to use the tools of this generation".

The presence of ICT in schools bas been a reality from a long time ago, including of course in Higher Education, and its use at organizational, structural and academic levels is frequent. Their purposes in terms of education are multiple and are used in a variety of contexts, with diverse objectives and ways of exploration, such as a means of communication between teachers, students and employees, and means of supporting the launching of grades, class registration, among others. In the school environment, it is also possible to consider the different uses of ICT in school management and administration, as well as being the subject of study of several curricular subjects. At the level of education, according to Gomes (2005) ICT allows: (i) to support classroom teaching; (ii) to provide opportunities for self-study, based on electronic documents; (iii) to facilitate the development of distance learning systems; (iv) to extend the classroom virtually face-to-face; (v) to generate new online training modalities.

According to Martins (2008), the use of new information and communication technologies in higher education has fostered new educational practices, mainly fomenting the distance education paradigm. Several changes occurred with the increase of use of ICT in educational practices, from the production of teaching materials to teaching and learning methodologies. It is possible to produce teaching materials that allow more interactivity between educational agents during the teaching and learning processes. On the one hand, the student can access content at any time, requiring more autonomy and independence, as well as knowledge of the technologies at his disposal. On the other hand, the teacher will have to spend more time in the formulation of contents and the attendance of his students (Martins, 2008).

2.2 Application of ICT to support the teaching and learning processes

Some studies have shown a positive impact of ICT in the teaching and learning processes, making it possible to implement didactic strategies more focused on students (Junior & Coutinho, 2009, Junior, 2009) with gradual autonomy towards the teacher. With the development of ICT, it is possible "to explore factors such as multisensory association, human-computer interaction and experimentation, in solving teaching problems, aiming at greater understanding of information and faster and more effective learning" (Isotani et al., 2001: 533). Thus, it can promote a meaningful construction of knowledge, which "has associative characteristics and structural aspects, is cumulative and depends on the characteristics of each one and what already knows about the subject" (Miranda, 2009: 94). Learning can be understood as the process that leads to the acquisition and development of skills, involving knowledge, attitudes and values, and behaviour change (Miranda, 2009). In order to strengthen it, it is fundamental that teachers are familiar with the theories of learning, but more than this, they exert praxis, according to the most recent teaching and learning theories. Learning theories comprise the mechanisms that explain learning processes, while instructional theory focuses more on how one learns and "cares more about improving or optimizing learning than on describing it" (id, id: 83). For Miranda (2009) there are, currently, two instructional approaches: the instructionism (with cognitivist and behavioral support) and constructivism (supported by cognitive and socio-cognitive development theories) that complement each other. In both approaches it is argued that in order to plan the instructional process, it is necessary to consider what the student already knows, so he/she may anchor new knowledge on his/her actual knowledge. According to Merril (2007), when "the instructional process directs the student to remember, relate, describe or apply relevant knowledge derived from past experience that can be used as pillars of new knowledge" (id, id: 63), learning is more effective. Several instructional models were developed, some in the 1960s by Gagné (1962, 1985) and Glaser (1965) and more recently by Silvern in 1965 (cited by Gustafson & Branch, 2007) as one of the earliest Instructional Designers (ID) Models. The Silvern model, like many others, considers the existence of 5 phases: Analysis, Design, Development, Implementation and Evaluation (Gustafson & Branch, 2007). The Analysis phase consists of evaluating the need for training in order to define user input characteristics and goals to be achieved. The design phase aims to establish the objectives to achieve, what is to learn, to describe the activities to do it and the media to be used. The Development phase is intended for building materials or reusing existing ones. The Implementation phase consists in putting into practice what has been planned and developed. And, finally, the evaluation phase is aimed to evaluate, revise and improve the instructional system. Thus, the ID model must be congruent and take into account what students have to learn in order to obtain better results. For Miranda (2009) it is inconceivable to design any course or even online content without establishing the use of an ID model. It is important to remember the objective of information is to become a learning object, taking into account the educational functionality.

3. ESTG-IPVC web educational platforms

It is possible to find several tools, based on web platforms, which are used in for educational activities. Some are developed specifically for this purpose, being more comprehensive (such as: Moodle and Blackboard) and others focused on more specific areas, such as *M@T-Educate With Success* (Araújo et al., 2016) and *PMate*, and some not specifically developed for this purpose, but are nevertheless used in this context (such as Chat, Email, Facebook, YouTube). Some of these platforms have free and commercial versions. Higher Education Institutions often have comprehensive institutional platforms. The School of Technology and Management of the Polytechnic Institute of Viana do Castelo (ESTG-IPVC) uses the Moodle platform, mainly as a content repository. However, this platform also allows: content management; tools to validate the generated contents; courses management; customization (modules, themes, etc.); tools to ensure accessibility to content; participation in forums, wikis and blogs; and other features. Another platform used in this institution, but of a more specific nature, is the *M@T-Educate With Success* platform. The development of this platform began in 2008, with the purpose of supporting students' studies on the Mathematical Analysis curricular courses. Digital guides are available in .pdf format, and also interactive dynamic guides, from which the student explores and interacts with content, building knowledge at his own pace (Araújo et al, 2010). Both institutional platforms are based on web technologies and optimized to use on mobile devices, which students normally have with them.

In the ESTG-IPVC higher education institution, in addition to the timetable inherent to the curricular plan of the courses, there is a weekly attendance time in the teachers’ office, which students can use to clarify their doubts in a more personalized (individual) way. This timetable is optional for students, and although it is beneficial to learning, it is notorious that few students actually make the most of office hours. Students do not recognize the importance of the timetable and the need to move physically to the teacher's office. It should be noted that this practice of not using these hours is generalized to most of the courses, including those with a higher rate of school failure.

Moreover, it is noticed that the few students who attend office hours are able to obtain better results. Thus, focusing on measures to combat school failure, it can be seen that the two institutional platforms used in the ESTG-IPVC are not enough to meet students' needs. In this sense, taking into account students' technological aptitudes as well as their habits and attitudes, it was verified the pertinence of creating a space, besides the teacher's office, that allows the clarification of doubts and a greater accompaniment of the teacher in the students' learning process. And, in this way, enhance the approach between students and teachers facilitating the clarification of doubts without both having to be in the same physical space.

4. The Higher M@T-EduTutor platform

In order to increase the proximity between teacher and student, during office hours, an online environment/platform was developed to allow expanding the space of the students’ attendance, beyond the walls of the teachers’ offices. This platform was designed taking into account the practice of clearing up student doubts, in person. In this sense, the Higher M@T-EduTutor platform was created, applying the ADDIE Instructional Design model (Gustafson & Branch, 2007) (Figure 1). Each of the 5 phases is described below.

Figure 1: The ADDIE instructional design model

4.1 Analysis

Students’ lack of interest in going to office hours was identified as a problem, although those students who look for this attendance are able to achieve approval on the course. On the other hand, the lack of students to the evaluation elements is high, and consequently school failure occurs, contributing in the medium and long term to school dropout. In this sense, an opportunity arises to take measures in order to minimize this reality. Aware of the almost natural habits of our students, confirmed by previous studies already done that reveal the use of technologies promotes school success (Bringula, 2017; Fabian, 2016), it was considered the implementation of a virtual space. In this sense, it was decided to develop an online platform, that would expand the space of the students’ attention beyond the walls of the teachers’ offices, in which communication between teacher and student would be feasible simultaneously, facilitating doubts clarification, without the student and teacher had to move to the same physical location.

4.2 Design

Emerging mobile technologies are effective platforms for the delivery of digital learning resources, anytime and anywhere (Churchill, 2017; Saman, 2017). Thus, it was planned the design of an online web platform, responsive and suitable for mobile devices. The platform was designed taking into account the practice of clarifying doubts in person. One of the main objectives was to create an area in which both users could freely interact, collaborate, using different tools, which would enable, among other things, to scratch, draw and write simultaneously. In this way it would be possible for the student to write/draw on the canvas (typically an HTML element used to draw graphics on a web page) and thus to present his/her doubts to the teacher. On the other hand, the teacher, besides visualizing, can scratch and write at the same time. In this way, it will help to clarify the student's doubts.

4.3 Development

With the objective of having a virtual environment, for both students and teachers, the Higher M@T-EduTutor platform was developed, as a prototype of a collaborative, real-time, responsive and mobile-compatible web platform (e.g. smartphones and tablets). One of the main objectives that it is intended to achieve with the development of this platform is to substitute the use of a whiteboard like the one that is present in a classroom. This platform has features of an online editor, which includes basic writing and drawing tools, being able to write and freely draw, in real time, with other connected users, having the user at his disposal several tools, among which, a text tool, a brush, a rubber, the possibility of loading images, cleaning the drawing area and export the work area as an image. It should be noted that there was a concern to implement a sufficiently large and flexible working area (canvas), allowing users to freely write/draw/browse. Three of the developed functionalities are: in order to identify what each user writes (student and teacher), in one of the displays, what the user draws appears in blue colour, while in the other user display it appears in brown colour. Such variance allows the teacher to identify what the student wrote and vice versa. Another functionality allows the user to upload documents (such as .pdf files) to the canvas, so that both students and teachers can more easily expose and clarify doubts. A third functionality allows the student to record/export, as an image, the canvas where he is working with the teacher, in order, later he may use, when carrying out his individual study.

4.4 Implementation

In the implementation phase it was decided to verify the relevance of the eLearning platform for the students. Within a mathematics course, the students were asked to use the platform to clarify doubts. For this purpose it was necessary to provide the URL address, as well as to arrange the online meeting day and hour, with the teacher, ensuring that both users (teacher and student) would be online simultaneously. Among several students who used the platform, one of the students, who showed greater readiness to test it, was selected (besides being one of the students who did not use office hours regularly) to do a more detailed analysis of the platform usage. To do this, a date and an hour were scheduled, ensuring that both users (teacher and student) were simultaneously online. The clarification session started with both, teacher and student, connected online, through the Higher M@T-EduTutor platform. The student initiated the communication by using the text tool to write, "I have doubts about an exercise. Can I transcribe it and what I've been able to do?" The teacher agreed and the student uploaded an image with a few steps of the resolution of the exercise, as far as he could get. Then the teacher managed to interact on the image presented by the student, writing and scratching. At the same time, both were writing and scratching, and the teacher was able to clarify the student doubts. The Figure 2 represents part of the experience here described.

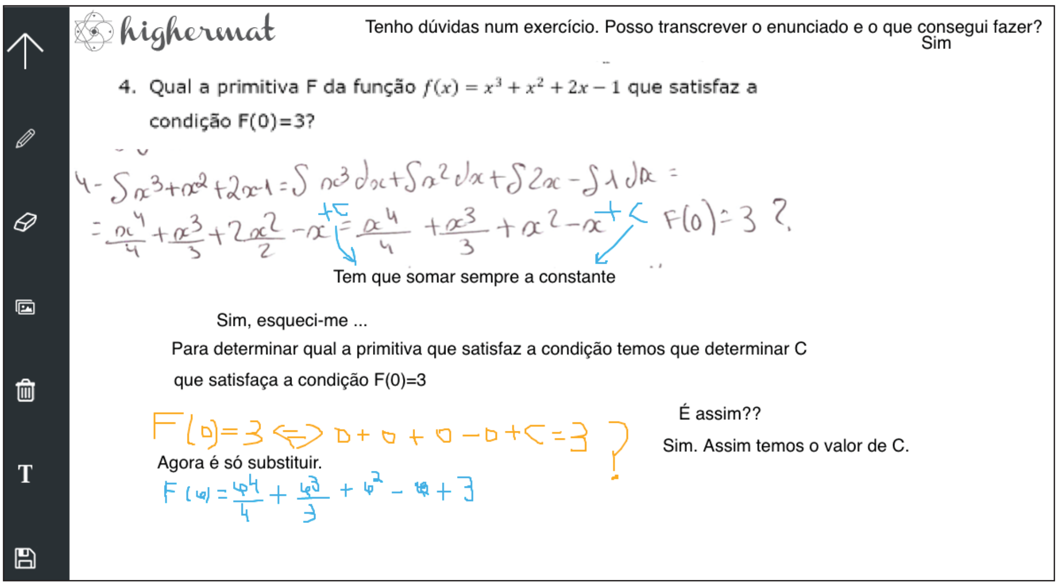

Figure 2: Example of a clarification session using the Higher M@T-EduTutor platform.

At the end of the clarification session, the student informed the teacher that he would use the platform tool that allows the canvas to be saved under the .jpg image format. Thus, later he could use it in his individual study. In this way it was possible to exemplify, through a practical example, the use of the developed platform.

4.5 Evaluation

Taking into consideration the purposes for which the Higher M@T-EduTutor platform was developed, it was possible to verify that its objectives were achieved. It was possible for the student to share his doubts with the teacher, through the platform, just as the teacher was able to clarify the student doubts, in a collaborative way in real time using a web platform, suitable for mobile devices.

After using the platform the student was asked to fill a small questionnaire. The student, when asked about the pertinence of this platform, as a support for the clarification of doubts, answered that the concept was innovative and he had enjoyed participating in the experience. He also mentioned that he was able to clarify the doubts he had. The student was also asked to indicate some of the advantages and disadvantages he encountered on the platform. The advantages indicated were: the possibility to clarify doubts about some content, without the need to physically be in the school; the possibility to record the drawing area (canvas) with the explanations, as an image, which in a face-to-face session does not happen. As disadvantages the student mentioned the difficulty in arranging an online meeting with the teacher, and the URL address for such clarification session; and he also mentioned as a disadvantage of the platform the lack of audio support, becoming necessary to use an external application (e.g. Skype) to be able to communicate through this mean.

In addition to this empirical study, carried out by a teacher and a student, this platform prototype had already undergone a usability study (Araújo & Faria, 2017) in order to validate its use in mobile devices. This study involved 16 students between the ages of 18 and 25 and the System Usability Scale survey (SUS) was used. It was concluded that the use of this platform has been recognized by the students as suitable and useful in an educational context, has a high degree of usability and may contribute to learning mathematics, namely in the clarification of doubts.

5. Conclusions

In ESTG-IPVC higher education institution the use of ICT for educational purposes is already a reality. In addition to the Moodle platform, other platform, the *M@T-Educate With Success* is used in some Mathematic courses. These two platforms do not completely comply with the students' needs, though. Additionally, there was no experience at ESTG-IPVC of using a platform, having an interactive area, where teachers and students, collaboratively, at distance, clarify doubts in real time. Moreover, the use of platforms of this type for this purpose (free, responsive, suitable for mobile devices, having touch support for tactile screens, with a flexible canvas size, a "rubber" tool to erase part of the drawn object, support to files import and allowing to export the drawing canvas as an image.) was not found in the literature.

Thus, it was decided to develop the Higher M@T-EduTutor platform, applying the ADDIE Instructional Design model. This platform would allow the student to clarify their doubts, without having to move to the same physical space where their teacher is in a particular moment. In this way, it is possible for the students, using the electronic devices with which they are familiar, to clarify their doubts about certain contents, and thus to contribute to the improvement of their learning.

In short, using ICTs can help students synchronously overcome their difficulties, in any place, using virtual spaces that allow them to associate, in the same environment, image and communication, which facilitate the clarification of doubts.

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Performance Forecasting of University Students Using Machine Learning[1]

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Abstract: This work is aimed to show a learning analytics testing in grade courses of the School of Engineering (UBA). The purpose is to analyse how to apply machine learning tools and to get predictions of students' progress. In order to achieve this, an action research is carried out. The main goal is to employ machine learning to perform a forecasting analysis about the students' marks. These marks are obtained from several self-tests, which are carried out in the School Campus, and from face to face tests. Moreover, attendance to class is taken into account. The test is applied in a b-Learning course of basic science. The machine learning tasks were driven by TensorFlow and other Python packages like Request, Pandas, Numpy, Scipy and Beautifulsoup. The model in this environment is nothing but a set of elements called features, which will be used to estimate another element called label on the basis of data obtained in previous courses. The test set contains the examples used to evaluate the trained model´s effectiveness. The models test starts out as a data set of one course. Adding data of other courses to the training set usually builds a better and more effective model. Two different models were performed using the TFlearn and Keras APIs, having theTensorFlow as backend. The appropriate shape of the training set to perform the model was chosen in an empirical way. With this training, the lowest loss and the highest percentage of accuracy were determined, avoiding the occurrence of overfitting. These two parameters, loss and accuracy, were also used to determine the most appropriate Application Programming Interface (API) and the neural network model. It was possible to predict which students may have problems in the second exam and help them with the aim of increasing the number of students who pass the exam. This prediction was made with a percentage of error lower than 10%.

Keywords: eLearning analytics, learning physics, TensorFlow, model, prediction

1. Introduction

In the first years of the studies in the School of Engineering, many students have important difficulties in basic sciences. Such difficulties depend on many factors, such as comprehension, contents, motivation, academic goals, time, etc. In some occasions, they decide to stop studying asubject to devote more time to another one, or because they start working. Therefore, the School has implemented educational resources in its virtual campus, in order to identify which of the students need particular help to continue their studies. These resources are required as a complement, an expansion and a means of evaluation. The main objective of creating such resources is improving the effectiveness of teaching and learning activities to help students achieve significant and independent learning (Barberà & Badia, 2004; Papamitsiou & Economides, 2014). This kind of learning requires students to know their own condition in relation to the subject. Predicting students' performance may allow an educational institution to provide appropriate assistance to students who are prone to fail (Gerritsen, 2017), and thus, it is considered a very important issue. With this purpose, machine learning algorithms that can automatically predict this outcome in courses of the first year of the School of Engineering are used. Some previous works study the prediction of students' performance in a specific course, which relies on the students' past performance in other courses (Kotsiantis et al., 2003; Xu et al., 2017). Instead, in this work, the prediction of students' performance relies on the students' present performance in the courses.

The Learning Analytics is the focus of this action research and the aim is to help students improve their learning experience (Cabero, 2015), as well as facilitating the process of obtaining predictions of students' marks. This alerts students and allows them to optimize their study effort. In order to do this, machine learning, a method of teaching the computer to analyse big data sets and use them to make predictions is used. TensorFlow program environment is an example of these machines developed by Google. The aim of this study is to characterize students' behaviour and correlate it to achieve learning objectives (Forokhmehr & Fatemi, 2016). So, for this research, students of Physics I courses of this School are examined. These students have two face to face exams. LA is used to predict the mark of the second exam taking into account the mark of the first one, attendance and self-tests in one of the b-Learning courses of basic Physics. If the forecast for the second exam shows bad results, preventive strategies to help students will be applied. Therefore, this research can be divided into two stages:

[1] Work developed within the framework of the project 20020150100134BA

- Development and learning of the machine learning tool and the model testing; and
- Design of preventive strategies to help students in the learning process with the aim of improving their performance.

2. Methodology and development

An action research is carried out, and it may be cast as a binary classification problem, where the two prediction labels are students who are prone to fail the course, and students who are prone to pass (Gerritsen, 2017). The final purpose here is to help students whose predictions are negative. Then, educational materials will be employed to reinforce the learning of the contents. In this way, students obtain more tools to learn appropriate physics models and pass the course. The variables studied to carry out this analysis are the marks of three self-tests, attendance to classes and the marks of face to face exams. The techniques used for analysis in this research process are network and exam analysis. For this research, two samples are considered. A primary sample, called data, is required as an input for model training. In this case, it consists of 200 students from previous iterations of Physics I courses. The secondary sample, used to predict the result of the second exam, consists of 46 students. Both samples are convenience samples.

2.1 Learning analytics

There are two common terms that are close to big data sets: learning analytics (LA) and educational data mining (EDM). LA refers to measurement, analysis, collection of student information and learning context. On the other hand, EDM is concerned with developing methods for exploring data sets of education and using them to understand students and their learning environment. Both of them share the goal of improving education, but they have some differences. EDM has a focus on automated discovery, whereas LA has a focus on influencing human judgment. Moreover, in EDM research it is more common to see a reduction of phenomena to components and relationships between them. On the other hand, LA researchers attempt to understand systems as wholes (Siemens & Baker, 2012). So, in this work, the study is conducted in the field of learning analytics because it tries to predict students' achievements based on big data sets of students' experiences and logs available in the database of Learning Management Systems (LMS) of the School, to change students' performance (Morabito, 2015).

A model consisting of the above mentioned tensor of variables (features) and a label with two categories are chosen. In order to implement machine training, data from the previous three iterations of Physics I courses are loaded. The training data is loaded into a .csv file and it is transformed into a features and label tensor using the Keras API. Finally, to make the forecast, a tensor with the features of the current course, without labels, is entered. The set of data is divided into two subsets: the test setand the training set, that is used to train the Deep Neuronal Network (DNN) which forms the model.

There are two numbers that characterize the performance of the model: loss and accuracy. The loss value is not a percentage, it refers to how well the model is doing for the training set and the test set. On the other hand, accuracy is the probability of success. In order to minimize loss and maximize accuracy, the best number of epochs, which is the number of times to loop over the dataset collection, is determined. Counter intuitively, training a model for longer does not guarantee a better result. In doing this, two problems may appear: overfitting and underfitting. The sample sizeis a subset of data used to perform the estimation of the parameters which give the model accuracy and loss (Gerritsen, 2017). So, the problem is addressed in the following 5 steps:

- Import and analysis of the dataset.
- Selection of the type of model.
- Model training.
- Evaluation (test) of the effectiveness of the model.
- Use of the trained model to make predictions.

2.2 Keras

Keras is a high-level neural network API, written in Python and capable of running on top of TensorFlow. TensorFlow is used to develop students' classification problems. Its main function is to use neural networks to detect and decipher patterns and correlations analogous to human learning and reasoning. Keras supports the creation of easy and fast prototypes (TensorFlow´s code) and convolutional and recurring networks, as well as combinations of both of them. The implementation of Keras and its different stages are shown in the table extracted from the TensorFlow page (https://www.tensorflow.org/get_started/get_started_for_beginners)

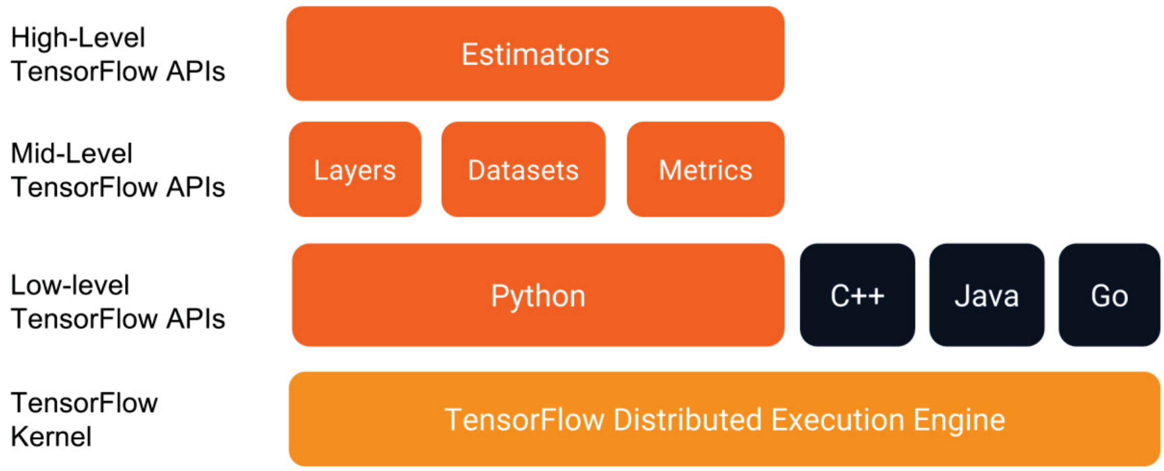


Figure 1: Keras' different stages

2.3 Code implementation

Machine learning is the process of training a model constituted of features and labels to make it able to estimate the values of future labels based on current features. The ideal number of hidden layers and neurons depends on the problem and the dataset. Like many aspects of machine learning, picking the best shape of the neural network requires a mixture of knowledge and experimentation. As a rule of thumb, increasing the number of hidden layers and neurons typically creates a more powerful model, which requires more data in order to train effectively.

For the implementation of the model, API Keras is used, so Python and all the dependencies necessaries to allow TensorFlow to run with Keras must be installed. The implementation requires information of students from other years, which define the features. When it comes to developing the code, the first thing to do is activate the eager execution, thus TensorFlow will be executed in its fastest way. During the process, an analysis of the data of different marks of the students and of the attendance index of offline class is carried out. The objective is to use the marks of self-tests and of the first exam, in conjunction with attendance, to be able to estimate the mark of the second exam. As the model does not use continuous variables for labels, two categories are established: 1 pass, 0 fail.

The Bucketize function, with the marks of the first partial exam, is used to form a tensor that divides the marks into three categories. Data binning or bucketing is a data pre-processing technique used to reduce the effects of minor observation errors. The original data values which fall in a given interval, a bin, are replaced by a value representative of that interval. That is a form of quantization.

Data analysis is treated, as in Python dictionaries, in the pre-process instance. Another measure to take, so as to avoid overfitting, is to divide randomly and in equal proportion students who pass and fail the exam. A training of the data set formed with labels and features, and using the sequential model is then carried out, with a hidden network of ten nodes and two levels. The input has the shape of five features which are continuous variables and two levels of categorical labels.

Epoch is a hyper parameter that can be tuned. Choosing the right number of epochs usually requires both experience and experimentation. If the number is not chosen in the correct way, overfitting or under fitting happens. Overfitting occurs when a model learns the training data too well and cannot generalize. Underfitting, the opposite of overfitting, can also happen with supervised learning. In the case of underfitting, the model is unable to make accurate predictions with both training data and new data.

The test values are introduced in the same way as training values, for which two categories (0 = fail, 1 = pass) are defined. Once the model is found to be trained with the training and test sets, five features are introduced in an unlabelled tensor, which is formed by the marks of the students of the real course. The stack of programs used to perform the analysis can be summarized in the following table, which was extracted directly from the TensorFlow page (https://www.tensorflow.org/get_started/premade_estimators).

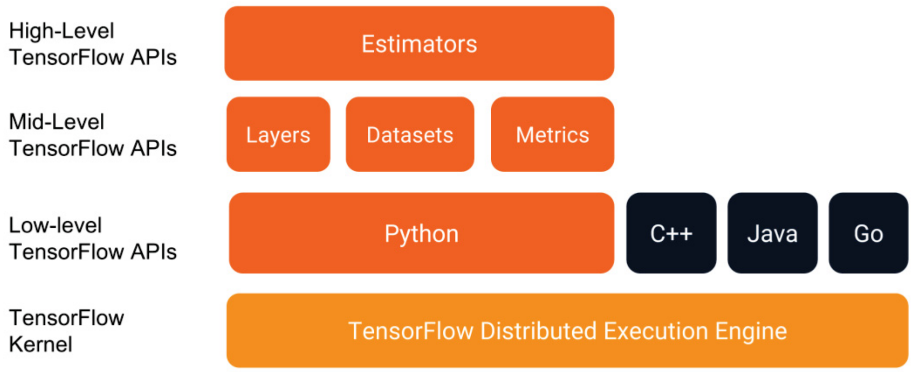


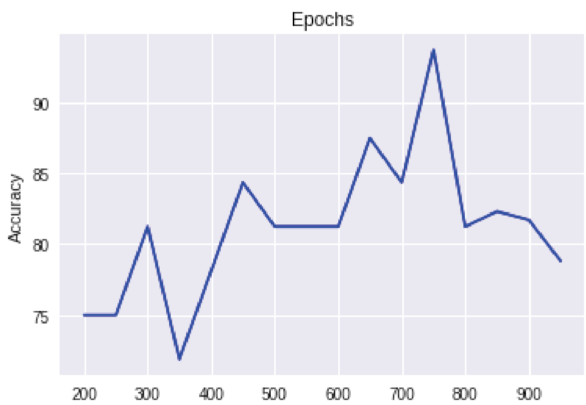
Figure 2: Tensorflow table

3. Results

Students' data from old periods was taken and used to build a dataset consisting of two subsets: the training set and the test set. Previously, the pre-process function was used to build the tensor that was applied in the DNN model. Actions to avoid overfitting, underfitting and to minimize the loss were taken.

Finally, an unlabelled tensor form was introduced with the current students' marks. The model detects the unlabelled data and places on the function a label of what is learned during the training process. The pass/fail forecasts for students in the second exam were determined. With such input, extra activities will be prepared for those students, such as self-tests with the explanation of the errors, videos to explain important concepts, materials for reading, or additional video-streaming practice classes.

Once the training and test set have been selected, the accuracy and the epoch are selected. The prediction is made with a percentage of error lower than 10% because accuracy is about 90%, which is the probability of being right when predicting whether a student passes or not the exam that is set as a label. The best number of epoch is 752. Both parameters are shown in graphic 1. Moreover, and as it has already been mentioned, we can see that training a model for longer does not guarantee a better result.



Graphic 1: Accuracy as a function of the epochs

4. Conclusions

A model able to predict future results for students' marks has been defined. It is a fact that machine learning is like human learning: first, it needs to have a question to be answered and a little background knowledge of the correlation between the variables that are going to be defined as features and labels. The second step involves the necessary pre-process to accommodate the data in the way the API needs to treat it; the type of result, which is as a categorical label, must also be provided to shape the data accordingly. Finally, the model chosen should analyse the data splitting it in datasets of training and test, which will be formed taking into account different parameters and will draw conclusions in the form of results of the unlabelled set.

The analysis of the results of the second exams was not the one expected. Taking into account the results obtained during the training process, an accuracy of about 93% was expected, but a value of 72% was actually obtained. Incorporating more variables to the model (previous training, country of origin, start date of studies, if students work and for how many hours) is highly necessary. In order to find out those values, data from another source beyond the e-learning platform needs to be incorporated. Thus, a system with Python bottle and MongoDB is under construction, in order to gather the information and create a .csv file to be used, in final instance, with TensorFlow. The reason underlying the choice of MongoDB is the possibility of performing a specific kind of update called upsert. This operation is useful while importing data from external sources. It will update existing documents if matched, otherwise it will insert new documents into collection.

The character of the model can be considered in the way that it only evaluates students inside the subject. Using a global model (Hartman et al., 2016) would be interesting because expected results can be evaluated within subjects, using students' results in preceding subjects.

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Student Engagement and Perceptions of Quality in Flexible Online Study Programs

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Abstract: VIA University College in Denmark offers a variety of online study programmes in administration, nursing, preschool teaching, teaching and social work. The study programmes are organized as blended learning with a large percentage of students' activities designed to be carried out online and in collaboration among students. It is well established that student completion rates are often lower in such flexible study programs. This might be due to factors such as less face to face contact with faculty and challenges regarding student self-motivation, when study time must be self-organized to a much larger extent than in traditional study programs. Thus, it is of great interest to investigate which factors keep students motivated and engaged in these programmes. The paper will investigate and discuss the following research question: How does educational design affect students' social and academic engagement in and connection to their study? Our aim is to discuss education designs and their potential role affecting the students' social and academic engagement. Our data collection method is designed to investigate students' points of view. Using a hermeneutical approach, we have conducted semi-structured interviews with study groups from the different programs. In the interviews, we asked students which factors were important to them regarding 1) their social engagement in the study programme, 2) their engagement in the study content (academic engagement), 3) their experience and use of guidance and feedback from faculty, 4) retention in the study programme. Analysing the interviews, the paper seeks to understand quality in these study programs from the students' point of view. We hope to outline some propositions for educational designs in online study programmes, which support the social and academic engagement of students. The results obtained in this study may be used in future design of online study programs, with the aim of increasing student motivation, retention and completion.

Keywords: blended learning, students' point of view, educational design, students' motivation, academic engagement, social engagement

1. Introduction

1.1 Setting

VIA University College, Denmark, online study programmes

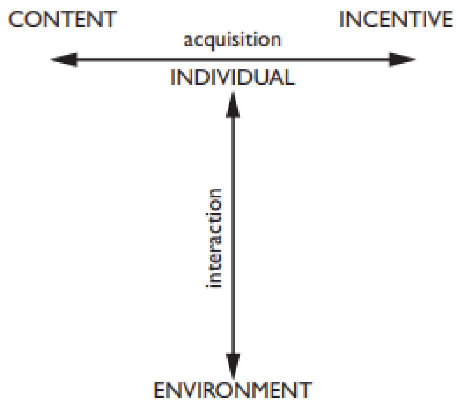
1.2 Theoretical background/framework

The project aims at investigating how educational design affects students' social and academic engagement in and connection to their study. Using a learning model from Illeris (2015), we seek to analyze the influence of study content and the possibilities of interaction with instructors and peers on student engagement.

To investigate student engagement, the project investigates the different elements in student work in online study activities. An element in this is students´ experience of the balance between a clear structure and a high level of flexibility in the study (Yukselturk and Yildirim, 2008). Furthermore, the project seeks to elucidate the students' experience of opportunities offered in the programs in terms of guidance and feedback in connection with their study activities.

1.2.1 Definitions

In the following, we identify key concepts in the study. Social and academic engagement are among them, and we distinguish between students' academic and social engagement. This distinction originates from Illeris´ learning triangle, which contains the processes of acquisition and interaction (Illeris, 2009).



Illeris sees the learning triangle as a relationship between content, incentive and environment. In the model, the learners' individual acquisition of content is influenced by the incentive of the student, but the incentive of the learner is also influenced by content. Content is defined as the educational structure of the academic content of the study, and the learners' coping with this. Engagement is the student's readiness and emotional commitment to learning, while interaction is the influence of the learner's social background and learning environment on learning. We make use of Illeris' learning triangle to emphasize the importance of both the professional organization of the content and the importance of the interaction with the learning environment – also because both content and interaction play an important role in the learner's incentive to engage in the acquisition process. We associate incentive with concepts such as motivation and engagement, which in turn means that students´ engagement is not a fixed quantity but will be influenced by the way the content is organized in online education and the interaction in the learning environment.

We understand social engagement as student involvement in their study groups and in their collaboration with teachers, fellow students and other staff. Social engagement relates to the interaction process and is expressed by the students' collaboration with other students and teachers. Educational framing and design that may affect students' social engagement are also relevant.

We understand academic engagement as the students' work while delving into and elaborating on the subject matter, or their reflected use and application of the academic content in their future professional practice. Academic engagement relates to the learning process and to the students investing time, effort, energy, thought and emotion in the learning process based on either internal or external motivation.

Hampton and Pearce (2016) however do not distinguish between social and academic engagement. They use a conceptual engagement model in which they define engagement as *"active participation of students, interaction and collaboration with the teachers, the academic content, the other students and other staff"* (p. 294). They further state that *"student engagement means investing time, effort, energy, thought, and emotion in the learning process"* (p. 294). According to Hampton and Pearce, there are significant correlations between student engagement and their outcomes of the education.

> *Investigators have demonstrated positive correlations between engagement and outcomes such as grades, critical thinking, ability to apply knowledge in the practice setting, self-esteem, satisfaction, and persistence to get tasks accomplished (Hampton and Pearce, 2016, p. 295).*

Furthermore, they argue that student engagement is a key component in ensuring lower dropout rates in online education. They state that the dropout rate in online education is generally 10-20 % lower than in face-to-face education: *Engaged students are more likely to succeed in the program and complete their degree… Engaging students early in the program and keeping them engaged and excited about the program is the key to prevent program dropout.*

Finally, they point out that an educational design that allows students to link the elements learned to authentic issues in their field of study can be a way of creating greater engagement. Schools may use case studies, discussion forums and other strategies that help students associate course content with their present or future field of practice. At the same time, Hampton and Pearce point to the importance of creating a positive learning environment, including *"... early and frequent course contact with other students, course orientation, course instructor and student introduction forums…"* (Hampton and Pearce, 2016, p. 297). This is in line with the thinking of Illeris, as he emphasizes the importance of the educational design, including the organization of the academic content and the possibilities in the educational design for students to interact with other students, teachers and other staff.

In this study, we are interested in the importance of the educational design on student engagement. Xu and Jaggars mention the following design parameters that may affect students' learning outcomes (Xu and Jaggars, 2013):

- Organization and presentation
- Learning objects and assessment
- Interpersonal interaction
- Use of technology.

In their study, they find that only interpersonal interaction has a significant effect on student learning outcomes. Xu and Jaggars do not focus on engagement but look only at student outcome of the study.

Considering the above, this study will focus on the interpersonal interaction and the possibilities for this in the educational design. It means that we study students' experience of opportunities to interact with other students and with the teachers in online education. We will also look at the students' interaction with the academic content.

This leads to the following research question: How does educational design affect students' social and academic engagement in, and connection to, their study? Our aim is to discuss education designs and their potential role affecting students' social and academic engagement. Our data collection method is designed to investigate students' points of view.

2. Method

Using a hermeneutical approach, we have conducted semi-structured interviews with groups of students from six different online study programmes in VIA University College.

2.1 Empirical background

Finding study groups was done by means of email-contact to a coordinator representing each of the six study programmes, and these coordinators then established contact between study groups and researchers (se table 1).

Table 1: Overview of study groups represented in the study

Study programme (titles collected here from education curricula)	Bachelor of Education	Bachelor in Social Education	Bachelor of Social Work	Bachelor's Degree Programme of Nursing	Bachelor of Public Administration
Number of students /number of groups	4/1	3/1	3/1	10/2	3/1

Study groups were asked to record online collaboration on video and share the video with researchers.

In videos from study groups, short clips of students showing social or academic engagement were identified. Following this, two researchers from the project group conducted semi-structured focus group interviews, following an interview guide, as shown in table 2. The video clips were presented prior to or during focus group interviews, in order to support students remembering their setting and their experiences in working together on the current assignment.

Table 2: Interview guide used in focus group interviews

Research question - subtopics	Interview question
Which elements support students' social engagement?	How was your study groups formed?
	Do you get to know each other through working on the current assignment?
	What is needed to ensure your social connections in the study programme?
	How can assignments support your social engagement?
Which elements support students' academical engagement?	How has the current assignment supported your academic engagement?
	Have you used the amount of time set for the current assignment?
	Which kind of assignments have supported your academic engagement – and why?
What may be described as important regarding feedback and guidance?	Did you receive guidance and/or feedback in relation to the current assignment?
	What kind of guidance and feedback did you receive?
	To what extend have you used the guidance and feedback offered?
	What kind of guidance and feedback gives you the best outcome?
Which elements affects students' wish to stay on in the study programme?	What affects your being happy about your choice of study programme?
	Do you feel it difficult to socialize because you are an online student?
	Which elements from study activities strengthen social relations?
	Which elements from study activities strengthen academic engagement?

2.2 Data collection

In the interviews, we asked students which factors were important to them regarding 1) their social engagement in the study programme, 2) their engagement in the study content (academic engagement), 3) their experience and use of guidance and feedback from faculty, and 4) retention in the study programme. Interviews were recorded and subsequently analysed, using the video-platform IRIS Connect (https://www.irisconnect.com/uk/).

Interviews resulted in six recordings, two from two different study groups in the Bachelor's Degree Programme of Nursing, and one from study groups representing the other study programmes in the project.

2.3 Data analysis

Data analysis was carried out following six phases of thematic analysis (Braun and Clarke, 2006). Students' statements were analyzed, and subtopics were identified through describing initial codes. Codes were subsequently sorted into sub-themes and related to one of the themes in focus for this inquiry. An interpretation of the students' opinions was then conducted based on the expressions in the interviews (Kvale and Brinkmann, 2009).

Analysis was initiated by the project group, looking through all recordings, and the group assembled in order to identify themes in the interviews together. The identified themes from interviews are listed in table 3.

Table 3: Identified themes in focus group interviews with students.

Social engagement
Academic engagement
Guidance and feedback
Factors affecting risk of dropping out
Quality in online education

Subsequently the research group split out in twos and twos, in which two researchers went through the category in question and identified phrases where students expressed something relevant for the themes listed in table 3.

Students' expressions were sorted by theme, and the expressions related to one theme were compressed in a single text including the meaning of what was regarded as relevant and central expressions from the students.

3. Findings

3.1 Social engagement

Several of the students interviewed indicated that the study group is where their primary social engagement as students is. Here there is mutual respect, responsibility and dependence.

It can be an advantage to the social engagement that study group members are similar with respect to e.g. age and family relations. It can also be an advantage when they contribute with different strengths and perspectives and have different approaches to studying.

Working together on study content results in social engagement, e.g. when there are discussions on professional practice, and when there are group activities other than online meetings, e.g. excursions. It is important for social engagement that there is also laughter and small talk in the study group. When a study group functions well, students are less willing to take in new members.

If one or more study group members do not contribute, this will cause problem for social engagement.

According to several of the students interviewed, it is possible to develop close social relations in the study group even though most of the contact takes place in online meetings (on Skype). One study group mentioned that the distance experienced in online meetings may actually be an advantage, making it easier to talk about difficulties in group dynamics in meetings without video.

Generally, the interviewed students are primarily engaged socially with students in their own study group, although they do meet end engage socially with other online students in their class when they are taught face to face on campus. They also help each other in class using online tools.

Some of the interviewed students did not find that being online students made it difficult to engage in social relations, whereas others mention that they do not know other students in the class very well, and that it is difficult to develop social relations when they only meet each other a few times during a semester. One student talked about being 'lonely', another about being 'isolated' – they missed closer social relations. Some older students, with family and children, said that the limited expectations regarding social relations among online students was actually an advantage, since they did not have the need nor the time for such relations.

Several of the students told us that they do not know their teachers very well – both because of limited contact and because of frequent replacements.

The flexibility inherent in being an online student is important for many of the interviewed students, especially for the older students with family obligations. For some of them, flexibility is what enables them to study: Without it, it would not be possible for them to study. Some of these older students said that they typically do not join other students for a weekend beer or two, but sometimes go out for dinner together.

3.2 Academic engagement

A number of intrinsic factors were mentioned by students as important regarding their academic engagement. This engagement was fueled by interest in the assignments, by having a say themselves, and by intellectual challenges, resulting in the identity that they were developing as professionals. Some of the interviewed students also mentioned personal ambitions, demands on themselves, and a sense of meaning as factors strengthening their academic engagement. They prefer to be proud of the work they do.

The interviewed students also mentioned a number of extrinsic factors of importance in relation to their academic engagement: the prospect of a better job in the future, higher salary and improved career opportunities.

Assignments of importance with regard to grades or exams translated into higher academic engagement for most informants, and so did assignments allowing the student to apply academic content to their field of professional practice, which they consider relevant. Variation in assignment types, e.g., not only writing papers, also contributed to academic engagement. According to some of the informants, the study group was of great importance with regard to one's own engagement, since academic engagement was built up when all group members contributed as agreed and expected. There was, according to some of the interviewed students, a feeling of responsibility among study group members, and this resulted in higher engagement. Differences between group members regarding their level of ambition could cause frustrations and a reduction in academic engagement. Some informants believed that age and life experience are factors that can increase engagement, older students being more determined. For some older students with a family, being an online student was, in a very basic way, essential to their engagement: This was the only way they were able to study and, at the same time, take care of family obligations.

The teachers' engagement and presentation of study content, online and face to face on campus, had a positive role on academic engagement, according to some of the students interviewed. It was also engaging when teachers displayed understanding for the circumstances and challenges of being an online student, including the need for both structure and flexibility that online students have. Some students said that teachers were generally not sufficiently available to them for guidance and feedback – and that this could have negative consequences for their engagement.

3.3 Guidance and feedback

Generally, the interviewed students found that they lacked insight into their own levels of knowledge and understanding. This was, according to some students, closely connected to the fact that they were online students, being alone a lot of the time.

Informants said that they received both oral and written feedback, but there was a general call for more feedback from teachers, and more timely feedback. Several students said that the feedback they received did not live up to their expectations. One group said that feedback on student papers was very inadequate. Several students expressed a preference for individual feedback – as opposed to group or class feedback, which they sometimes received. Furthermore, written feedback on papers was of value to the students, and some students stressed the value of oral feedback because it included dialogue with a teacher. Several students mentioned that feedback should also include comments and suggestions as to how they could develop and improve their professional level (formative evaluation). Some students stressed that there was a need for guidance early in the process of writing.

Some teachers did not have the necessary competences to deliver guidance and give feedback online, according to some informants. This gave the students the impression that as online students, they were prioritized poorly. Adding to this, guidance was, according to some informants, planned for students in ordinary programs, creating logistical problems for the online students. Some students experienced large variation from teacher to teacher in the time allocated to guidance. Generally, students made use of the possibility of obtaining guidance, especially in relation to exams.

3.4 Retention

According to several of the students interviewed, teachers that were engaged and enthusiastic about their work and what they taught had a positive influence on student retention. Even so, some found that their relations with teachers were not the same as for students' in ordinary programs.

The interviewed students also found that being in a study group with a positive attitude towards cooperation and in which group members supported each other, both socially and with regard to study content, influenced retention positively. When study group members shared a similar life world, understanding each other's life situation and challenges, this also positively influenced retention, according to some of the interviewed students.

Some students had experienced that a teacher did not show up for class or that no classroom was booked for face-to-face teaching on campus. Such events made students feel that they were given low priority – which influenced retention negatively.

One study group said that being enrolled in an online study program in a small institution had a positive influence on retention, as it helped developing good relations to other students and teachers.

Students also mentioned that a clear structure was of importance regarding retention, since it was the basis for the flexibility that students, especially students with a family, valued and needed.

3.5 Structure, flexibility and quality

Generally, students expressed a large degree of satisfaction with the flexibility, and thus freedom, in their online study program. This freedom was motivating and entailed a sense of responsibility. One student found that there was a perfect balance between structure and flexibility. Other students pointed out that sometimes there was a lack of sufficient structure, making it difficult for them to plan their work. These students needed structure in order to be able to take advantage of the flexibility.

Some informants mentioned that the study program should match students' needs, an example being livestreaming of teaching, which some students requested.

Flexibility is challenged when online students are treated like ordinary students.

Some study programs have developed guides for students on how to organise their studies, a fact which some students thought of as positive.

Regarding their perceived quality of the study programs, this was increased, according to some informants, when each assignment could clearly be seen as part of the overall study program. Working with such assignments taught students to take responsibility. Overall, several students expressed satisfaction with the assignments despite unrealistic deadlines at times.

Factors perceived as threatening to quality included students being used as 'guinea pigs' and when the institution ignored students' suggestions. Also, some informants said that in their opinion, the quality was not as good as they expected due to their not receiving necessary information in proper time and insufficient feedback.

Some of the interviewed students were surprised about the lack of control regarding student activity, e.g. that students could figure as authors of papers without actually having contributed to the paper.

One informant believed there was too much work in her online study program, and some students were surprised by the amount of work in their study program, and found that the ambitions on behalf of the study program were too high. One study group said that they had not received the amount of guidance that they had been promised, which reduced the perceived quality.

Generally, teachers who were competent, enthusiastic and engaged and who took the special circumstances of being an online student seriously were perceived as very important for the quality of the study program by the informants. Not all teachers lived up to these characteristics, according to some. Furthermore, some students said that some teachers were unaware of the content and form of exams, a fact which these students found was a problem.

Several informants called for more feedback from teachers and expressed a need for teachers to participate more when establishing study groups. One group wished that teachers had more time for them.

Some informants found that social and work relations supplemented each other well, and that study group members sometimes paced each other positively.

4. Discussion

Our findings show that students' perceived experiences of quality in online education depend on many and various factors. Below, some of the central findings of the project will be discussed, and questions will follow that may hopefully give rise to new, inspiring and continued discussions on how to create increased quality in online education.

4.1 Social engagement

Social engagement is found especially in the study groups, in which students' pace and hold on to each other, and in interaction with teachers, while social factors in classes are of minor importance in this respect. Several online students express the view that because of the social elements otherwise embedded in their everyday lives, they have no great need to socialize with a number of students in their study programs. Social and academic engagement is related. It appears that academic engagement is often a prerequisite for social engagement. If groups do not work together well, social engagement does not materialize to any great extent. Xu and Jaggers (2013) emphasize in their study that 'interpersonal interaction' is the only significant factor for students' learning outcomes. In the current study, informants clearly express the importance of interpersonal interaction on their social and academic engagement. Interpersonal interaction with other students in the study group and with teachers seems to strengthen student engagement. Nonetheless, in this study, we have focused on both social and academic engagement throughout the learning process, more so than on student outcome only, since our observations pointed to both of these categories. In this connection, it appears reasonable to assume that increased student engagement will result in increased learning outcome.

Structuring online learning around activities taking place in the study groups in greater measure might be considered here. Social engagement appears to result. Conversely, a specific refusal within groups to enter into social engagement has dire consequences for academic engagement as well. This is very much in line with Hampton and Pearce's (2016) use of their conceptual engagement model, in which they do not distinguish between social and academic engagement, and emphasise the significance of interpersonal interaction on student outcome in online study programs. Illeris (2009) also points out that students' incentive in their individual acquisition process depends very much on content organization and learning environment interaction.

4.2 Academic engagement

4.2.1 Intrinsic motivation

Several students express the view that the possibility of working with what is of interest to them is important to their motivation. Academic engagement is underpinned by the fact that students find it meaningful and purposeful to work with a specific activity, and choose fields of enquiry themselves, as well as cooperation partners in the practice areas in question.

Also, it may be considered whether assignments linking the academic content of the study to students' future professional practice may be utilized further in online education, in which placements and teaching periods alternate, in view of the fact too that many online students have a lot of practice experience.

Students' own ambitions also form a strong incentive – they want to create good study products, and might accordingly be given the time needed.

4.2.2 Extrinsic motivation

Grades and feedback from teachers motivate most online students, but factors beyond the education as such also contribute to students' academic engagement, as do the possibilities of better pay and a more interesting job, as a consequence of having completed one's education.

It may be considered whether increased use of grades during the learning process could be used for didactic designs in online education – or whether this will have an adverse effect on students' intrinsic education?

4.3 Academic guidance and feedback

Students lack insight into their professional levels – from day one in their education. They would like more individual feedback, and not only in the form of grades, but also in the shape of comments which may develop their professional skills and knowledge in the years ahead. There seem to be good reasons for accommodating students' perceived needs in this respect.

4.4 Retention

Relations to fellow students and to teachers are of great importance to student retention. Especially teachers' engagement in their subjects is deemed very important indeed. Informants also draw attention to the importance of all students in an online group having a positive attitude to cooperating, and that they are to have reasonably homogenous 'life worlds,' so that they may understand each other's challenges and the life-work balance involved, for example in family lives.

Study groups could be assembled on the basis of 'life worlds.' For instance, surveys might be sent out to students prior to term beginnings, in order to facilitate the formation of study groups, or a digital tool like 'Padlet' could be used to give an overview of preferences and competences present in the class.

It is important for the education in question to recognize the special conditions applying to online students. Clear expectations adjustments are experienced as important to students, in relation to the possibility of work on the side in addition to studies, clear messages as to when teaching takes place, deadlines for papers to be handed in, etc.

It may be considered whether long teaching periods, e.g. entire semesters, might be planned in one go, so that students will be better able to plan ahead. Also, expected workloads for individual tasks might be announced beforehand.

4.5 Structure, flexibility and quality

Several students emphasize the fact that a prerequisite for using the flexibility present in online education is a clear structure offered by the institution, which includes announcing framework conditions and timetables well ahead of deadlines. It may also be beneficial to offer 'guides' that describe how online education may be structured on the part of students and on long stretches of studies as well.

In conclusion, the study groups dealt with here may well be biased in the sense that a well-functioning group is more likely to volunteer for a research program like this one, unlike groups that do not work together quite as well. Even so, we have been given glimpses into the worlds of online students, and hope that the experiences reaped will benefit them in the long run, both elite and much more vulnerable groups. We hope to be of help to them all.

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Formal, Informal and Non-Formal Language Learning Contexts for the University Students

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Abstract: The paper applies the perspective of blended approaches in order to present some specific aspects of foreign language learning in formal, informal and non-formal learning contexts in the university setting. Due to the aforementioned key concepts, the main theoretical standpoint is provided by means of andragogy, i.e. the theory of adult education, which addresses this particular theme in its complexity within the conceptual framework of lifelong learning. In line with the author´s previous attempts to analyse the topics applied to the field of foreign language education primarily from the area of corporate learning and development, the paper also draws on the concept of "microlearning" which represents one of the current global learning trends. The empirical evidence is provided via the data collected within the group of students of Master degree programmes, studying the English language courses at the particular technical faculty in the Czech educational context. The comparative analysis intends to illustrate a potential "dividing line" between the pre-service vs. in-service use of the acquired language skills with regard to entering the labour market and thus, the researched group comprises both the full-time and part-time university students. The empirical investigation is centred on the students´ subjective perceptions of the three options of completing their seminar papers within their English language courses. The choice of each of these options deliberately represents the particular primary learning context the students are expected to use as a source for fulfilling the required criteria of the selected seminar paper, i.e. the area of formal learning is represented by a professionally-related English presentation of the previously completed Bachelor thesis, the potential of informal learning is exploited by means of the students´ participation in the professionally-oriented use of English language within the social network Instagram, and the non-formal learning contexts are addressed via a guided procedure of creating a LinkedIn profile in English language

Keywords: English language learning, blended learning, microlearning, informal learning, non-formal learning

1. Introduction

Numerous analyses of the massive use of modern technologies in the area of education which have been carried out in previous years provide large amounts of highly relevant data and simultaneously, they offer a wide range of theoretical perspectives that might be found useful for predicting the further development of e-learning field. After more than two decades of gathering the experience with the use of online environments for educational purposes, the variety of existing viewpoints comprises even some recurring trends which seem to be capable of indicating potential further directions of exploiting the power of the particular e-learning tools, systems and strategies in the specific contexts.

One of the ways of analysing the issues of e-learning in their complexity might be observed in prioritising general educational frameworks rather than the individual "fads". This particular perspective is clearly manifested for example in drawing analogies between the e-learning field and other areas of social science, such as the so called Gartner hype cycle (Rouse 2013, no pagination) which describes the use of technologies in terms of a product life cycle, i.e. technology trigger, peak of inflated expectations, trough of disillusionment, slope of enlightenment, plateau of productivity. In order to reach the above mentioned "plateau of productivity", the need for considering broader educational concepts in the area of e-learning arises in various forms, such as for example by means of the re-discovered focus on the specifics of formal, informal and non-formal learning contexts (as defined by CEDEFOP 2014, no pagination), with their theoretical basis in the andragogic theory and research. Also, the meaningful integration of e-learning activities into broader teaching and learning schemes seems to attract a higher degree of attention, resulting for example in emphasising the desirable complementarity of the individual components of blended approaches, such as in the field of corporate learning programmes where "there are many examples of how face-to-face training programs help build soft skills, and plenty of opportunities to use mobile, games, video and other trends to build on these programs" (Boller 2017, p.12). Besides, the desired conceptual shift from the issues of form of the content towards the "impacts and values", such as in case of the phenomenon of "microlearning" (Jimenez 2017 in Brebera 2018, p.179), heads for addressing the core qualities of learning in the current era. Therefore, our further analyses are focused on the potential of the specific type of impact, which consists in extending the formal foreign language curricula towards informal and non-formal learning contexts by means of applying the blended approach in the university setting.

2. Variability of language learning contexts in higher education

In the area of higher education, the main focus of the debates on e-learning is usually represented by the possibilities of its effective implementation into formal university curricula. However, if we apply the perspective of the generally accepted lifelong learning concept, the insights of the current andragogic theory seem to be capable of broadening the horizons of our contemporary views of e-learning. Due to the usual overlaps of one´s studies in the area of higher education with the processes of acquiring the first types of real professional work experience, the "dividing line" between the pre-service users and in-service users of the acquired skills appears to be rather unclear. For example, Eraut (2004) draws an interesting parallel between the areas of formal education and workplace learning, as he points out that "the workplace context brings new perspectives to research on learning because it encompasses a wide range of more or less structured environments, which are only rarely structured with learning in mind", and at the same time he notices that "formal education can be also viewed as a workplace and uses a discourse in which the term 'work' is normally quite prominent" (ibid). Therefore, even in the foreign language skills area, the basic classification of intentional vs. incidental learning as defined by Beneš (2014, p. 56) proves to be highly inspirational since the "incidental learning may lead to the intentional learning" and at the same time the "intentional learning always contains also unplanned learning", and both of them exist inherently in a highly complex and very wide area of building the foreign language competence.

Thus, the foreign language development programmes may to a high extent draw on a meaningful combination of intentional and incidental learning opportunities, which can be observed not only within but also beyond the formal learning curricula. This assumption concerns the situations when the learners unintentionally meet some personally relevant learning content, representing the area of informal learning "resulting from daily activities related to work, family or leisure" (CEDEFOP 2014, no pagination), as well as the learner´s intentional activities "not explicitly designated as learning (in terms of learning objectives, learning time or learning support), but which contain an important learning element", exploiting the potential of non-formal learning contexts. In the area of adult education in the Czech context, the perspective of non-formal language learning contexts is usually reflected in the studies on needs analysis, such as in the empirical investigation carried out by Průcha (2014, p. 41-42) who summarises his findings in the corporate environment in the categories of the perceived importance of foreign languages, professional use of foreign languages, range of communicative needs, real state of the foreign language competence, perceived usefulness of language courses. Illustrative situations of the variety of language learning options in informal and non-formal contexts appear in Canadian study carried out by Eaton (2010, p. 16-17) who includes various age groups in her analyses, and uses the examples of "youth learning languages while on backpacking holiday" and "adults learning through experiential learning while on holiday" for describing informal contexts, and the examples of "university student taking a summer immersion course in another language" and "adults taking an evening course to learn another language" for defining non-formal learning, which unlike formal learning, typically does "not lead to certification" (according to CEDEFOP 2014, no pagination). From the curricular perspective, the implied variety of potential learning opportunities therefore confirms a more general assumption that formal and informal learning are "essentially different, but capable of greater combination – even if that combination is partly problematic" (Hodkinson, Colley and Malcolm 2003, p. 313).

The effectiveness of the use of learning sources which exist in formal, informal and non-formal contexts also depends on student´s approach to learning. For university students, an influential classification provided by Entwistle (2009, p. 36) might be considered especially useful as the "deep approach" with the intention to "understand ideas for yourself" does not limit itself only to the formal learning contexts (similarly e.g. Boekaerts, Minnaert 1999, in their analysis of the complementarity of informal and formal learning contexts with regard to the range of the students´ self-regulatory skills and strategies) while the "surface approach" characterised by the aim "to cope with course requirements" does not manifest any overlaps with informal and non-formal learning contexts.

The fields of e-learning and blended learning demonstrate a huge potential in the area of integrating various types of language learning contexts as well as in offering opportunities for applying deep learning approaches. Due to the omnipresent penetration of mobile technologies into learning environments, also the issues of motivation logically play an important role in learning processes (e.g. Jones et al. 2006 listed "six factors why mobile devices may be motivating, namely: freedom, ownership, communication, fun, context and continuity"). However, for example Hockly (2016, p. 35) points out that even "adolescent learners are not automatically effective users of technology" and comments on the need for 21st century skills in terms of digital literacies. The complex nature of language learning in the digital age is also analysed by Walker and White (2013, p. 17) who make an observation that "digital contexts create new communicative purposes" but at the same time, they conclude that "new linguistic cultures have developed in terms of both language use and cultural behaviours" (ibid). In order to facilitate the processes of coping with the demands of appropriate language use as well as the effective use of technology, they take the generally accepted concept of communicative competence suggested by Canale and Swain (1980) as the basis for their own proposal of "digital competence", comprising the elements of procedural competence, socio-digital competence, digital discourse competence and strategic competence (ibid, p. 7). Based on that, it might be concluded that the huge demands on new language learning curricula or projects should be carefully considered not only at the stage of their design but also during their detailed evaluation.

With regard to the issues discussed above, two important perspectives need to be listed for the sake of creating a desirable conceptual framework for carrying out further potential innovative efforts in the educational area. Firstly, an urgent call, expressed more than a decade ago by Bull et al. (2008, p. 106) in response to the boom of the so called participatory media, stating that the students´ experience with communicative technologies "must be tapped by educators and connected to pedagogy and content, however, in order to address learning objectives in schools", seems to be still valid. Secondly, the current trend of "active learning" offers a highly inspiring complementary viewpoint by claiming that "in order for student learning to become more personalized and targeted, students will need to build skills of self-awareness and learner capacity; come to see themselves as the designers of their learning contexts and learning environments; build their understanding of the concept that meaning is negotiated and constructed; and participate actively to build the capacity of the learning communities who will support them in meeting their learning goals" (Robertson 2018, p.29)". The nature of learning objectives thus appears to be constantly the central point of educational discourse in the field of e-learning and blended learning.

In order to contribute to the current debates in the field of learning and development, the following part provides an evaluation of a small-scale educational project aimed at the intentional integration of various types of learning contexts within the English language courses taught at the university level.

3. Empirical evidence

3.1 Research context and methodology

The aim of the empirical investigation was to identify the specifics of the students´ perceptions of the learning contexts which were defined as the key sources for the completion of the pre-defined tasks. The task of preparing and giving a professionally-related presentation in front of the audience represented the "formal learning contexts", the completion of a microblogging task via the social network Instagram was used as an example of the "informal learning contexts" (for a more detailed analysis, see Brebera 2017, Brebera 2018) and a peer-reviewed process of creating the material potentially displayable on the LinkedIn platform was used in order to exploit the potential of the "non-formal learning contexts". The research was carried out by means of the mixed design, i.e. it combined the quantitative data collected via a structured questionnaire with the qualitative data elicited in the form of students´ free response in an open-ended feedback questionnaire, during four semesters of the academic years 2016-17 and 2017-18. Altogether, 152 students of both full-time and part-time study Master degree programmes taught at the particular technical faculty of the University of Pardubice, in the Czech Republic, participated in the research. Since the choice of each particular task was optional, different numbers of students decided to select the particular options according to their preferences, as summarised in Table 1.

As for the instructions for the individual tasks, the students were expected:

- to prepare a professionally-related presentation of the recently completed Bachelor paper which would take 7-10 minutes and cover all relevant aspects of the topic, i.e. theory and research, and respond to the questions of the audience during the presentation seminar;
- to generate min. 100 lines of text within approximately 3 - 7 Instagram posts representing the broad topics "Me and Transport", "Me and English" and "Me and My Job", including the responses to the contributions of the others;

- to prepare a text representing their professional self-presentation structured according to the categories used within the LinkedIn platform, i.e. Professional summary of min. 100 words of text accompanied by a structured CV, and then provide a review of the material written by one of the colleagues according to given criteria (content, organisation, language adequacy)

Table 1: Categorisation of research participants

	The study programme		Total
The selected option	Full-time students	Part-time students	
Presentation	12	22	**34**
Instagram project	24	21	**45**
LinkedIn project	19	54	**73**
Total	**55**	**97**	**152**

3.2 Research results

3.2.1 Quantitative analysis

The results of quantitative analysis primarily confirmed the effectiveness of the differentiated instruction sine each of the optional tasks proved to be generally well-accepted in terms of its usefulness. The fact that the students were given the possibility of choosing one of three options according to their preferences seems to influence their attitude towards language learning in a very positive way, as documented by a high degree of perceived meaningfulness of the selected option (see Fig. 1).

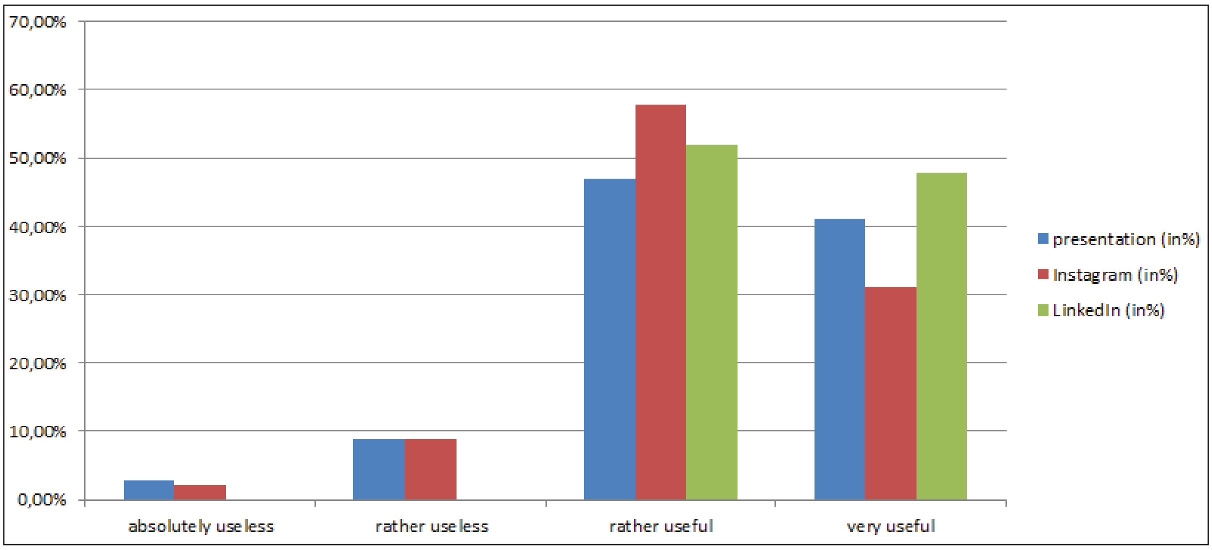

Figure 1: The perceived usefulness of individual tasks

According to Fig. 1, the highest degree of task acceptance can be observed in case of the LinkedIn option, representing the non-formal learning contexts, which might be interpreted in terms of the highly personalised efforts to meet the externally defined formal requirements of the labour market. The other two tasks demonstrated similar levels of acceptance, though the presentation as the formal learning option obtained more responses at both extreme ends of the "perceptions continuum" while the data concerning the informally-conceived Instagram task can be interpreted in terms of its moderate general acceptance.

Other interesting findings can be observed in the area of expected degree of voluntarism of formal, informal and non-formal tasks within the language learning curriculum. The data in Fig. 2 confirm that the incidental nature of informal learning activities is reflected also in the perceptions of the Instagram project participants who opt for the non-compulsory nature of the Instagram project and at the same time, they would appreciate a higher degree of freedom in choosing the material for their posts. On the other hand, the representatives of formal and non-formal learning assignments manifest either the tendency towards having the presentation as a compulsory task or towards a higher degree of specifying the expected outcome of the LinkedIn material.

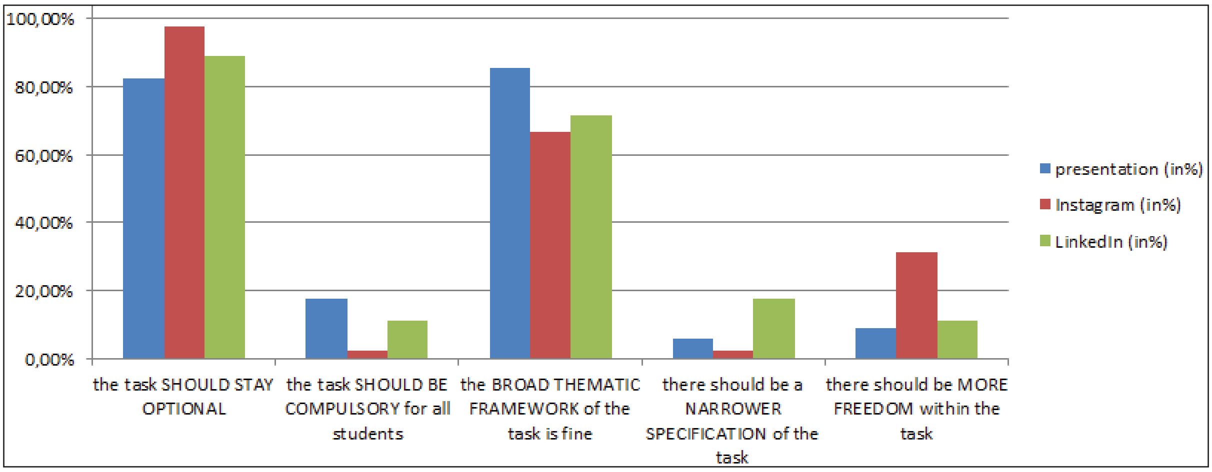

Figure 2: Aspects of voluntarism within formal, informal and non-formal learning contexts

Other interesting outcomes of the quantitative analysis reveal for example some relevant contextual information about the previous experience with the use of social networks Instagram and LinkedIn as potential sources of language learning in informal and non-formal contexts. For example, only 9% of all participants of the Instagram project admitted that they had published some posts in English in the past, and only 8% of LinkedIn project participants had attempted to create the LinkedIn profile in English prior to the project. Besides, in case of the LinkedIn project, 80% of all respondents admitted that they either had not established the LinkedIn profile before or that they had not been using it at all.

With regard to the above mentioned implications arising from the quantitative analysis, the search for deeper insights into the reasons why the students decided to choose the particular learning opportunity and how they perceived its specifics was carried out by means of the qualitative analysis.

3.2.2 Qualitative analysis

The main focus of our previous studies on the aspects of social learning within the foreign language courses has already resulted in identifying some basic categories of the perceived strength and weaknesses of informal learning via the Instagram project. The motivation to join the project was mainly expressed in terms of "curiosity", "previous experience with the use of Instagram", "appreciation of informal learning contexts" or "an opportunity to use the language authentically for real life purposes" while the main drawbacks were observed in the area of "aspects of organisation of an online project" (e.g. non-participation of the students in the initial stages of the project) which resulted in the students´ calls for a higher level of formalising the primarily informally-designed learning project (for more, see Brebera 2018, p. 181-182).

Similarly to the participants of the informal learning project, also some representatives of formal learning project, i.e. the presentation, expressed their motivation in terms their previous experience, but they mainly focused on the aspects of "professional relevance" (*"It is a good training of skills for my job."),* "personal relevance" *("I think I have an interesting topic of the Bachelor paper, which would be good for presenting.")* or perceived "practicality" (*"I had my presentation in Czech so I just prepared its English version."; "It seemed to be the easiest and quickest option.").* Other types of comments demonstrated the "reluctance to use social networks" (*"I am not a fan of social networks."*) and the "preference of spoken production to writing" *("I preferred the oral form as there are too many written tasks in other subjects.").* The main drawbacks were perceived in the area of either "productive or receptive use of specialised vocabulary" ("*I was not sure about the English equivalents of some specialised vocabulary;" "My topic was quite sophisticated and nobody knew what I was talking about."*).

A high level of acceptance of the LinkedIn task demonstrated by its participants in a quantitative survey was confirmed also in the qualitative analysis. The focus on acquiring the skills which might be potentially validated in real-life contexts seemed to be the main motivator for the participants of the LinkedIn project. The students often mentioned an "opportunity to receive feedback on their real professional CV" (*"Based on the feedback, I can have my CV checked and completed"*) or a "real career advancement opportunity" (*"It can be useful for finding new job opportunities. Thanks to it, I can get in touch with a lot of people").* Similarly to the Instagram project, some students commented on the aspects of "novelty and curiosity" of the professionally-oriented social network LinkedIn (*"I used this opportunity to finally establish the LinkedIn profile"; "I wanted to know how LinkedIn works."),* and the practical nature of preparing the material for the LinkedIn profile was sometimes expressed in terms of "contrast of the practical LinkedIn with irrelevant options from the area of formal and non-formal learning contexts" (*"I had enough presentations in my previous studies and I do not see any point in creating the Instagram posts, so LinkedIn was the only reasonable option.")*.

4. Conclusion

The analysis shows that the stimuli for English language learning existing within the university curricula can be interpreted in terms of the huge variety of sources the students can draw on, both in formal but also informal and non-formal learning contexts. The variability of preferences for the particular sources and contexts demonstrates a wide range of learning needs as well as a legitimate existence of minimalistic "task completion scenarios" applied by the students with the so called "surface learning approach".

Providing the opportunities for English language development of future university-educated professionals obviously manifests a large number of challenges. Nevertheless, the richness of the sources in all kinds of learning contexts proves to be a desirable "meeting point" of synergic efforts of both university teachers and students in pursuing not only the pre-defined educational goals but also in heading towards the unlimited horizon of learning needs. For this particular purpose, blended learning appears to be a very powerful "driving force".

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Attaining 21st Century Skills Online: A Programmatic Approach

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Abstract: This case study reports on the practical use of technology to support a programmatic approach to achieving learning outcomes. This is achieved through the provision of appropriate opportunities for online distance learning (ODL) students to achieve the range of 21st century skills needed to manage the complexity of future problems and continue to be critical consumers and producers of knowledge throughout their lives. A programme-focused assessment strategy is utilised on an ODL Humanities programme with a distributed, modular provision model, in order to satisfy related learning outcomes. This strategy allows for the deployment of a range of assessment types, many of which are only possible through the current affordances of online learning, for example, wiki-building in groups and debates using discussion forums. Both the students and the majority of the academic staff are off-campus, with technology providing the means for interaction and communication relating to assessment of learning outcome achievement. Technology is also the medium through which the off-campus subject experts who develop assessments receive appropriate, professional development such that they understand the pedagogical approaches and technological solutions available for assessment and feedback design and development. This paper will present the model through which this professional development takes place, and the way in which a team-based approach is used to ensure the appropriate design and development of assessments and related feedback mechanisms.

Keywords: 21st century skills, higher education, assessment strategy, learning outcomes, professional development

1. Introduction

This case study reports on the learning journey that the Humanities Programme Team (DCU Connected), in Dublin City University, have undertaken in the practical use of technology to provide appropriate opportunities for ODL students to achieve a range of 21st century skills. These are the skills students need in order to manage the complexity of future problems and continue to be critical consumers and producers of knowledge throughout their lives. DCU Connected has responsibility for ODL programmes in the National Institute of Digital Learning (NIDL), Dublin City University, and more specifically this case study relates to an undergraduate Humanities Programme which includes three DCU Connected qualifications: the Bachelor of Arts (Hons) in Humanities; the Bachelor of Arts (Hons) in English and History; and the Bachelor of Arts (Hons) in Humanities (Psychology Major).

2. Teaching and learning model

The teaching and learning model in use on the Humanities Programmes is underpinned by well-defined staff role delineation similar to other ODL models (Sangra, 2002). Team members can be both geographically distributed and functionally disaggregated in terms of their roles. A core, full-time team works with a larger part-time staff network from a variety of industry and academic backgrounds. With the full-time team members executing a wide range of roles and functions, centred on the coordination and management of the teaching and learning process, the part-time team members have very distinct and specific roles and responsibilities. The part-time team members consist of subject experts who execute a diverse range of quality assurance, learning, and teaching functions. Through their work they provide: academic leadership, design and develop academic learning resources, design and develop assessments; teach and support students through asynchronous and synchronous means, mark student assessments and provide detailed, timely feedback; and also review the quality of that marking and feedback.

3. Learning outcomes and a programme-focused assessment strategy

Appropriate design and development of assessments is important to a positive student experience, and poorly designed assessments can have a negative impact, which can diffuse into students' wider lives (Race, Brown and Smith, 2005). An assessment should have a structured design, be clearly written, unambiguous, and comprehensive (Nicol and Macfarlane-Dick, 2006). Rossiter (2013) highlights the importance of assessment design that: ensures an assignment has broad-based coverage of learning outcomes and/or related accreditation requirements, graduate attributes, etc.; challenges students to excel though high but appropriate expectations, with penalties for unprofessional practices; and facilitates transition by mandating regular engagement, with related support and feedback. Instructions for assignments need to provide students with guidance on the assignment task, how to complete the task(s), and the evaluation criteria for that assessment (Speck, 1998). This level of detail can be especially useful to those students who are new to, or have no recent experience of, higher education and off-campus students who need to study without access the cues and tacit information of the physical lecture-hall. Well-constructed and appropriate criteria for assessment evaluation allow students to inform their studies and also facilitate the organised provision of tutor feedback (Carless, 2006). Where students have been provided with the evaluation criteria along with the assessment instructions this can enhance the relevance of feedback received, which is useful as students often seek "better feedback, more frequently, and more quickly" (Nicol and Macfarlane-Dick, 2006; Whitelock, 2008, p.2), and feedback received has a powerful impact on student learning (Evans, 2013; Hattie and Timperely, 2007). However, feedback practices vary widely in Irish higher education (O'Regan et al., 2015), perhaps due to, as Nicol (2009) found in Scotland, there being little or no support for those marking student assessments.

In 2012 an initiative that was to be the first step in the design of a programme-focused assessment strategy began. This was to constructively align programme learning outcomes with assessments across the programmes, in addition to the pre-existing alignment between module learning outcomes and assessments. Programme-focused assessment is defined here as an assessment design that explicitly provides students with opportunities to achieve all module and programme learning outcomes as they progress through their programme (Brunton et al., 2016; PASS, 2012). Programme learning outcomes were examined in order to identify assessment types that could be utilsed to provide appropriate opportunities for students to achieve a specific learning outcome. These assessment types were compared to assessments in use, with deficiencies being identified, for instance a need to bring in more reflections, presentations, and group-work in order to provide opportunities to achieve learning outcomes relating to communication, collaboration, reflection, etc. This initiative is in line with Boud and Falchikov's (2006) comment that those designing and managing academic programmes need to look at the assessment practices they utilise and ask whether they are "able to adequately address a wider set of needs. Can they and do they equip students for a lifetime of learning?" (p.401). This initiative, and the programme-focused assessment strategy that followed, was underpinned by the idea that, as Goodyear (2015) describes,

> *"careful forethought, imagination, empathy and planning will often tilt the balance towards success. As many experienced teachers will know, when it comes to planning educational activities, the devil is often in the details: small oversights can have disproportionate effects on how a learning activity unfolds" (p.31).*

This process allowed us to further realise many of the benefits identified in the literature of having programmatic constructive alignment (Biggs; 1996; Biggs; 1999; Biggs and Tany, 2007; Conole, 2013; Sharpe et al., 2010; Moule, 2007; Palloff and Pratt, 2009; Salmon, 2004). Specifically, we sought to promote both self-directed and collaborative learning in order to support stronger learning communities (O'Shea, Stone, Delahunty, 2015).

The implementation of the assessment matrix enhanced the variety of assessment types in use. Table 1 below shows the development of assessment use in Sociology modules, between 2017-2018 compared with 2012-2013. As can be seen the Assessment matrix facilitated a shift away from an over reliance on essays towards a range of different assessment types, while maintaining a strong focus on academic writing. These facilitated students in achieving a wider variety of learning outcomes relating to the development of knowledge, skills, and competencies.

Table 1: Assessment types in sociology modules 2012-2013 and 2017-2018

Module	2012-2013	2017-2018
Sociology Foundation	Essay Online Discussion Essay Essay Examination	Study skills activity Information gathering task Writing task Essay

Module	2012-2013	2017-2018
The Changing Social Environment	Essay Essay Essay Examination	Essay Online debate Essay Examination
Power, Social Order, Crime, Deviance, Work and Employment	Essay Essay Essay Examination	Reflective learning portfolio Literature review Online debate Case study project
Social inequality and Intergroup Relations	Essay Essay Essay Examination	Online debate Social policy task Essay Examination
Language, Culture and Society	Essay Essay Online Discussion Essay Examination	Essay Online discussion Case study and reflective eportfolio Examination
Research Methods and Project	Quantitative Research Methods Exercises Research School Examination Research Project	Draft Literature review Statistics Exercises Research School Report Research School Test Online contributions Weekly reports Journal Poster Presentation Dissertation

4. The assessment matrix

The assessment matrix facilitates the explicit linking of each assessment in a module to associated learning outcomes as well as the university's defined set of graduate attributes, which are a formal part of programme structures. Table 2 gives an example of this, where one of the assessments for a sociology module, 'The Changing Social Environment', is linked to graduate attributes and learning outcomes.

Table 2: Example of an assessment with related DCU graduate attributes and learning outcomes

Module	Sociology 2: The Changing Social Environment
Assessment Type	Online Debate
Assessment Question	Write a series of posts debating the following topic: *"Involvement of the State into the private domestic sphere has brought more harm than good for Irish family." vs. "Involvement of the State into the private domestic sphere has brought more good than harm for Irish family"* Chose and submit 6 posts to the online learning environment, Loop.
Module Learning Outcome	Reflect on the domestic context of social life and the factors that have impacted on its constituent concepts of family, household and home
Programme Learning Outcomes	Utilise physical and/or electronic resources and tools in the preparation and presentation of academic work. Participate constructively in group based activities Employ individual, interpersonal, and team working skills to successfully complete a range of academic and practical tasks

Module	Sociology 2: The Changing Social Environment
Assessment Type	Online Debate
DCU Graduate Attributes	***Effective Communicators*** "DCU motivates students to appreciate the importance of communication in all its dimensions. DCU graduates will be able to draw on appropriate skills to negotiate effectively, to collaborate, and to influence others." (DCU Graduate Attributes, 2018) ***Solution-Oriented*** "DCU emphasises the use of evidence and understanding as guides to action. DCU graduates will be adept at applying knowledge to issues encountered in the workplace and in society." (DCU Graduate Attributes, 2018)

A challenge in developing the assessment matrix was that it was necessary to spread assessment types across the programmes due to the flexible progression routes in this type of modular, continuous programme. While some restrictions are in place, the flexibility of module selection is a defining element of these programmes. Where programmes share a module the assessment types developed must work effectively for both qualifications. The matrix provides an overview of assessments to enable effective curriculum design work. This approach mitigates against over and under reliance on certain assessment methods. It enriches the feedback types for students and ensures a mix of assessment types across the students learning journey through the humanities programmes. Learning, and its design including the design of assessments, is too often decontextualized, where different aspects of a programme can be seen as distinct entities "apart from the bodies of knowledge and practices from which they are generated and on which they focus" (Boud and Falchikov, 2006, p.405). Nichol (2009), when discussing first year assessment, cautions against only making changes in assessments in some modules, which may "reduce the coherence of the first-year experience and send mixed messages about assessment and feedback requirements and expectations" (p.10). The assessment matrix details: assessment type; number of assessments; assessment weightings; marking rubrics; and the feedback format for every module. See table 3 below for an example of the assessment information relating to two modules on the Philosophy subject stream. A team-based approach, bringing together "content, pedagogical and technical expertise" (Burrell et al., 2015, p.1) is taken to the creation and iterative review of the matrix.

Table 3: Assessment matrix for two philosophy modules.

Module	Assignment 1	Assignment 2	Assignment 3	Assignment 4	Exam
PH100	study skills activity Weighting 15%	information gathering task Weighting 20%	writing task Weighting 30%	Essay Weighting 35%	N/A
Phil2	Essay Weighting 10%	Online Discussion and Blog Weighting 20%	Extended Essay Weighting 20%	N/A	Weighting50%

The assessment matrix is a key part of the Humanities Programmes' quality assurance processes. The matrix is reviewed at annual subject review meetings. These discussions are also impacted by student feedback. The assessment matrix is approved by the Humanities Programme Board, and then by the Open Education Unit's Teaching and Learning Committee. In this way the programme-focused assessment strategy is developed systematically by: the Humanities Programme Team who make sure constructive alignment of assessments to learning outcomes; subject teams, especially Subject Leaders, who make sure appropriate assessments are placed across modules; and Assessment Developers who develop the assessments themselves. The Humanities Programme Board and Open Education Unit's Teaching and Learning Committee maintain an overview of the process, which demonstrates, to any internal or external stakeholders (Ascough, 2011), that this this approach to assessment development is rigorous and transparent.

5. Professional development for assessment developers

The model of assessment development in use on the Humanities Programmes follows from a tutor-centered tradition of Open and Distance Learning (ODL) provision, which has evolved with the affordances of online learning (Sangrà, 2002; Simpson, 2013). The process of designing, developing and implementing assessments, as directed by the assessment matrix, is a disaggregated and distributed activity with the part-time academic staff involved being geographically spread throughout the Republic of Ireland. With much current discussion about unbundling of education we present our practice as one example of the opportunities and challenges inherent in a relatively high degree of division of labour in an ODL mode of academic work. The role of the Assessment Developer is central to this mode of academic work. Assessment Developers design and develop assessments within a team-based context as they work collaboratively with the full-time team members and Subject Leader, communicating and working together through email, shared online documents, online meetings, and occasionally face to face meetings. The work is also carried out in line with existing templates, which include: detailed instructions for students; marking guidelines for the markers of the assessment; and rubrics, grading schemes and/or rubrics. An underpinning principle of this provision of pedagogical and practical guides to the Assessment Developers is an aim to ensure a consistent experience for students as they progress. Many Assessment Developers have been in that role for many years, with accumulated expertise relating to development of assessments for ODL students. Assessment Developers are often also Tutors, and so have additional experience of ODL teaching and learning.

Within the parameters of the requirements given to them as directed by the assessment matrix, the Assessment Developers are free to design and develop assessments. Developed assessments are reviewed to ensure consistency within and across assessment documents, and to ensure that due dates are spaced out appropriately, in order to manage student workload and support effective provision of feedback. Assessments are internally moderated by the Subject Leader. If there are any issues to be addressed the Subject Leader and team work collaboratively with the Assessment Developer to further develop the assessment(s), such that they are ready for release to students on the first day of the academic year.

In the iterative development of the assessment matrix difficulties can arise. Assessment Developers may not have previously engaged in this work in the context of a programme-focused strategy. Academics from particular disciplinary backgrounds may show resistance to, or ignorance of, those pedagogical approaches and practices that are beyond their existing practice (Burrell et al., 2015). Assessment Developers and/or students may be unfamiliar with, or hold pre-existing negative views of, particular assessment types, for example group work assessments (Donelan and Kear, 2018). These difficulties can be mitigated against through: providing information to, and engaging in discussions with, students and subject teams; the development of an asynchronous online course for Assessment Developers; and the provision of synchronous training for new Assessment Developers. Such challenges need to be overcome in order to ensure that the assessment matrix can be an effective part of the Programme's teaching and learning processes.

Assessment Developers may be more accustomed to scenarios where the design and development of assessments lay within their remit, and not where an Assessment Matrix indicates the necessary assessment types to be developed. For some, designing and developing 'non-traditional' assessment types requires a culture change, with negotiation required to gain acceptance of the new processes and different assessment types. For some the new processes were seen as encroaching on academic freedom (Fuller, Henderson and Bustamante, 2015; Haviland, Hi-Shin, and Turley, 2010). This resistance is consistent with research carried out by Haviland, Hi-Shin, Turley (2010, p.263) which found that "faculty members perceive accountability-driven assessment as at odds with their culture, priorities, and practices". Yang and Cornelious (2005) discuss other, similar changes in role for academic staff members, who may be more familiar with traditional modes of instruction, when becoming 'virtual instructors'. In developing 'non-traditional' assessments some may demonstrate "compliance without understanding" (Fuller et al., 2015, p.346), as they over-rely on templates supplied resulting in, for example, rubrics that did not appropriately reflect the assessment. Initial and ongoing discussion and negotiation is necessary as some Assessment Developers need more support in creating further iterations of assessments.

In order to support Assessment Developers there is a related online course within the university's Virtual Learning Environment (VLE), Loop, which is a customised version of Moodle. This course provided flexible professional development opportunities of the type recommended by Forsyth (2002). To adapt a point Yang and Cornelious (2005) make regarding online instruction, Assessment Developers must adjust their attitudes to creating assessments for ODL students, understand what qualifications are needed, and know what they can do to ensure the quality of those assessments. With the introduction of a number of assessment types to the assessment strategy, the main development work undertaken was in the expansion of the resources available to developers relating to different assessment tools and strategies. These resources detail: the benefits and pitfalls of each assessment type; the structure of assignment documentation for students (i.e. sources to be used, aims and objectives, which module/programme learning outcome is being assessed, detailed guidelines, assessment weightings, evaluation criteria, format for submission, and specific instructions relating to any digital technologies used); provide guidance on how to create assignment marking guidelines for Tutors; and supply sample assessment grading scheme/marking scheme/feedback grids.

Periodic professional development workshops are held to bring together the Assessment Developers to discuss the programme-focussed approach to assessment, and the assessment design and development process. These workshops often take place online using the Adobe Connect live, online classrooms. Workshops focus on developing the competencies and skills of Assessment Developers to enable them to create and design new forms of assessment and new approaches to feedback (Haviland, Hi-Shin, Turley, 2010). It is important to focus on student learning through the use of effective assessment technique, rather than just focus on assessment types (Fuller et al., 2015). More importantly workshops facilitate discussion with and between Assessment Developers, allowed time for the voicing of concerns, and for proposing ideas on how different forms of assessment and related approaches to feedback can be developed. Workshops allow assessment writing communities to form within subject areas, which make discussions around approaches to assessment and feedback more cohesive. Overall, workshops provide an opportunity to model the type of participatory pedagogies we wished to enact with students amongst ourselves as an ODL teaching team.

This is an ongoing iterative process that must produce a variety of assessment types that also satisfy subject teams' preferences for assessments in their subject area. Specific educational practices, which Schulman (2005) has termed signature pedagogies, can play longstanding and important roles within different disciplines of study. A study is currently underway to examine the experience of Assessment Developers in the processes described above.

6. Technology enhanced assessment methods

Following the identification of the different assessment types needed to provide appropriate opportunities to achieve learning outcomes, these assessments then need to be designed and developed for the online distance learning context. Technological solutions were needed to facilitate the achievement of the pedagogical goals bound up with the use of these varied assessment types. Table 4 below provides an overview of the technologies in use for the variety of assessment types in use:

Table 4: Technology enhanced assessment approaches

Assessment	Tool(s)
Online presentation	Adobe Connect
Online debate	Moodle discussion forum
Wiki	Moodle Wiki
Reflection on learning	Mahara eportfolio
Peer review	Moodle Workshop
Student created video presentations	Screencasting software, webcam or mobile phone, Youtube
Group project	Google docs, Google Hangouts
Reflective journal	Moodle journal
Formative assessments	Moodle quiz, moodle lesson
Online assignment submission	Moodle assignment, Urkund text matching

The institutional VLE was the primary enabler of technology enhanced assessment. Each module on the Humanities programmes has a Moodle course where the students engage with tutors, fellow students, learning resources and assessments. Students engage with tutors and students via the module discussion forums and in the Adobe Connect live, online classroom. Students engage with assessments on the module's Moodle course that contain the assessment information and links to the necessary technological tools such as Moodle Wiki, Moodle Quiz, a Mahara eportfolio, etc.

7. Communication

Due to the distributed and disaggregated nature of our online distance teaching and learning model, the majority of students and academic staff are off-campus (Sangra, 2002). Technology is fundamental to communication and interaction between ODL staff and students. The formal communication tools which are available in our institution to facilitate interaction are Moodle discussion forums, email (Google Apps for Education) and Adobe Connect live online classrooms. Informal communication tools adopted by the student community are Whatsapp groups and social media such as Facebook groups. The formal and informal communities of staff and students enabled by communications technology are essential sources of support, encouragement and human connection in the context of an online distance learning programme (O'Shea, Stone, Delahunty 2015; Andrews and Tynan 2012). A research study is currently being planned to investigate the role of formal and informal communication methods in an online distance learning context.

8. Summary

This paper provides a case study of how a framework can be implemented in an online distance learning context whereby the practical use of technology, led by appropriate pedagogy, can provide appropriate opportunities for the achievement of 21st century skills. The development over time of a programme-focused assessment strategy has facilitated the deployment of a variety of assessment types linked to learning outcomes. A team-based approach is utilised at each level of this work: the iterative, annual review and development of the assessment matrix; the design and development of assessments; and the choice of appropriate technological solutions in the assessment design and development process. It is within this team-based approach that assessment developers receive professional development such that they understand the technological solutions available for assessment and feedback design and development. Such professional development is necessary to avoid, minimise, and counteract the resistance to, or ignorance of, pedagogical approaches and technological solutions for assessment and feedback design and development.

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The Role of Visualizations for Digital Learning Designs in Collaborative Group Work

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Abstract: This paper presents a study about the use of visualizations among university students in different phases of their digital learning design project. The aim was to investigate what types of visualizations the students produced and used, as well as how the visualizations functioned in different design phases. The purpose was identifying different uses of visualizations to illuminate the learning potentials, and thus, the relevance for all who work with elearning and digital learning design. The practical frame of the study was problem based and project-oriented group work with a case from an external stakeholder. The theoretical framework drew on current discussions that problematize the concept of representations, claiming that visualizations can be translated into words. Focusing on the social life of images, the concept of visualizations was used to emphasize the imaging practices in the design process as a social knowledge practice for producing and negotiating meaning. Visualization in the study covered practices with, for example, drawings, digital images, graphs, and models produced and performed during different development phases of a digital learning design, such as digital and analog sketching of ideas, interim mockups, and prototypes for presentation. The empirical data consisted of student-produced visualizations and six group interviews. The study revealed that the students used visualizations to concretize and discuss brainstorming ideas and as an argument to support and convince each other about the usability of a design draft. They organized the visual practice differently by pointing out a leading visualizer, making a relay race or performing a collective practice. Furthermore, the visualizations served as boundary objects for the groups' elaboration of design solutions. Previous visualization drafts served as recollection and documentation of former design phases. The role of visualizations was that of communicative glue in collaborative processes where ideas are developed and discussed, problems are set and solved, target groups are identified, and stakeholder collaboration can take place.

Keywords: visualization, digital learning design, visual analysis, social practices of knowing

1. Introduction

Visualizations are an integrated but often overlooked part of learning practices in universities where there is no curriculum for fine arts or graphic design. Visual practices play different roles in many educational programs in the natural and social sciences and humanities. However, as a practice, field of competence, and potential for knowledge generation, visualizations are rather unnoticed, despite the diverse visual cultures that are represented in the scientific domains (e.g., Pauwels 2006). This paper discusses the role of visualizations based on an empirical study where university students' use of visualizations in different phases of a digital learning design project were investigated. The study was conducted in fall 2017, and the practical frame of the study was two courses related to problem-based and project-oriented group work, with an external case along, theoretical lectures, and practical exercises related to the course's learning objectives.

Two different student groups participated, as follows: bachelor's students from the 6-week-course, "Communication Design: Learning, Network and Organisation," and master students from the 5-week course, "IT-didactic Design." Both courses were offered at Aalborg University in Denmark. Aalborg University is a problem-based learning (PBL) university, and this pedagogical model constituted the overall frame where students developed digital learning design solutions based on cases from external stakeholders in both courses. Initially, the courses were neither design courses nor visual design courses, and the students were not expected to be professional designers. They were trained to develop new designs for digital supported learning practice. Both courses were organized through a design-based research (DBR) approach, where an initial problem was identified and analyzed, followed by a design proposal and test (Amiel & Reeves 2008). DBR is a pragmatic research approach that combines the iterative development of a design with research activities aimed at enhancing the design and developing theory. In DBR, a theoretical concept based on domain-specific knowledge forms the outset for generating design principles that are tested, reflected, and enhanced. The first day of the courses introduced the students to a DBR phase model that structured theoretical lectures and exercises, as well as project work. Furthermore, the learning design principle theory-generating practice (Buhl 2016) framed the students' activities. The design principle emphasizes materializing as a mode of explicating and concretizing tacit knowledge and generating new theoretical knowledge. The students did not require visualizing and drawing skills. In addition, they were not informed about the research objective of visualization in advance. However, they were encouraged to materialize and visualize during the different phases of their learning design process and make drafts for the digital learning design. The material from their learning practice, together with group interviews after they finalized the course, represents the empirical material informing the discussion in the paper.

2. Visualizations as a concept for social image making

The theoretical framework of visualizations in this paper takes its point of departure in the imaging practice as a social practice of producing, exchanging and negotiating meaning, drawing on insights from Burri and Dumit (2008). Visualizations are part of several practices and occur on various occasions, such as data in scientific practices (e.g., Lynch & Woolgar 1990, Latour 2001), to "make a point" in a PowerPoint on communication practice (e.g., Ledin & Machin 2018), or to make subject-specific content identifiable in teaching practices (e.g., Trumbo 2006, Buhl 2009). All scientific disciplines use visualizations, and each discipline is specified and recognizable by its visual culture (e.g., Pauwels 2006, 2010). Scholars discuss various concepts for defining image making for scientific knowledge practices (e.g., Coopmann et al. 2014) and problematize a concept of representations in terms of the claim that an imaging practice can be translated into words or objects (e.g. Lynch 2014, Woolgar 2014). Scholars in the visual arts and visual culture studies followed Mitchell's (1994) proclamation of a so-called pictorial turn, and a group of scholars investigated the cultural embeddedness of visuals in different contexts (e.g., Mirzoeff 1998, 2001, Rogoff 1998, Elkins 2003). Art theorists' analysis, together with science and technology studies (STS), made a fruitful encounter with ideas of scientific knowledge as a social construction, and they showed that aesthetic forms like style and genre created contexts in which scientific work could be understood (Jones & Galison 1998); moreover, they anticipated what later was discussed as the visual cultures of science (Pauwels 2006). Burri and Dumit's (2008) article titled "Social Studies of Scientific Imaging and Visualization" aimed at discussing what happens when images leave the academic environment and float into shifting contexts; the researchers investigated images and visualizations by focusing on their social dimension from an everyday perspective. The challenge of framing the practices of visualization was taken up from and by many disciplines to understand their different roles rather than pursuing the nature of what an image is. Investigating visualizations in learning practices, like in the development of a digital learning design for a specific knowledge domain or professional practice, illuminates the complex of scientific imaging practices.

3. The practicing of visual learning

Visualizations may hold the potential for knowledge generation if we obtain more insight into how students make use of them in their real learning processes. For instance, when students sketch their first doodles to share ideas, download a YouTube video, combine visual frames from graphic design apps to develop an animation, synthesize information in a graph, or model a mockup related to a specific problem, they work with it visually. Visualization is a well-known practice in the form of sketches in professional design fields, which serve different purposes. Olofsson and Sjölén (2007) differentiated sketching into four different activities, representing an internal dialog between the designer and a design problem and an external dialog between the designer and the stakeholders of a design solution. The internal dialog comprises investigative and explorative sketches, while the external dialog comprises explanatory and persuasive sketches. Due to digital technologies, sketching has developed to include animated sketching, which adds time and movement to the sketching dialog (e.g., Vistisen 2016), as well as video scribing, which adds a collaborative learning possibility for peers to sketch in processes of problem solving (Ørngreen et al. 2017). The latter indicates the use of visualizations in collaborative learning practice and—I would add—an emphasis on the visuals' social embeddedness in a learning process. Unless a visual practice is a trained profession, the visual repertoire used in these situations draws on a mix of personal preferences and different visual cultures. The learning environment of both investigative and product design creates a complex of diverse practices. In this paper's study, the use of visualization practices for developing a learning design takes different forms, while the use of visualization serves in diverse situations of either internal or external dialog. According to Burri and Dumit (2008), visuals are embedded in social practice; the authors discuss images' social life, signifying that visualizations are not representative of an objective reality. Visualizations are social constructions from which meaning may be constructed. This paper uses the concept of visualizations to emphasize the imaging practices in the design process as a social knowledge practice of producing and negotiating meaning. This means that visualizations are not fixed meanings that can be mediated. Rather, the meanings are constituted in the contexts they are embedded in and enacted by. The notion of visualization in the specific study covers practices with, for example, drawings, digital images, graphs and models produced and performed during different development phases of a digital learning design, that is, digital and analog sketching of ideas, interim mockups, and prototypes for presentation.

The theoretical framework of the visualization study draws on Burri and Dumit (2008). They proposed three artificially separated topics of visualization for discussing the social practice of visualization's effect on knowledge generation. The first is *production*, which means studying images as artifacts. The second is *engagement*, which involves analyzing the images' role as instruments in science. Finally, the third is deployment and stands for how images are used outside the laboratory in other contexts (Burri & Dumit 2008: 300). Burri and Dumit (2008) argued that, by employing these three topics, they illuminate the interpretative openness in scientific images, as well as their persuasive power. This paper adopts the authors' social perspective on visualization, but it focusses on images and visualizations in a digital-based teaching and learning context. In this way, the scientific knowledge is still the context, but it is used for educational purposes.

The diversity of images and visualizations are not necessarily an integrated aspect of the teachers' pedagogical planning of a learning process. In academic schooling, texts are used as the predominant source for knowledge generation, and the practices of visualizing seem to be an underprioritized modality for learning. In higher education, academic work is often associated with written and oral performances, and the prioritizing of verbal discourses for education shown in the exams and assessment procedures is significant.

4. Methodology

Inspired by Burri and Dumit's (2008) three topics, the empirical study aimed to identify how the students made visualizations, for example, sketches, drawings, and video footage. The purpose was identifying the genres or styles of the different visual artifacts produced. Furthermore, we looked at how students used visualizations for different purposes, such as in the processes of generating ideas, mockups, and prototyping, and what role they attributed to the visualizations in different phases of the learning process. Finally, we looked at how the visualizations and knowledge generation interacted in the group in different phases of the design process. From this, a suggestion of visual learning potentials in problem-based, project-oriented group work in higher education may inform the discussion of how visualizations take on different forms and are attributed different meanings and roles depending on the social practice in which they are embedded.

The empirical data comprised seven student-produced reports and digital design proposals, including drafts, drawings, and mockups, that were produced during the course. Furthermore, six group interviews were conducted immediately after the students' submission of their assignment and an oral and visual PowerPoint/Prezi presentation of their final digital learning design solution to the external case givers and stakeholders, but before the oral examination. The students were not instructed on the research focus beforehand, as we did not want them to focus on it especially. They were invited to the interview a week before the course ended, and they were then informed about the visualization focus on the interview day, where they also gave informed consent to participate in interviews and provide access to material produced during the course. The interview questions were semi-structured (Kvale 2009) and organized around stimulated recalls (Calderhead 1981). Stimulated recalls open the opportunity for remembering situations from the design process where the visualization practice took place. The first stimulated recall in the interview was a materialized DBR model that the students were familiar with from the course. Furthermore, the interviewer encouraged the informants to include their produced material in the forms of visual draft mockups and prototypes to show and tell during the interview. The interview questions were formed and structured based on the courses' learning design, with a focus on visualizations. The students were asked about their experiences with the design process and how they made use of visualizations during the different phases of problem identification, design, testing, and test analysis. The interviewer took an open approach but was persistent on making the students show exemplifications of statements given by the informants. The interviews were video recorded and coded using NVivo software. The empirical material was organized according to Burri and Domi's (2008) three topics, and Ledin and Machin's (2018) focus on what accomplishments emerge from using visuals in the various phases of a digital learning design inspired the analysis.

5. Findings

The student-reports and learning designs mockups represented a wide variety of visualizations contextualized by the phases of the DBR structure. The interviews revealed that, initially, the students attributed no meaning to and saw no significance in their visualization practice. Typically, their recall of visualization experiences was vague when they described how they developed ideas, design drafts, and mockups. For instance, they had difficulties in explaining what happened between idea emergence and idea choices. However, the interviewer's request for exemplification made the students recall their real practices. The last parts of the interviews were richer in descriptions of the actual visual practice and helped by the concrete exemplifications, the students gradually came to reflect. The following section present findings from the empirical data.

5.1 How the students made visualizations

The material showed a variety of commonly used types of visualization. The students used analog sketching on paper and whiteboards, digital sketching, digital design elements, self-produced photos and photos from the Internet, video footages for scenario production, and drawings as visual elements in mockups. All groups explained that they took on a random and/or pragmatic approach to the choice of media. Either they chose media based on easy access or usability (e.g., Marvel App or Go Animate) or the convenience of having quick access (e.g., pen and paper). One group mentioned that a specific app had limitations in access to preproduced visual elements, which ended up determining the final choices of how the visual production of a prototype would look. Thus, this group's choice of digital tool was a result of the negotiation between digital apps based on their usability. Most groups used manual and analog sketching for their first ideas and then shifted to digital tools for the design phase. One group made a drawing and then used Adobe Illustrator for a makeover to make the drawing "look better". The visualizations showed no evidence of explicit style or genre choices. One group made drawings on paper to an animation using the StopMotion app. No groups reflected on the aesthetic qualities involved in choosing one media rather than another. One group stated that they agreed on the same visual expression of the design immediately. This may be either an extraordinary coincidence of similar taste or a lack of ability to take a stand. The diversity of visualizations represented in the study exemplify and support results from elementary school (Meyer 2015) showing how digital media provide new visual practice in which existing materialities and their visual representations find new forms in combination with digital artifacts and software.

5.2 How students *used* visualizations for different purposes

The organization of the course as a DBR process influenced how the students used the visualization practice. Several groups stated that they had already developed ideas in the initial phase, where they were working on identifying the case problem and doing context inquiry. This was partly because they were asked to conduct a rapid process to practice the idea of DBR, partly because, with reference to Schön's distinction, they started thinking about problem *solving* rather than problem *setting* (Schön 1983). The informants stated that they started the visualizing practice rather quickly for generating ideas because they were inspired to find a solution as soon as they read the case content. They used whiteboards or paper for visualizing ideas from their brainstorming. The brainstorming typically produced a storyboard, mind map, or sketched visual elements.

Asked about why they started by visualizing ideas instead of verbally discussing them, all the groups stated that it was necessary for creating a common understanding of an idea. Some reflected on how something's appearance in one's imagination may be different from that of another group member. Others had experienced that, for some time, they thought that they all were talking about the same idea in the group, and when the idea was visualized by one of the others, it turned out that they were talking about completely different things. They considered such incidents as evidence for the importance of visualization. One group started sketching ideas for problem solutions with many specifications for an app before realizing that it would never work; they then had to return to work with the problem setting and exploring visual material connected to the context. Most groups stated that the initial phase was back and forth between problem setting and solving, and the visualizations served as a sort of mediator between the two movements. Thus, visualizations served as a rapid tool for exploring possibilities in the initial processes, as concretization of imagined scenarios, and as a platform for mutual understanding.

In the design phase, the visualizations served as concrete steps in the iterations of the initial ideas. Some groups retained a version of the initial idea and made smaller changes, while others developed new design ideas based on theory, field studies, and collaboration with the stakeholders. One group was quite far into a design when the group members decided to discard it and start over. In the design phase, the groups used visualizations for discussions and decisions about the design. They used more methods, like use case diagrams, acquired during the course lectures, and added them to their repertoire of visualization forms. During the design process, previous visualizations served partly as documentation for design historism in the groups and partly for the groups' revisiting of them when working with design problems. The group stored them with the purpose of using them for remembering phase content and attachments in the final report.

In the test phase, visualizations took the form of paper/digital mockups presented to potential users and the stakeholders. The low-fi mockups served for rapid feedback, and the groups could discuss the visual production with reference to the target group. Questions like the following were posed by the groups: *Is this drawing appealing to the target group? Are these pictures too patronizing? Is the video's framing of the problem insulting to the end users, and will it thereby create a barrier for learning? Are the visual elements in this app too childish or fancy?* In all three phases of the digital learning design, the use of visualizations revealed a mix of different purposes. Olofsson and Sjölén's (2007) differentiation in internal and external dialog appear less systematic and more intertwined, when nonprofessional designers use designing approaches for developing technology-enhanced learning practice. The internal dialog between the designer and a design problem and the external dialog between the designer and the stakeholders of a design solution seemed to be happening simultaneously in the groups as both internal and external dialogs when they navigated their way through the process. When it comes to presentations to the stakeholders, the external dialog is more explicit.

5.3 How the visualizations *interacted* with the knowledge generation in the group process

The visualizations' role in knowledge generation throughout the design process took different forms in the different groups. When asked how the visualizations emerged during the design process, the groups answered differently. The data revealed three different categories of practice, as follows:

- 1. Collaborating on visualizing: A group develops and contributes alternately with visual elements and negotiates what stays and what goes. Here, the groups worked synchronically in time and were present in the same physical space;
- 2. Leading visualizer: A group appoints one member to perform the visualizations based on the group discussions. Here, the leading visualizer executed the ideas visually, while the rest commented and corrected; and
- 3. 'Relay race': Each group member takes a shift on the visualization task and pass it on to one of the other group members to continue the work. Here, the suggestions for change are communicated via the changes in the visualizations

Collaboration in the groups appeared to be either process oriented (Collaborating on visualizing, 1) or product oriented (Leading visualizer, 2 and 'Relay race', 3). When asked why they performed the actual visualization in a specific way and with a certain organization, the groups in categories 2 and 3 answered mostly with a practical rationale: We did not have much time or we perceived he/she was a skilled visualizer. The group in category 1 argued that by doing it collectively, not only were they able to correct visualization expressions, but the visual process also served as a driver for theoretical discussions related to the course learning objectives and design decisions. The three categories indicate that visualizations interact differently with meaning-making processes, although not all interactions may be considered in PBL pedagogy based on social constructivism. Some students shared knowledge by outsourcing tasks to each other, divided, for example, into reading articles, transcription of interviews, visualizing, testing, or contact with stakeholders. From this perspective, the study gives insight into how students organize project work individually and socially using pragmatic solutions. From another perspective, the study shows how other students used the collaborative process and visualization as a sort of boundary object for negotiating meaning and constructing new knowledge. Furthermore, some students stated that they used the visualizing practice as a mode of understanding the theoretical lectures. They connected the concrete materialization of designing to understand theory and stressed that this approach helped not only to understand theory but also in determining how to apply it to the design practice. This indicated a reference to the design principle for theory-generating practice that was integrated in the course design (Buhl 2016).

To summarize, the data indicated an added dimension to Burri and Dumi's (2008) discussion about how scientific images and visualization forms take part in diverse social contexts when leaving science, thereby gaining a different life. The real visualization practice among university students taking courses in the humanities shows that diverse scientific visual cultures create mergers of genres, styles, and media, along with mergers of knowledge practices, group organizations, processes, and products. Furthermore, the data revealed that visualization served as a sort of unacknowledged factor in many facets of learning practice.

6. Conclusion

This paper was initiated from the claim that visualization is overlooked as actors in academia and the study revealed them to be involved in knowledge practices in two specific courses. However, the empirical study revealed a randomness of media-, genre-, and style choices mainly based on limited aesthetic skills among the university students that participated, and it was explained as the result of an educational down-prioritizing in the Danish educational system's elementary and secondary schools. Furthermore, the study revealed a limited focus on own visualization practice among students, who at the same time, had proven they were present as a resource for learning in all phases of their projects. By their actions and reflections, all the groups in the study showed that visualizations are crucial for making imagined ideas concrete and producing shareable suggestions. In other words, the role of visualizations is that of communication glue in collaborative processes where ideas are developed and discussed, problems are set and solved, target groups are identified, stakeholder collaboration can take place, and theory can become understandable and applicable. However, the lack of visualization training and attention to the potentials of visualization in university education are critical problems in a society with a growing digitalization, where images and visualization are ubiquitous and integrated in all parts of knowledge generation.

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Blended Learning Strategies for Successful Language Acquisition

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Abstract: Blended, hybrid, mixed, or integrative learning are all expressions used to describe the combining of traditional classroom methods and independent study to create a new teaching methodology. The implementation of blended learning strategies allows schools to teach more students more efficiently and furthermore, because students are required to use online technologies in blended/online learning situations, they naturally acquire more technological literacy and greater confidence using technologies in their studies. Digitally delivered materials, either online or blended, also prepare students for lifelong learning and play an important role in their further development. Blended learning strategies also serve as a tool to achieve the required language level according to "alma mater" demands, especially if the number of lessons is not sufficient and learning outputs are high. It is not easy for students to pass the exam corresponding to B1 according to the Common European Framework of reference in four language skills if their entrance level is A1 or A2. The authors describe their experience with blended learning implementation in courses at military university. The first focus was placed upon reading and listening comprehension via online course called English for the Army), but later on writing and speaking skills were also developed. Speaking skills development via Discussion Club shows another initiative and the first outcome shows that this method is effective. Qualitative research, students work analyses and semi-structured interviews prove this statement.

Keywords: blended learning in military environment, e-course of English, Discussion Club, semi-structured interviews, students´ work analyses

1. Introduction

Many students come to college/university with little understanding of what it takes to succeed; they make an assumption that class attendance is optional, or that the level of effort that got them through high school will be sufficient for college work. However, university courses require much more effort than high school classes. Some universities provide their students with a guide to studying effectively and emphasize students' active approach to their studies. Studying at university is about developing students´ independence as learners and working with academic staff and other students to become capable of critical thinking and communicating ideas within a scholarly community.

When the Czech Republic joined the Bologna process, all universities agreed to commit and fulfil a number of conditions, including:

- to adopt a system of easily readable and comparable degrees with two main cycles (undergraduate/graduate);
- to establish a system of credits and to promote mobility of both students and teachers
- to promote European co-operation in quality assurance (1999, Bologna declaration).

An important part of the Bologna declaration is the European Credit Transfer and Accumulation System (ECTS), which expresses the volume of learning based on the defined learning outcomes and their associated workload. Workload is an estimation of the time the individual typically needs to complete all learning activities such as lectures, seminars, projects, practical work, work placements, and individual study required to achieve the defined learning outcomes in formal learning environments. The correspondence of the full-time workload of an academic year to 60 credits is often formalised by national legal provisions. In most cases, workload ranges from 1,500 to 1,800 hours for an academic year, which means that one credit corresponds to 25 to 30 hours of work. It should be recognised that this represents the typical workload, and that for individual students the actual time taken to achieve the learning outcomes will vary (ECTS Users ´ Guide 2015).

There are many tools that can help students learn and work more effectively, one of them being ICT implementation to educational process. According to Oliver: "Through technology-facilitated approaches, contemporary learning settings now encourage students to take responsibility for their own learning" (Oliver, 2002). Development of Learning Management Systems and e-learning courses result in various means to encourage students to take a more active role and employ an individual approach in the process of knowledge acquisition, thus creating opportunities for better student collaboration. With data-driven learning and assessment practices accessible via learning analytics, both instructors and students are able to track students' progress and interaction with material that provides opportunities for instructors to gain insight, and provide timely help to students performing poorly.

2. Blended learning

Blended learning, which combines face-to-face learning with the "blended learning approach", has been practiced in different educational contexts for many decades. The purposes the universities reported for implementing blended learning aligned with those reported in the literature: "pedagogical improvement, increased access and flexibility, and cost effectiveness" (Graham et al., 2005). The term 'blended learning' does not have any generally agreed definition, therefore teachers and course designers develop their own understandings of the term within the context of their courses or institutions and then use that as basis to design their blended courses (Alammary et al, 2014, p. 450). Kopecky (2006) defines blended courses as those that "integrate online with traditional face-to-face class activities in a planned, pedagogically valuable manner" (Kopecky 2006, p.29). This means a teacher must implement modern technologies into classes, while wisely maintaining timeless pedagogical values. According to Graham (2012b), blended learning is defined with "considerable variation across institutional contexts" (p.17). Trasler (2012) in his article "Effective Learning Depends on a Blend" claims: "As the over-riding aim of a blended learning programme id to meet the training requirements of both individual learner and company, it is vital to ensure that the different learning media are employed appropriately and in a right mix." Blended learning solutions have many benefits, but also present a challenge for some teachers: the reduction, or elimination, of face-to-face contact. The success of the blended learning approach depends upon striking the right balance between the number of face-to-face lessons and the number of lessons for students' self-study in the form of blended learning. Oliver and Trigwell (2005) proposed three different definitions of blended learning:

- 1. "The combination of media and tools employed in an e-learning environment.
- 2. The combination of a number of pedagogic approaches, irrespective of the learning technology used.
- 3. The integrated combination of traditional learning with web-based online approaches" (Oliver and Trigwell, 2005, p.17).

Kay Baldwin-Evans, (2006) writes: "The ideal blended learning model is one that integrates a wide range of functions that empower learners with more control to participate in several formal and informal learning activities''. Cerna (2016) mentions the role of blended learning for part-time students and self-study and emphasizes, "e-courses are actively and systematically used as a source of study material, an information noticeboard and as a forum" (Cerna, 2016, p.271).

The term blended learning is used almost interchangeably with hybrid learning. According to Vinke and de Prez (2015), there is a subtle distinction: "In hybrid learning, a significant portion of the course takes place online. In contrast with blended learning, a hybrid learning scenario replaces much of the student-teacher "face time" in a brick-and-mortar location with online interaction". Horn and Staker (2015) claim: "Blended learning is not just about adding more tech tools to a classroom. Rather, it consists of three separate ideas:

- It's part of a formal learning program using online learning that gives students some control over the time, place, path and/or pace of the learning.
- At least part of the learning happens in a supervised, brick-and-mortar location.
- The learning experience integrates online and face-to-face learning".

The guideline for the courses design was the Grub and Hinkelman publication (2012) which presents the following definitions for blended learning and hybrid learning:

- "Blended learning: Subjects that utilise some significant online activities in otherwise face-to-face learning, but less than 45 per cent.
- Hybrid learning: Subjects in which online activities replace 45–80 per cent of face-to-face class meetings. "

Teachers of English at the University of Defence are combining face-to face lectures with online activities as it is one possible method of motivating students to study hard and to achieve a relatively high level of English, which in the military environment is NATO Stanag 6001, SLP2. Once the decision to employ blended learning strategies had been taken, the next stage was to determine the blend itself. Banados (2006) suggests the following elements: face-to-face English, learners´ independent work, online monitoring, and conversation classes with a native speaker. The authors respected the fact that lessons and self-study represented the biggest part of the students´ everyday workload, and that it was necessary to develop all skills (speaking, listening, reading and writing) proportionally in the teaching process. Our aim was to distribute the workload evenly to balance the self-study with the amount of time spent in the classroom. Due to all the above mentioned considerations, we divided each course content as follows:

- face to face lessons and conversation with a native speaker;
- learners independent work: APA and Discussion Club.

3. Unique features of language studying at the University of Defence

Beside future military professionals studying at the University of Defence (hereinafter UD) there are also civilian students who after graduation apply for positions in the state administration or in the Rescue system of the Czech Republic. Our research has focused on military studies, which differ considerably from those of civilians. Before entering the UD all military students have to take part in basic military training and swear the oath of enlistment, thereby becoming military professionals with the rank of corporal. They receive wages and are required to fulfil all military duties and responsibilities resulting from their commitment. Nevertheless, they are still university students possessing the same rights and facing the same requirements of an academic environment.

Language studies represent one of the major differences between military and civilian students. The Ministry of Defence decreed that studying English language would become compulsory for all students without exception. However, while civilian students have to pass semester exams at the end of the 6th and 10th semester, military students have to pass the exam according to STANAG at the level of SLP 2 in all four skills, corresponding to B1 level according to the CEFR, by the end of the 5th semester at the latest. Although civilian students can choose to take a credit test at the end of each semester in either French, German or Russian language, military students can choose from French and German only, and by the end of the 9th semester they have also to pass the exam according to STANAG at the level of SLP 1, corresponding to A1 level according to the CEFR, in all four skills.

A STANAG, or STANdardisation AGreement, is an international military standard created by the North Atlantic Treaty Organisation (NATO) for regulating equipment, procedures, tactics, training and just about everything that affects how armed forces from different countries work together on operations and exercises

The English language is taught in five semesters only, with a total number of 149 classes. For the sake of comparison, the recommended number of classes required to pass the STANAG SLP2 exam is 400 for students who start their studies at the level SLP 0-1. Students of the UD have to pass an entrance exam from English language set at the level of SLP 1+ (A2-B1 according to CEFR). Nevertheless, students still struggle to pass the required exam according to STANAG. During their studies, military students have to gain a total number of 12 credits, which equals a study load of 150 hours in accordance with Bologna Declarations.

4. English for the Army course

Regardless of the fact that there is a great number of English language textbooks and on-line courses of very high quality available these days, the teachers of the English department of the UD have decided to prepare an electronic course in English language in LMS Moodle called “Angličtina pro Armádu” (English for the Army). The aim of the course is to provide all the candidates applying for the exam according to STANAG 6001 SLP 2222 with sufficient study materials to practice vocabulary, grammar and receptive skills (listening and reading comprehension). The course is available on the Internet and the user only needs a common pc, tablet or smart phone with a web browser and non-stop Internet connection. The course offers a large scale of interactive activities supported by feedback. In case this form of self-study does not comply with the needs of the user, they can print out lessons in PDF format and then check individual exercises by entering results into the electronic version. The course consists of 12 units and contains topics mirroring the requirements for the exam according to STANAG 6001 SLP 2222. This tool is available for both military students of the UD as well as for all military professionals who are obliged to pass the exam by the end of 2019.

Beside topic-based lessons the course provides various interactive tests focused on listening and reading comprehension. It also includes grammar summary, a dictionary and a set of individual lessons in PDF format. The dictionary is based on American Language Course (ALC) and covers all the vocabulary essential for passing the ALCPT Test. It also offers a wide selection of relevant web pages for further practice of English language.

The APA course was launched in July 2016 and the first participants registered in August 2016. At the end of August and the beginning of September several workshops were organised to inform military professionals about this self-study option in addition to the courses organised at individual garrisons. The first students of the UD were also informed about this form of self-study at the same time. During the workshops, the daily participation was considerably high, but gradually started to decrease. Actually only 112 of 620 registered participants actively worked in the e-course and statistics showed a maximum 250 accesses per week.

This situation remained the same until December 2016 when the number of participants started to slightly increase. At the beginning of February, the number of registered APA users had risen to 2975. Figure 1 shows weekly accesses of all users from February 2018 to May 2018. Graph legend from the left: guest, student, teacher without editing right, teacher with editing right, manager, all functions.

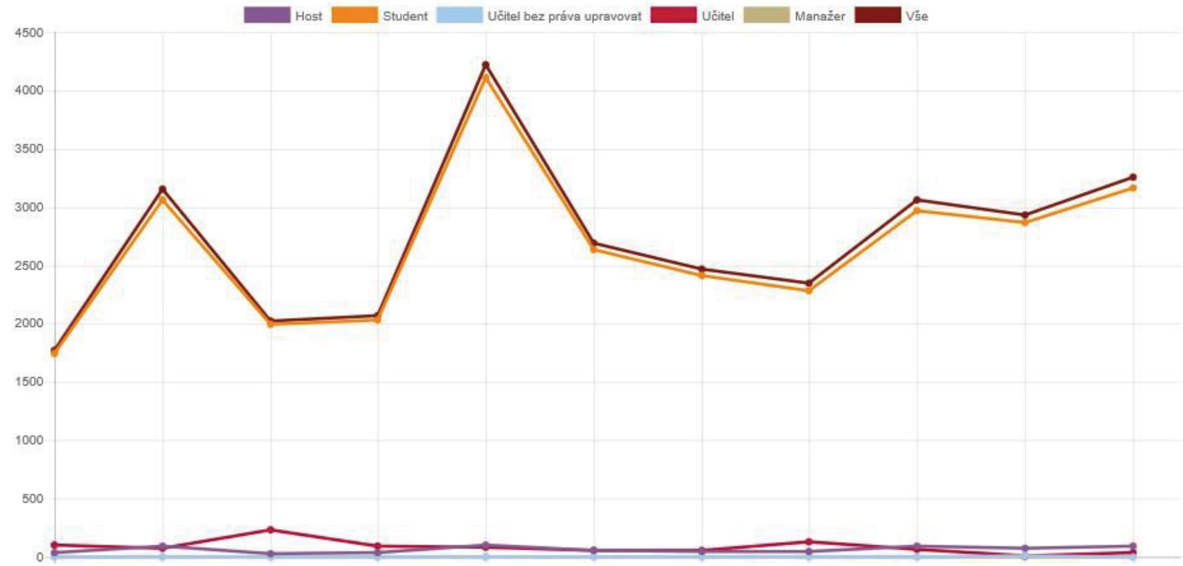

Figure 1: Course activities from February to May 2018

However, the authors are more interested in students' outcomes than in pure accesses only. In the first part of the research, the authors focused on qualitative research and, above all, on the students' opinion of the e-course APA, how the APA helped them in the studies and especially in the preparation for the STANAG 6001 SLP 2 exam. In our research we worked on the following assumption:

- Whether and how APA helps students prepare for STANAG SLP2 exam in listening and reading

The target group was formed by students of the 3rd grade, in their 5th semester, studying at the Faculty of Military Leadership and the Faculty of Military Technologies, whose pre-requisite for awarding credits in the 5th semester is passing NATO STANAG 6001, SLP 2222. Students may take this examination at any time during their English language study. The total number of the 3rd grade students was 115, of whom 99 students passed their exam in all skills. Only 5 students out of 115 did not pass listening comprehension and 6 students out of 115 did not pass reading comprehension. However, the authors cannot confirm that APA only helped students to pass the receptive skills. During face-to face lessons the focus is on speaking and writing skills, but it is necessary to emphasize that language acquisition consists of two communicative processes. The speaker (writer) produces his/her speech and transfers information. The listener (reader) receives the information and reacts to it. In other words, every student of foreign languages needs a whole range of skills and abilities, e.g. writing letters and emails, reading books, listening to the radio, speaking on the phone, which supposes four basic language skills: Listening comprehension, Speaking, Reading comprehension, and Writing. The aim of language teachers is to train and practise all four language skills equally; relations between productive and receptive competences are described in the following table (Table 1):

Table 1: Relations between language competences (Harmer, 1991)

Production	Speaking	Writing
Reception	Listening comprehension	Reading comprehension
	Spoken language	Written language

The goal of the authors' endeavour was to find out whether students perceive the APA as a tool that helps them to pass the STANAG examination in listening and speaking comprehension. Therefore, students were given the task of writing a short essay (120 words) on what and how helps them most in preparing for the STANAG exam and in passing the STANAG test in listening and reading comprehension. In this part of the research only two groups of students participated, altogether 17 students. They were not given any clues as to what to write about, just the following task: "Recommend to your schoolmates how to successfully pass STANAG SLP 2 from listening and reading comprehensions. Mention particular activities that helped you and describe how they helped you". Then we analysed students´ writing and chose the most frequent answers (Table 2).

Table 2: What helps students to pass reading and listening comprehension

Mock tests (APA course)	78 %
Tests to practise listening and reading comprehension	75 %
Interactive exercises	59 %
Internet	36 %
Face-to-face lessons	31 %
Discussion club	26 %
Films and computer games	26 %

It is positive that majority of students mentioned the APA course, mock tests and other tests in the same format as the STANAG exam. They also mentioned (75 %) interactive exercises to practise grammar and vocabulary, and generally the Internet offers a number of activities, courses, films, songs, etc. One of things that also helps students is a Discussion club. Students found that the overall structure of English lessons, including face-to-face lessons, the APA, Discussion Club, was integrated well and that this structure has a good balance. Several suggested changes were also made, focusing on a greater amount of tests as well as practising writing and speaking via APA. The traditional lecture is considered as effective and efficient by many students (31%) in order to grasp concepts and principles. However, they prefer to have an online course as a supplement to face-to-face lectures

5. Discussion Club

In order to transfer a part of the study load to students themselves, an initiative called the Discussion Club (DC) was created, which is an additional way to learn English systematically and to prepare for passing the exam according to STANAG 6001 SLP 2. The activity in this club is focused on practicing speaking skills, and the role of lecturers is provided by students who have passed the exam according to STANAG SLP 3333, which corresponds to C1 level of the European Reference Framework. Students/lecturers studied at universities abroad under the Erasmus programme, participated as interpreters in the Winter Survival International Exercise, and also have further experience with using English in an international environment. All students/lecturers were acquainted with STANAG 6001 SLP 2 test descriptors, teachers provided them with handouts and study materials and the rest were then created by students themselves. The students consulted all their activities with their tutor.

The primary goal of DC was to provide students with the opportunity to practice their speaking skills in a familiar environment, in student clubs, which are directly at their accommodation facilities, and to stress the informal aspect of this activity by the fact that the teachers do not take part in the activities, and act only as advisors. The interest was enormous. In the winter term, students met 2-3 times a week, in the summer term they met every day.

And what do students themselves say about this initiative? In order to find out their opinions, we randomly chose 5 students from each year, module and specialization, and completed semi-structured interviews with them. The selection of students was random and there were 19 interviews altogether. In our research we worked on a following assumption:

- Whether and how DC helps students prepare for the STANAG SLP2 exam in speaking.

We created a set of basic questions which we modified according to the individual interviews. All the interviews were recorded and analysed. Students' feedback was positive, and we also appreciated their suggestions and comments. The interviews have shown that DC is a good initiative and makes a great deal of sense, as all respondents evaluated DC positively from the point of view of a success in the STANAG exam. The scope of the article does not allow us to include all the interesting points of view, so we will only mention some reactions:

> *"Excellent flexibility, help at any time, detailed feedback, grammar help, the explanation of difficult vocabulary, grammar, etc., extremely close to the exam itself, a great choice of time to come to have a chat."*
>
> *"It certainly makes sense to me, it helped me to talk, the initiative and the quality of all the speakers is on a high level, but I would add more time for each student because 15 minutes were not sufficient for me."*
>
> *"Seems good to me. Alexander is a good speaker and it was not a problem to arrange the DC for 30min +. It definitely helped me to succeed in the speaking skill."*
>
> *"I consider Karolína to be the best, I got level 2 from speaking thanks to her. I also think it´s organized in a good way, it's great to talk and listen to other people."*
>
> *"It certainly helped me a lot. Lukáš and Alexander helped me to achieve level 2 from speaking. "*
>
> *"Radek helped me to talk and not to be afraid to talk. I like it and I think it would be great to extend it somehow."*
>
> *"I found out where my weaknesses are and that I have to study more. It's not easy, but it's good to hear not only from the teachers where my weak points are. Now I speak English almost every day and I think I have a great chance to succeed in speaking."*

Students evaluated positively:

- Informal aspect: environment, time, lecturers;
- Information aspect: learning from one another;
- Increase in mutual cooperation and coherence;
- Possibility to choose the topic, the method, to influence the pace and time spent on individual activities;
- Taking responsibility for their learning.

The interviews have shown that DC is a good initiative because it helps students gain the necessary self-confidence in communication and it also appeared to be a significant extra activity together with other initiatives, such as voluntary English lessons (Preparation for STANAG) taught by teachers and the previously mentioned APA e-course. The increasing sense of responsibility for students´ learning was an unexpected bonus and a confirmation that this method is quite effective.

In the near future, we are planning to have regular meetings with foreign students currently studying under the ERASMUS programme at the University of Defence, and we also want to hold discussions with English teaching students from the Univezidad Andres Bello of Santiago de Chile using Skype under the supervision of a Canadian lecturer.

6. Conclusion

The authors in their work continue in research done at the UoD by e.g. Ullrich et al who describe in their work skills and abilities for military professionals necessary to perform the activities and functions in challenging conditions in military environment, especially at the University of Defence (Ullrich, 2017). Cechova and Saliger focused on academic workers skills in their research from pedagogical and language point of view (Cechova, 2016). Charbonneau Gowdy concentrates in her research on using technologies in a language training and especially on its social aspects (Charbonneau-Gowdy, 2017). In her work, she has cooperated on projects enhancing ICT implementation in the language training, especially web-conferencing with the UoD.

There is no doubt that blended learning came to prevalence because of its mixing of different platforms of learning – typically virtual and physical – in order to enhance the effectiveness and efficiency of a learning experience (Bonk et al, 2005). Blended learning has many benefits, but it also presents a challenge: the reduction, or elimination, of face-to-face contact. However, communication, either face-to face or via e-media (e.g. Skype) is crucial in language lessons and DC shows that interaction between speakers can be kept or even enhanced. Above all, students themselves were involved in the role of teachers, and they accepted that role with full responsibility. Other students were motivated via those who were able not only to achieve a higher level in English but also to teach them in very informal settings. Students also found that the overall structure of English lessons, including face-to-face lessons, the APA, Discussion Club, is integrated well and they appreciated a good balance between face-to-face lessons and online lessons. Students might also bring specific and problematic issues from APA and DC to consult and discuss with a teacher in a class, which makes learning even more relevant and personalised. The traditional lecture is considered as effective and efficient by many students (31%) in order to grasp concepts and principles. However, they prefer to have an online course as a supplement to face-to-face lectures. The majority of students (78 %) think that tests are the best part of APA as they can practise them whenever and wherever they wish, and they consider familiarization with the test format as crucial. However, the authors want to put the main emphasis onto the social role of this tool, and in the near future will strive to extend DC and involve foreign students under the ERASMUS programme in their regular meetings, both formal and informal. The DC might be completed with English teaching students from the Univezidad Andres Bello of Santiago de Chile using SKYPE under the supervision of a Canadian lecturer, which is another significant motivating factor. Bound et al write in their book that peer learning promotes certain types of learning outcomes that include learning with others, self and peer assessment, communication, articulation of knowledge, understanding and skills (Bound et al, 2014). The authors strongly believe that DC with Erasmus students or students from the Chilean university will be more natural, which will represent a practical step towards acquiring a foreign language and building cultural awareness.

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Endpoint: Insights for Theory Development in a Blended Learning Program in Chile

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Abstract: A growing temptation in many higher education institutions to move Blended Learning (BL) course offerings towards fully online distance learning programs underlines the immediate and critical need to "get it right" at this stage in terms of providing advanced opportunities for learning – the kinds of opportunities that continue to elude many classic educational settings. Based on much of the current scholarship in applied BL research, current trial and error efforts to improve learning in these new settings are falling short of leading the way to program development. Scholars have argued that such small-scale initiatives fail to provide the basis for a much needed and explicit e-learning theory that institutions can apply on a more general scale. To respond to this call, we report on a two-year longitudinal study we conducted at the *micro* (student and instructor), *meso* (Director and coordinator) and *macro* (institutional) levels of a BL program in a large private-for-profit university in Chile. Convinced of the importance of adopting a sociocultural perspective to move towards e-learning change, our focus was particularly on the perspectives of the BL players at all three levels - and the identities they were mediating. Using a grounded theory methodology within the qualitative research paradigm and an iterative approach to the research design, data was collected and analyzed at all three levels. Data sources involved questionnaires, individual and focus group interviews, field observations, policy documents and reflective journals. The most salient understandings uncovered from the inquiries revealed strengths and gaps in terms of community building, collaborative learning and self-directedness – the essence of any successful learning environment. These findings suggest a practical framework for supporting BL program design and innovation across a plethora of contexts and institutions and we believe bring us a step closer to e-learning theory development.

Keywords: blended learning, grounded theory, higher education, identity, macro-meso-micro level inquiry

1. Introduction

The rising tide in the marketization of institutions, coupled with the ideological growth in neoliberalism and its emphasis on individualism that have accompanied the surge in interest in digital technology (Duchêne & Heller, 2012) is having an impact on education, both at the *micro* level of the classroom, the *meso* level of program administration and at the *macro* level of higher education institutions. We would argue that nowhere are these forces more obviously being played out in higher education than in the context of BL programs. In these evolving learning contexts, what it means to be a "good" teacher, "good" learner (De Costa & Norton, 2017) as well as a "supportive" administrator and institution is in flux. Yet, there seems no turning back from the trajectory of increased online learning programs, especially at the higher education level. The importance of understanding the struggles of all players - learners, instructors, administrators and institutions in the educational games that are being played out currently in BL programs, is quite evident. That importance is highlighted especially in view of how the quality of this education will impact learners in an age where the rules of what it means to be *educated* are dramatically and rapidly changing.

Our longitudinal inquiry looks at the complex social realities within an English BL program at a private-for-profit university in Chile. Our research and teaching experience in BL for close to two decades on three continents - Europe, North America and South America, combined with our knowledge of scholarship in the field of e-learning and the broad field of education in general, has convinced us that *context is everything* when it comes to innovation and assimilation of new approaches. For it is in the context of formal learning in which technology is deeply embedded, that as Hall (2007) points out, people and institutions are mediating "significant changes in the scope and nature of human cognition", and are redefining their roles and sense of selves, their *identities* in this new paradigm of education. Influenced by the seminal work of Norton (2013) and the extensive research it has spawned in SL education, the field wherein the studies reported here lie, much of our focus has been on *identity* in the context of BL. We have assumed this positionality, believing deeply that learning, digitally supported or not, is primarily a sociocultural activity and that adding digital technology to the process is ultimately direction changing in terms of how individuals build their subjectivities. Drawing from a) Sociocultural Theory (Vygotsky, 1978), and b) Feenberg's (2008) postmodern perspective and critical theory of technology as socially constructed practices-in-action have added to our attempts to gain a more nuanced understanding of how learners and teachers' identities are mediated in BL settings and the external and internal forces that influence that mediation. It is by teasing apart the intricacies of this dynamic process, in our view, wherein lies the basis of a more applicable theory of practice for BL programming, regardless of the discipline. In other words, it is through adopting a humanistic lens that we can build standards for what "good" teaching, learning, administering and policy making look like in this modality - the kind of standards that can lead to quality BL programs that exist already in our combined visions, but are still out of reach.

In the remainder of the paper, we first build the framework for an emerging theory for BL by discussing the existing literature that supports our work. Then, we explain details of the multi-level inquiries we conducted in the institution and its umbrella organization and the methodologies we used in that process. Next, we discuss the analysis and findings that emerged from our inquiries. Finally, we reflect on the implications of adopting a sociocultural perspective for BL theory making in higher education more broadly.

2. Theoretical framework

Despite the move by higher education institutions, at least at the discourse level, to move from traditional pedagogical practice to more engaged learning and innovative teaching approaches, progress has been slow (Andres, 2017). Declines in student performance and enrolment, passive learners and high dropout rates have been on the agendas of most universities and colleges worldwide over the last few years (OECD, 2013), including in Chile. The temptation to see BL as a method of moving away from purely face-to-face programs, with their stubbornly unchangeable information transfer-based teaching/learning practices, towards what appears to be a forum for active, engaged and creative both teaching and learning, has been an attractive alternative for many institutions, especially with an eye on the bottom line. While studies have demonstrated the apparent benefits of the BL mix, at the same time others have reported on clear resistance towards this mode of teaching/learning (Vaughan, 2007). Change management principles remind institutions that a) resistance to a top-down imposition of new modalities will most often lead to failed attempts to innovate (Kotter and Schlesinger, 2008), that b) strong leadership and support for bridging the gap between what exists and what is meant to change is critical (Charbonneau-Gowdy, 2018) and c) that change of any kind needs to be customized to contextual realities (Gibbert et al., 2011). It appears that these principles often have fallen on deaf ears.

Scholarship in e-learning has not remained silent in pointing to the problems that have occurred in BL settings from a lack of attention to key change principles on the part of institutions (Carbonell et al. 2013; Garrison and Vaughan, 2013). And more recent literature has discussed solutions. For example, solutions have included: a) adopting a bottom-up approach on the part of faculty and learners (Carbonell et al. 2013), b) moving away from reliance on institutionally controlled Learning Management Systems for the blended functionality and replacing them with shared practice of Personal Learning Environments (Dibbagh and Kitsansas, 2012) as well as c) adopting a flipped classroom paradigm approach (O'Flaherty and Phillips, 2015). What each of these recommendations for implementing successful BL programs share in common is recognition that learning, or change, is by its very nature a socially constructed activity. From a sociocultural perspective, these solutions are based on the premise that there are advantages to human development, or cognition, in the dialogic interaction with others in teaching and learning processes (Vygotsky, 1991, Wertsch, 1995). And in this age of emerging socially mediated technologies available to support such interactions, there are consequences when such opportunities are ignored.

Another advantage of the BL solutions suggested by many scholars is that there is an understanding embedded in each of the potential influence of technology on humans involved in their use. Scholarship (Hinkleman & Guba, 2012) helps us to understand the existence of three perspectives that have dominated most e-learning studies with regard to the influence on individuals through the use of technology. From a *deterministic* view, technology is considered to dominate and control human action. An *instrumentalist* view accepts that technology is a neutral tool. A third post modern perspective of technology use, a *relational view*, adopted by Feenberg (2008), and to which we adhere, suggests digital technologies are *influenced by* and *influence* both practices *and* individuals. In other words, we see technologies neither as inanimate objects nor as human inventions intended to dominate human beings, but rather having the potential, depending on their use and the context of their use, to evolve and to lead to human evolution. Thus seeking solutions to BL challenges involves, in our minds, necessarily shedding a spotlight not only on *context* but also on the *identities* of individuals that are being constructed within contexts of blended learning settings. By identity, we reference Fong et al. (2013), as a site of struggle, changing across time and space, and reproduced in social interaction. With few exceptions (Darvin and Norton, 2015; Fong et al. 2016), there has been a paucity of literature with regard to identity issues when looking at the challenges and proposing solutions to BL in higher education. This gap seems particularly short-sighted given the importance that identity research has played in a broad spectrum of scholarship over the last two decades in the study of human practices – in business, psychology, sociology, general education and economics, to name a few. Further, we consider a focus on the sociocultural contexts of BL settings and the identities of the players in these settings as key to the basis of constructing a BL theory. In light of this paucity of research, we hold to our conviction that solutions, models and eventual theories of effective BL will come from a deeper understanding of the ways in which identities are being mediated by various contextual forces within these evolving practices, rather than in prescriptive "to do" lists. Our report of the longitudinal study we conducted in BL in the context of our institution in Chile, was guided by the following questions:

- What are some of the important contextual factors at various levels that played a role in the BL programs offered in the institution?
- How were identities of certain individuals at the different levels – student, teachers, administrators and program overseers, being mediated in this context?
- How can this knowledge lead to greater understanding of successful BL approaches and theory building, if at all?

3. Methodology

The longitudinal study took place between 2016 and 2018 at a Chilean university - one of a corporate Network of private affiliated universities worldwide. Other than an initial Network BL pilot conducted across their universities in Latin America, the study focussed on an English Language BL program in one of the universities in the corporate Network – a large, private university in Chile. It is important to point out that the Chilean university functioned according to Network directives and much of the decision-making regarding the BL program offered in Chile was made at the Network level.

The longitudinal study consisted of the following five individual inquiries (see Figure 1):

- A two-stage inquiry into the BL program offered at the Network level across South America (Charbonneau-Gowdy, 2017);
- An inquiry into the coordinators' perspectives and experiences in administering the Chilean private university BL program (Charbonneau-Gowdy & Cechova, 2017) across various campuses of the university;
- An inquiry into the Director of the BL program and her efforts to incorporate a BL approach in her own teaching (Charbonneau-Gowdy & Frenzel, 2018);
- A mini-study of BL teachers' perspectives teaching in the same BL program reported here
- A 6-month inquiry into the experiences of a small group of adult learners in the BL Chilean program (Chavez, 2018).

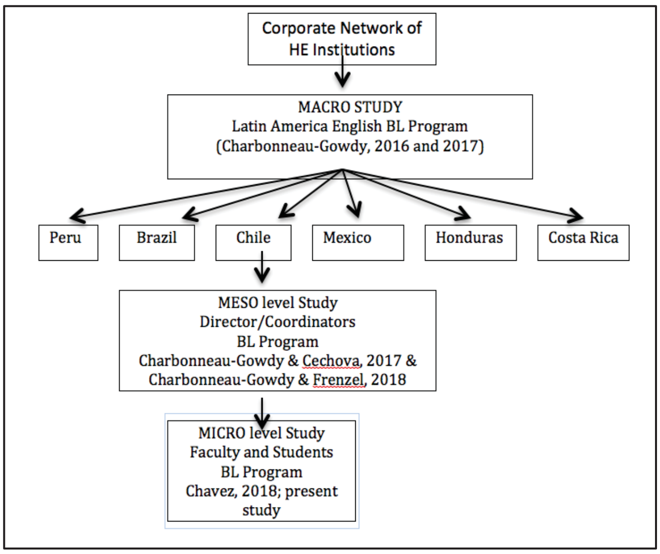

Figure 1: Overview of levels of inquiry in the longitudinal study

Brief summaries of the first three initial inquiries in the overarching longitudinal study supply a backdrop and contextual details that add to an understanding of the latter two inquiries that we report here in more depth. Extensive reports of the initial inquiries can be found in the earlier published articles referenced above. Our aim here is to show how all five inquiries are inextricably linked and are tied to the kinds of identity mediation that we uncovered at the lower BL teacher and learner level. At the same time, the findings of all five inquiries form the framework for the BL model that we propose as a first step in theory building at the end of this report.

3.1 Macro –level context

The original impetus to offer a English Language Learning (ELL) BL program in the Chilean university originated from above – from Network decision makers in the parent company office. In 2016, the Network Parent Institution decided to pilot a 10-week distance language-learning program across Latin America to over 500 employees and faculty working in their affiliated universities on the continent. Our first two-stage inquiry into the experiences and perspectives of both learners (Charbonneau-Gowdy, 2017), and subsequently teachers (Charbonneau-Gowdy, 2018), involved in the initial pilot program were instrumental in preparing for our follow-up Chilean-based inquiries for two reasons: 1) they provided *macro* –level insight into the goals and directives of head office decision makers regarding how they envisioned BL programs to operate across the institutions and 2) the findings offered a glimpse into the identity positions that teachers, learners and administrators were expected to take up in the BL programs at the institutional level, including in the Chilean one.

We concluded in our investigation of the Network, *macro* level BL pilot that the Network decision makers were well-intentioned trailblazers in offering such an innovative large-scale program in South America. For many who took part, the pilot program represented a unique opportunity to assume empowered positions as speakers of English and the personal and professional advantageous that accompanied that ability. On the other hand, elements of the program structure reflecting head-office decision-making detracted from exploiting this opportunity. Our study's findings in both the learner inquiry (Table 1) and teacher inquiry (Table 2) uncovered examples of some questionable decision-making on the part of the Network. The results In terms of the repercussions for learner and teacher identities suggested reasons for the lackluster attainment of otherwise noble Program goals to provide quality 21st century learning opportunities through BL. Indeed, although attitudes remained positive about BL, learning results were generally disappointing.

Table 1: Findings and results of macro level inquiry – learners

Disturbing Findings	Results
Pre-set one-size fits all platform with materials based on traditional pedagogy;	Many learners prevented from exploiting the professional development opportunity and from adopting 21st century skills
Less than effective testing materials – considered « a joke » by some BL teachers (Interview, January, 2017)	Many participants revert to traditional learning practices
Lack of technological infrastructure support offered to learners from some universities (ex. in Chile)	Failure to promote identity empowerment instead learners display a lack of confidence and hesitancy to be interactive social learners
Traditional teaching practices assumed by some pilot teachers in the program.	

Table 2: Findings and results of macro level inquiry - teachers

Findings – mixed messages	Results
Strong support from administrators to provide open communication and involvement of faculty	Willingness and openness to try to new approaches –active promoters of e-learning practices.
Feelings of being appreciated by administration: "I know that I have that backup" (Interview, February 2017)	Destabilizing of many instructors in terms of their confidence and in their openness to adopting social learning practices

Findings – mixed messages	Results
Teachers "allowed" little control over testing and program materials – for example, the ILMS learning platform & traditional testing materials	Conformism and decision to disregard task-based constructivist teaching approaches that rest on deductive learning, agentive learners and social interaction and revert to traditional practices
Lack of faith on the part of faculty in the restricting, restrictive and traditional nature of course materials	Disempowered instructor identities, forced to 'settle for less' and forgo principles and goals as effective 21st century educators

3.2 Meso-level context

The second and third inquiries in Figure 1, (Charbonneau-Gowdy & Cechova, 2017; Charbonneau-Gowdy & Frenzel, 2018), that form a further backdrop for this report involve the *meso* level context of the program administration – both the coordinators and Director of the BL program in Chile. In both inquiries, conducted between August 2016 and January 2018, based on a qualitative Action Research approach to data collection, similar findings were uncovered (see Table 3), this time with data from interviews, field notes and observations collected over the overlapping inquiry periods.

Table 3: Findings and results of meso level inquiry – coordinators and director

Findings	Results
No one had experience with that, nobody, nobody who was in charge, no teachers, no managers. I even think nobody in Lawrence [a pseudonym for Network) (Interview, January 30, 2018).	Director and coordinator ill-prepared and ill-equipped for assuming the roles as leaders in a BL program
Administrators struggling with "letting go" of traditional practices and adopting more learner-centred, dialogic teaching practices in their own classrooms	Assuming disadvantaged and uncomfortable positions in terms of mentoring others and taking on an "expert guide" role
I try to do my best. I spend so much time but I don't feel valued (Interview, October, 2016)	Adopting identities as "less-valued" and accepting lack of control over positive changes to learning results
Evidence of high stress levels stress-levels in teaching and administering of their daily professional practice	Disempowered in their working lives Displayed Identities as "unconvinced doubters" rather than embracers of a BL modality.

Despite the directive from above to put courses online, these administrators found themselves in the unenviable position of leading a BL program to which they felt little in terms of conviction that it would be successful. To carefully guide other teachers to adopt these practices in a BL setting was seen by each of these *meso* level administrators, somewhat beyond their present capabilities. In this disadvantaged and uncomfortable position, the Director and coordinators candidly shared that they had misgivings about the success of the BL approach to learning. It is little surprise that learning and teaching at the *micro* level was fraught with problems, both technical and pedagogical.

3.3 Micro-level context

With this backdrop to our report, we now turn to the *micro*-level context in which both authors' individually conducted overlapping inquires – one designed for teachers, the other that looked at a group of learners in the BL program. At this level, it is important to explain that the Chilean university in which these inquiries took place is a private one and thus generally students and their families assume a significant financial burden to attend the university. Indeed, many students are full time students, and simultaneously, full or part-time employees of local businesses. Students enrolled in the university are registered in majors, or "schools", in which English Language Learning courses (ELL) are a prerequisite for graduation and for many, an unwanted one.

Professors in the university, especially in the ELL BL program, are primarily part-time, who scramble for teaching positions in the cities in which they are located, sometimes even among several universities, in order to make a decent living wage. Their jobs in the university hinge on their availability to accept to teach courses with sometimes little advance knowledge and/ or planning, and generally with no employee benefits, and in some cases a lower than acceptable wage. Many spend exceptionally long hours in the classroom - up to 40 hours a week, which defies finding time for preparation and or reflection, let alone professional development.

The academic culture, as in most institutions in the country, is reflective of the Chilean culture at large – heavily divided socio-economically, a stubborn resilience to maintaining the status quo in the face of change and an inordinate reliance on standards and testing as an indication of academic success and self-worth.

3.4 Research design: Micro - level inquiries

In the teacher inquiry, a qualitative case study was conducted between August 2017 and January 2018. Seventy-seven instructors were asked to participate in our qualitative study. Anonymity was assured and strict ethical guidelines were adhered to in an effort to encourage transparency on the part of the participants. Forty-two teachers completed the questionnaire; nineteen attended online individual 35-45 minute individual interviews, totalling 11 hours approximately.

In the meantime, the inquiry into learner perceptions of the BL program took place between August and November 2017 (Chavez, 2018). It was conducted with nine students enrolled in one of the BL courses for evening students – in other words, fully employed individuals. Of the initial nine students who responded to the questionnaire, four participated in either focus or individual interviews. One of the co-authors, a part-time teacher herself in the BL program, collected the insights of the participants in the context of her Master's study. Primary data sources included: observations, field notes, a questionnaire, and focus group and individual interviews. Her stance as an insider in the inquiry, with several years of experience as a BL teacher in the program, as well as being a teacher of the participants, offered an advantageous perspective in analyzing the data that emerged.

3.5 Data analysis: Micro-level inquiries

In both the teacher and learner inquiry, results of the respective questionnaires were tabulated and analyzed for general themes. These themes formed the basis for the topics of the follow-up discussions in either the focus group and/or individual interviews in the respective inquiries as well as providing cross-referencing and greater reliability to the findings. The extensive data generated from the transcribed interviews in both inquiries were coded and analyzed using standard qualitative methods for uncovering salient themes and patterns. Given space limitations, in this paper we report on two of these themes that surfaced, one from each inquiry that resonate with the thesis from the longitudinal study. More detailed information will be reported elsewhere. Representative excerpts from the interview data sets are used to support the following analysis and conclusions.

4. Analysis and findings

Blended learning is ultimately all about teaching and learning **(Moskal et al., 2012, p. 16).**

No matter what is dictated by those above, it is how these ideas and directives are translated into classroom practice that determines whether new program initiatives reap the benefits that they are meant to achieve. The ways that many teachers and learners translated directives in the BL programs reflected an unease with and lack of belief in this new modality – feelings that are reminiscent of those of the administrators of the program. The lack of investment in change at both levels was all the more salient at the micro level, with few exceptions, and was evidenced not only in the actions but also in the identities of teachers and learners alike. Norton (Darvin & Norton, 2015) draws a direct connection between investment, both learners and/or teachers to engage in innovation, i.e. change or learning, and identity. In this section, the thematic analysis of the data from both the teacher and learner inquiries uncovers the nature and source of their identity issues.

Teacher Identities: Tell me to do and I will comply

Although the data sets revealed that many of the participants in the *teacher* inquiry had strong feelings about what *good teaching* looked like, they expressed that their hands were tied in terms of its practise. Strong support from their direct superiors, i.e. program coordinators, did not undo the feelings of a majority of the teacher participants that various elements of the BL program were counterproductive to successful teaching and learning. Overly large classes, mixed language abilities of students in those classes, online platform materials that had little relevance to the interests and professional aspirations of learners, unreliable and unstable access to the LMS platform and a highly rigid, complex and burdensome testing system were just a few of the ways the program structure was misaligned with their beliefs. Many saw their roles as teachers resemble gatekeepers or as one teacher voiced: "*I'm an online police*." (Valeria, Interview, Dec., 2017). Without formal training in the BL process and little in the way of expert mentoring from administrators, many instructors, even those who considered themselves more "techy" and experienced users were forced to learn by trial and error and expressed frustration at being bound by the technology tools that were at offer.

With regard to training and despite the social learning messages instructors were expected to project in the classroom, there was little evidence of those messages in the kinds of opportunities for peer learning or professional sharing - partly a function of an institutionally imposed part-time faculty and also an information-delivery agenda rather than an idea generating one at the few faculty meetings that were held. Working in silos was seen as a major stumbling block for many to change their realities and for creating a uniform approach to the program. Even the most experienced teachers voiced what Augusto referred to with some candour in his words: "*There are some islands*" (Interview, Dec., 2017), alluding to the need for more collaboration and sharing among faculty. It is little wonder given these constraints that many instructors adopted a 'safe', i.e. traditional, approach to teaching and followed the demands of the program. Yet, with this compliance along with it came the acceptance of an identity as a teacher that was not ideal. As Anna remarked: "*Sometimes, I feel like I can't shine*." (Interview, Dec. 2017). Her words sum up what many participants conveyed, that teaching in the BL program while on the surface appeared as an opportunity to move forward in one's career and professional development, to be current and progressive, at the same time along with this move came a required step back in terms of working towards one's ideal identity as a teacher. To add insult to injury in the self-effacing and less-than-ideal teacher identity that many teachers were forced to mediate in the program, a routine Network visit from "expert" assessors from Head Office left an unflattering review of their teaching quality.

Learner identities*: *Tell me to do, but know that I can't

A sensation of stepping forward and stepping back characterized many of the participants' opinions who participated in the *learner -focussed* inquiry (Chavez, 2018) in the same BL program. For these participants - evening students who were full time employees in local businesses, the BL program had the potential to offer access to enhanced opportunities to learn, in this case English. These opportunities undoubtedly could open doors in their careers. Thus, unlike younger students in the BL program, this particular profile of students brought with them certain openness to working towards and investing in that goal. The data sets indicated that indeed one of the participants showed an impressive interest in English and towards BL and its possible advantages. She used her BL course as springboard for engaging in self-directed online activities that would serve to improve her capabilities. At the same time, the majority of the participants found that the BL program conflicted with their view of learning language, which they saw as contingent on opportunities to socially interact with others rather than to work alone interacting with a machine. Yet, to succeed in the program, learners were forced to accept these kinds of behaviours and passive learner identities. Faced with that choice, the majority of the small group of participants made little progress and saw little reason to invest in learning. Their BL learner identities characterized by resistance or incapacity conflicted with their responsible employee identities and/or traditional learner identities of as information receivers. As a result, a lack of engagement and investment characterized many learners in the group when faced with the requirements of the BL course. One thus could see little hope for these individuals to make significant progress in meeting their language learning goals using a BL modality.

5. Discussion

From the various data sets uncovered in each of the cohorts of the longitudinal study, there is a clear indication of identity issues that existed at each level of the BL programs:

- a leadership identity characterized by top-down policy making whose decision-making often conflicts with its aims for promoting quality and innovative teaching and learning,
- a program administration forced to accept a disadvantaged position of having being placed in a learn-as-we-go scenario that is at odds with its desire to fulfill its mandate to offer strong guidance and support,

- a teaching faculty that is marginalized in terms of its decision-making and power to apply, share and strengthen their "good" teaching practices in a challenging cultural reality and the ever-changing demands of a BL modality,
- a context where learners with varying forms of capital are positioned as the 'real' victims amidst the "systemic patterns of control" (Darvin & Norton, 2015, p. 36) existing within the program. As Anna a teacher in the program, remarked: "*Here students are not permitted to learn, they are permitted to pass the course*." (Interview, December, 2017).

In an era, where increased agency and self-directedness are being hallmarked as key to personal and educational development, these identity issues can be seen not only predictive of unsuccessful and ineffective learning systems, but also offers strong insights into the human impact when institutional policy making and context are misaligned.

6. Conclusion

> *"A clear vision and strong support are necessities when moving to the blended environment. Only then can this modality not just succeed but become a transformational force…" (Moskal et al., p.20)*

Vision and support are both reflective of human interaction and its connection to transformation. As celebrated economist Henry Mintzberg (2017) has cautioned, beginning to make greater strides in the challenges that face education, and we include here BL education, will require a perspective of it as a human practice rather than a science. In reporting on the findings of our longitudinal study, we have adopted that human practice perspective. We have examined individuals in BL practice through the lens of identity theory and focussed on the kinds of identities being mediated at all levels of the BL program. We have done so in response to numerous calls in scholarship, like that of Bernard et al. (2014), who conclude from their meta-analysis of BL research that there is an urgent need for the study of *practice* to "provide the basis for a new and powerful theory of BL, thus laying the groundwork for future research agendas and even greater successes in practice (n.p.)" Our compelling findings strongly suggest an agenda and an important pathway to follow to arrive at that much-needed theory. While many of us in education, immersed in this digitalized age, share a common goal to promote and extend the boundaries of technology in the development of quality, equitable and universal learning, especially as it moves online increasingly online, we believe it will take systematic research and evaluation at all levels of our institutions with an eye on the sociocultural nature of our human practices to ensure these goals are soon met.

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Improving Learners' Inclination to Complete Online Courses: Motivation and Engagement Factors

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Abstract: Many learners born in and after the 1990s would be familiar with some form of digital technology. Labelled as digital natives, they are competent in searching the Web for information, communicating on social media, streaming videos and songs, and using application software. Considering that these digital natives have a high level of digital literacy, does it mean that they are more receptive to learning in digital environments over learning in physical classroom environments? Digital technology has enabled learning in ways that are beyond physical classrooms. Today, learners have access to courses on such massive open online course (MOOC) platforms as Coursera, edX, Udacity, Udemy, etc. These online courses, accessible for free or at a nominal charge, allow learners high course access flexibility at a time and place convenient to them. This study supposes that having high digital literacy is not sufficient to drive learners to undertake, and ultimately, to successfully complete such online courses. Instead, learners must be motivated to engage in learning activities to successfully complete these courses. Adopting the Motivation and Engagement Scale (MES) by Martin (2007, 2009), this study collected responses from university students to examine whether positive motivational thoughts (i.e. self-belief, valuing, and learning focus) alter positive engagement behaviours (i.e. planning, task management, and persistence); whether negative motivational thoughts (i.e. anxiety, failure avoidance, and uncertain control) alter negative engagement behaviours (i.e. self-sabotage and disengagement); and how positive or negative engagement behaviours affect learners' inclination to complete online courses. Findings show that there is a statistically significant positive relationship between positive motivation and positive engagement, between negative motivation and negative engagement, and between positive engagement and inclination to complete. However, the relationship between negative engagement and inclination to complete was statistically not significant. Findings of this study can be useful to MOOC providers and learners in their effort to develop strategies to improve completion rates of MOOCs.

Keywords: digital technology, engagement, inclination to complete, massive open online course, motivation

1. Introduction

Massive open online courses (MOOCs) provide learners worldwide access to a wide range of online educational opportunities at zero or low fees (Jung and Lee, 2018). The Web-based delivery approach gives learners much flexibility and greater autonomy in their learning process, and this makes MOOCs particularly appealing to learners, who recognise the need for continuous learning for personal or professional development, but are facing time and space limitations.

However, the self-paced learning approach poses a self-discipline challenge to MOOC learners. Only a small percentage of MOOC learners successfully completed their courses (Hone and El Said, 2016). Thus, to improve completion rates, it is essential to examine MOOC learners' expectations and motivation (Watted and Barak, 2018; Shapiro et al., 2017).

Past studies have examined the factors behind MOOC learners' motivation or engagement levels; e.g. the effect of perceived reputation, perceived openness, perceived usefulness, perceived enjoyment, and user satisfaction on intention to continue (Alraimi et al., 2015). However, it still remains unclear what the cognitive and behavioural factors are that affect learners' inclination to complete MOOCs. To fill in this gap, this study adopted the Motivation and Engagement Scale (MES) by Martin (2007, 2009) to examine the positive and negative motivational thoughts and engagement behaviours that could affect learners' inclination to complete MOOCs.

2. Research background

2.1 Massive open online courses

MOOCs present learners with an alternative to traditional education beyond physical limitations (Hone and El Said, 2016), and are quite distinctive in some ways from other learning environments (Alraimi et al., 2015). MOOCs are "massive" because learner enrollment can be in the hundreds or thousands; are "open" because any learner who is interested in a course can enroll without restrictions and for free; are "online" because courses are delivered virtually on the Web to learners worldwide; and are regarded as courses because they consist of lessons and learning activities that are to be completed within a certain time frame (Major and Blackmon, 2016).

Despite the advantages of MOOCs, their course completion rates are lower than that of other learning environments (Alraimi et al., 2015). Maxwell et al. (2018) studied four MOOC implementations in healthcare education to conclude that course completion rates varied from 2% to 13%. This could be because, as the learners enrolled in the courses at zero cost and were not given course credit, their course commitment and engagement levels were low. Shapiro et al. (2017), having interviewed 36 participants in two MOOCs, reported reasons for MOOC incompletion such as lack of time, previous bad classroom experience with the subject matter, inadequate background, and lack of resources such as money, infrastructure, and Internet access.

2.2 Learning motivation and engagement

Martin (2007, 2009) defines motivation as one's desire for achievement. Driven by personal cognition and emotion, one may exhibit positive or negative motivation towards learning or work. On the other hand, engagement is about the positive or negative behaviours that reflect one's motivation levels. Green et al. (2012) suggest that motivation and engagement levels play a key role in academic performance. In a study of undergraduate students, Cazan (2015) highlighted that learning motivation had a positive relationship with engagement.

Martin (2007, 2009) developed the Motivation and Engagement Wheel (Wheel) to depict the positive and negative dimensions of student motivation and engagement. The Wheel consists of four main dimensions, i.e. positive motivation, positive engagement, negative motivation, and negative engagement. In each main dimension, there are several subdimensions. Table 1 presents the main and subdimensions of the Wheel.

Table 1: The main and subdimensions of the Wheel

Main dimensions	Subdimensions	Definitions
Positive motivation	Self-belief	Believing and having confidence in one's ability to perform well
	Valuing	Valuing learning for its usefulness, importance, and relevance
	Learning focus	Learning to solve problems and develop skills
Positive engagement	Planning	Planning work and monitoring one's progress in completing the work
	Task management	Managing time effectively for study and tasks at hand
	Persistence	Being persistent in solving difficult problems and not giving up
Negative motivation	Anxiety	Feeling nervous when thinking about assessment and worrying that one would not do well
	Failure avoidance	Doing work just to avoid doing poorly or to avoid being seen as poor
	Uncertain control	Being not in control and uncertain over how to do well
Negative engagement	Self-sabotage	Engaging in activities that do not help one in doing well at work
	Disengagement	Giving up on one's work and accepting failure
Sources: Martin (2007, 2009, 2016a)		

Together with the Wheel, there is an associated Motivation and Engagement Scale (MES) (Martin, 2007, 2009, 2016b). Each of the subdimensions of the main dimensions is manifested by four indicators. Thus, the MES has a total of 44 indicators for the 11 subdimensions. All indicators are measured using a 7-point Likert-type scale, 7 being "strongly agree" and 1 being "strongly disagree."

2.3 Research model

Figure 1 illustrates the research model. Modelled as a higher-order structure, positive motivation, positive engagement, negative motivation, and negative engagement are the second-order formative constructs. At the first-order construct level, positive motivation is manifested by three reflective constructs of self-belief, learning focus, and valuing; positive engagement by three reflective constructs of persistence, planning, and task management; negative motivation by three reflective constructs of anxiety, failure avoidance, and uncertain control; and negative engagement by two reflective constructs of self-sabotage and disengagement. Each first-order construct is manifested by four indicators. Taking the cue from Martin et al. (2017) that motivation may help encourage engagement, this study proposes to model motivation as the predictor for engagement. In this study, the outcome construct is learners' inclination to complete a MOOC that they have enrolled for. It is a first-order reflective construct manifested by three indicators. The indicators are measured using an 11-point Likert-type scale, 10 being "most likely" and 0 being "least likely."

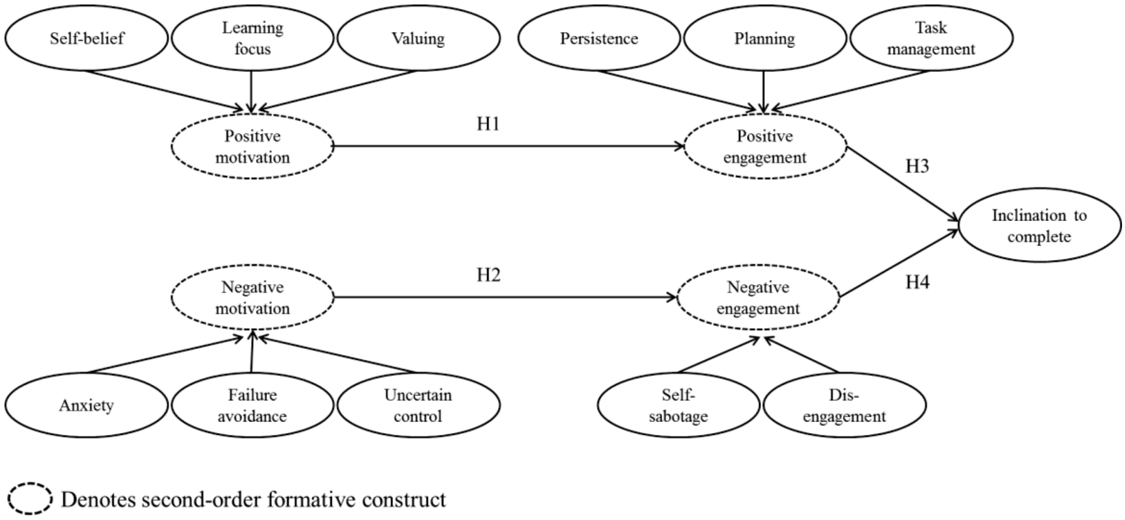

Figure 1: Research model

3. Data collection

License was obtained from Lifelong Achievement Group (Martin, 2016a, 2016b) to use the MES instrument in this study. This study also designed a questionnaire to be administered along with the MES instrument. Both the MES instrument and questionnaire were printed and administered in five tutorial classes of two undergraduate business modules. A brief introduction to the survey was first given and the respondents were assured of completely voluntary and anonymous participation. A total of 103 valid responses were received. Of the 103 respondents, 50 (48.5%) were male students and 53 (51.5%) were female. All of them were doing business-related courses, e.g. business administration, accounting and finance, and so on. 15 (14.6%) of them were in their 1st or 2nd semester, 54 (52.4%) in the 3rd or 4th semester, and 34 (33%) in the 5th semester or later. The average age of the participants was 21.3 years old.

4. Data analysis and results

4.1 MOOC experience

Only six (5.8%) of the 103 respondents had enrolled in a MOOC in the past. Table 2 provides a general profile of these respondents. Of the majority of the respondents (94.2%) who did not enrol in a MOOC in the past, 59 (60.8%) of them planned to do so in the next one to six months, 10 (10.3%) of them in the next seven to 12 months, 10 (10.3%) of them after 12 months, and 18 (18.6%) of them did not intend to take any MOOCs.

Table 2: Profile of the respondents who enrolled in a MOOC in the past

Items	Responses	N	%
Number of MOOCs completed in the past	One MOOC	4	66.7%
	Two MOOCs	1	16.7
	Eight MOOCs	1	16.7%
MOOC platforms that had been used	Coursera	4	66.7%
	Udemy	1	16.7%
	Others (e.g. OpenLearning, Course Hero, OpenTuition)	3	50%
Number of MOOCs currently enrolled in	One MOOC	3	50%
	Three MOOCs	1	16.7%
	Four MOOCs	1	16.7%

Items	Responses	N	%
	Nil	1	16.7%
Number of study hours normally spent on a MOOC each week	Less than one hour	1	16.7%
	Between one to three hours	4	66.7%
	Between three to five hours	1	16.7%

4.2 Confirmatory factor analysis

This study followed a two-step partial least squares (PLS) approach to do a confirmatory factor analysis (CFA) (Anderson and Gerbing, 1988). First, the measurement model was assessed for internal consistency reliability, convergent validity, and discriminant validity (Dunn et al., 1994). Next, the structural model was assessed for significance of the path coefficients and coefficient of determination (R^2) (Anderson and Gerbing, 1988). To perform the PLS analysis, this study used SmartPLS 3 Professional (Ringle et al., 2015). An inter-item correlation analysis was first performed on all of the first-order reflective constructs to check for scale parsimony (Gable et al., 2008). An indicator was removed if its inter-item correlation with any other indicator in the same scale is below 0.30 (Hackman et al., 2006). The results of the analysis showed that TAS_2 of task management, DIS_1 of disengagement, and ANX_3 of anxiety had a poor inter-item correlation with any other indicator in their respective scales. Thus, they were removed from further analyses. All scales showed good Cronbach's Alpha reliability of above 0.7, except that of anxiety (0.666).

4.2.1 First-order reflective measurement model

First-order reflective constructs were assessed for internal consistency reliability, convergent validity, and discriminant validity. Internal consistency reliability - The loadings of indicators were examined for indicator reliability. Those that did not load above 0.708 on the intended construct were deleted to establish unidimensionality (Hair et al., 2014). The following indicators did not meet the threshold value and were subsequently removed from further analyses: VAL_2 (0.561) of valuing; PLA_1 (0.681) and PLA_4 (0.580) of planning; SAB_1 (0.630) of self-sabotage, and ANX_2 (0.310) of anxiety. After they were removed, loadings of all indicators on their intended constructs were above 0.708, except that of BEL_1 (0.676) and BEL_2 (0.694) of self-belief. Although these two indicators did not meet the threshold value, deleting them would result in lower composite reliability for self-belief. Thus, it was decided to still keep them in the analysis. In addition, for satisfactory internal consistency reliability, composite reliability of a reflective construct should exceed 0.708 (Chin, 1998). As evident in Table 3, composite reliability of all constructs was above 0.708. Thus, internal consistency reliability of individual constructs was satisfactory.

Table 3: CR, AVE, and construct correlations

	CR	AVE	ANX	DIS	FAI	LEA	INC	PER	PLA	BEL	SAB	TAS	UNC	VAL
ANX	0.799	0.665	**0.815**											
DIS	0.868	0.686	0.125	**0.828**										
FAI	0.901	0.695	0.245	0.223	**0.834**									
LEA	0.870	0.626	0.271	-0.126	0.063	**0.791**								
INC	0.919	0.791	0.154	-0.196	-0.042	0.253	**0.890**							
PER	0.858	0.602	0.041	-0.214	0.043	0.476	0.358	**0.776**						
PLA	0.928	0.865	0.033	-0.130	0.109	0.291	0.296	0.623	**0.930**					
BEL	0.814	0.524	0.076	-0.301	0.222	0.410	0.193	0.530	0.342	**0.724**				
SAB	0.895	0.740	0.075	0.458	0.347	-0.068	-0.090	-0.284	-0.121	-0.176	**0.861**			
TAS	0.851	0.658	0.241	-0.039	0.159	0.434	0.177	0.480	0.428	0.444	-0.188	**0.811**		
UNC	0.869	0.625	0.214	0.575	0.292	-0.123	-0.069	-0.224	-0.129	-0.287	0.447	-0.059	**0.790**	
VAL	0.861	0.674	0.008	-0.105	0.079	0.465	0.297	0.659	0.618	0.419	-0.140	0.479	-0.151	**0.821**

Notes:
[1] CR: composite reliability; AVE: average variance extracted; square roots of average variances extracted (AVE) are shown on diagonal; correlations between constructs are shown on off-diagonal.
[2] BEL: Self-belief; PER: Persistence; LEA: Learning focus; VAL: Valuing; TAS: Task management; PLA: Planning; DIS: Disengagement; SAB: Self-sabotage; UNC: Uncertain control; FAI: Failure avoidance; ANX: Anxiety; INC: Inclination to complete

Convergent validity - For satisfactory convergent validity, the average variance extracted (AVE) of a construct should be above 0.5 (Chin, 1998). As shown in Table 3, the AVEs of all constructs were above 0.5. Thus, it was evident that all constructs had satisfactory convergent validity.

Discriminant Validity - For satisfactory discriminant validity, the indicators should load higher on the intended construct, but lower on the other unintended constructs (Chin, 1998); and the square root of the AVE of a latent construct should be larger than the correlation between that construct and any other constructs in the model (Gefen and Straub, 2005). Table 3 shows that the square root of the AVE of individual constructs was higher than the correlation between it and any other constructs. Table 4 shows that the indicators loaded higher on their intended constructs and significantly lower on any other constructs.

Table 4: Factor loadings and cross loadings

	INC	BEF	PER	LEA	VAL	TAS	PLA	DIS	SAB	UNC	FAI	ANX	P-values
INC_3	0.836	0.141	0.286	0.245	0.263	0.131	0.242	-0.140	0.009	0.033	-0.012	0.191	<0.001
INC_1	0.915	0.225	0.304	0.208	0.282	0.210	0.270	-0.149	-0.118	-0.076	-0.021	0.142	<0.001
INC_2	0.916	0.154	0.358	0.224	0.252	0.135	0.277	-0.225	-0.123	-0.126	-0.072	0.090	<0.001
BEF_1	0.242	0.675	0.396	0.198	0.224	0.192	0.267	-0.336	-0.236	-0.189	0.146	0.055	<0.001
BEF_2	0.090	0.693	0.299	0.331	0.188	0.219	0.304	-0.116	-0.076	-0.123	0.160	0.151	<0.001
BEF_3	0.167	0.737	0.454	0.329	0.439	0.458	0.256	-0.176	-0.047	-0.248	0.191	0.047	<0.001
BEF_4	0.052	0.786	0.357	0.319	0.306	0.359	0.169	-0.252	-0.175	-0.251	0.136	-0.019	<0.001
PER_1	0.301	0.448	0.783	0.423	0.539	0.404	0.510	-0.216	-0.172	-0.140	0.086	0.088	<0.001
PER_2	0.294	0.369	0.802	0.340	0.543	0.313	0.540	-0.154	-0.303	-0.245	-0.040	0.028	<0.001
PER_3	0.311	0.325	0.768	0.431	0.489	0.331	0.465	-0.125	-0.266	-0.109	0.045	0.069	<0.001
PER_4	0.198	0.506	0.748	0.276	0.468	0.444	0.410	-0.167	-0.139	-0.203	0.039	-0.071	<0.001
LEA_1	0.191	0.268	0.300	0.766	0.229	0.358	0.194	-0.029	-0.057	-0.069	0.005	0.283	<0.001
LEA_2	0.289	0.259	0.319	0.790	0.263	0.342	0.183	-0.137	-0.170	-0.114	-0.008	0.311	<0.001
LEA_3	0.116	0.377	0.249	0.764	0.239	0.294	0.119	-0.164	0.019	-0.114	0.059	0.229	<0.001
LEA_4	0.196	0.385	0.546	0.843	0.611	0.369	0.352	-0.091	-0.012	-0.098	0.117	0.101	<0.001
VAL_1	0.166	0.286	0.506	0.446	0.826	0.395	0.512	0.068	-0.085	-0.070	0.083	0.052	<0.001
VAL_3	0.267	0.289	0.503	0.244	0.784	0.201	0.492	-0.136	0.036	-0.133	0.000	-0.028	<0.001
VAL_4	0.295	0.438	0.603	0.434	0.851	0.539	0.519	-0.182	-0.255	-0.166	0.098	-0.007	<0.001
TAS_1	0.054	0.277	0.380	0.479	0.436	0.786	0.378	-0.044	-0.122	-0.061	0.019	0.157	<0.001
TAS_3	0.216	0.456	0.449	0.374	0.423	0.889	0.380	-0.094	-0.199	-0.084	0.216	0.208	<0.001
TAS_4	0.155	0.335	0.322	0.158	0.285	0.752	0.266	0.080	-0.128	0.025	0.146	0.234	<0.001
PLA_2	0.290	0.298	0.540	0.267	0.601	0.364	0.936	-0.080	-0.067	-0.096	0.099	0.060	<0.001
PLA_3	0.260	0.340	0.622	0.275	0.548	0.435	0.924	-0.166	-0.161	-0.147	0.105	-0.001	<0.001
DIS_2	-0.212	-0.305	-0.233	-0.138	-0.184	-0.150	-0.197	0.813	0.350	0.497	0.205	0.149	<0.001
DIS_3	-0.163	-0.229	-0.161	-0.149	-0.051	0.022	-0.056	0.812	0.395	0.441	0.047	0.079	<0.001
DIS_4	-0.110	-0.209	-0.133	-0.028	-0.017	0.043	-0.060	0.859	0.397	0.486	0.287	0.077	<0.001
SAB_2	-0.110	-0.195	-0.304	-0.088	-0.172	-0.203	-0.205	0.357	0.884	0.464	0.323	0.049	<0.001
SAB_3	0.005	-0.095	-0.114	-0.048	0.010	-0.149	0.060	0.361	0.861	0.285	0.330	0.055	<0.001
SAB_4	-0.112	-0.147	-0.287	-0.029	-0.174	-0.123	-0.124	0.475	0.837	0.375	0.241	0.094	<0.001
UNC_1	0.048	-0.188	-0.103	-0.006	-0.046	-0.140	-0.043	0.317	0.302	0.741	0.043	0.121	<0.001
UNC_2	-0.003	-0.246	-0.246	-0.068	-0.228	-0.077	-0.115	0.377	0.431	0.714	0.398	0.289	<0.001
UNC_3	-0.070	-0.215	-0.159	-0.118	-0.073	0.049	-0.050	0.544	0.329	0.845	0.122	0.165	<0.001
UNC_4	-0.155	-0.253	-0.187	-0.165	-0.122	-0.051	-0.186	0.535	0.350	0.851	0.322	0.104	<0.001
FAI_1	-0.035	0.188	0.068	0.085	0.116	0.172	0.125	0.212	0.303	0.306	0.869	0.264	<0.001
FAI_2	0.021	0.209	0.068	0.074	0.091	0.125	0.159	0.138	0.277	0.240	0.842	0.148	<0.001
FAI_3	-0.036	0.236	0.048	0.112	0.113	0.309	0.003	0.127	0.204	0.192	0.763	0.233	<0.001
FAI_4	-0.075	0.140	-0.024	-0.024	-0.023	0.005	0.064	0.236	0.343	0.224	0.856	0.182	<0.001
ANX_1	0.058	-0.090	-0.086	0.099	-0.062	0.131	-0.041	0.087	0.077	0.273	0.120	0.798	<0.05
ANX_4	0.189	0.202	0.142	0.334	0.070	0.257	0.090	0.116	0.047	0.084	0.274	0.832	<0.01

Note:
[1] BEL: Self-belief; PER: Persistence; LEA: Learning focus; VAL: Valuing; TAS: Task management; PLA: Planning; DIS: Disengagement; SAB: Self-sabotage; UNC: Uncertain control; FAI: Failure avoidance; ANX: Anxiety; INC: Inclination to complete

4.2.2 Second-order formative measurement model

To assess the second-order formative constructs, this study followed the suggestion of Hair et al. (2014). First, latent variable scores of the first-order reflective constructs were obtained. Then, these latent variable scores were used as the indicators for their respective second-order formative constructs. These formative constructs were then assessed for indicator weight and significance, and multicollinearity (Hair et al., 2014).

An initial analysis showed that the outer weights of four indicators were statistically not significant, i.e. learning focus (p=0.133), planning (p=0.072), failure avoidance (p=0.155), and anxiety (p=0.679). Hair et al. (2014) suggest that if the outer weight of an indicator is not significant but its outer loading is above 0.5, the indicator can be retained in the model. Learning focus and planning met this criterion. Thus, they were retained. On the other hand, when the outer weight of an indicator is not significant and its outer loading is below 0.5 but significant, the indicator may be retained. Failure avoidance met this criterion. Thus, it was retained as well. However, when the outer loading is below 0.5 and not significant, the indicator can be deleted. Anxiety met this criterion. Thus, it was deleted.

Table 5 provides a summary of the final weights of the indicators for positive motivation, positive engagement, negative motivation, and negative engagement. In terms of relative importance, valuing (0.694) contributed more than self-belief (0.345) to positive motivation; persistence (0.658) contributed more than task management (0.258) to positive engagement; uncertain control (0.909) contributed most to negative motivation; and disengagement (0.737) contributed more than self-sabotage (0.417) to negative engagement. For indicators that had nonsignificant outer weights, their outer loadings determined their absolute contribution to the formative constructs (Hair et al., 2014). In this case, the absolute contribution of learning focus to positive motivation was 0.644; that of planning to positive engagement was 0.780; and that of failure avoidance to negative motivation was 0.494.

Table 5: Outer weights of second-order formative constructs

First-order reflective constructs	VIF	Second-order formative constructs				T-statistics	P-values
		Positive motivation	Positive engagement	Negative motivation	Negative engagement		
Valuing	1.387	0.694				5.981	0.000
Self-belief	1.306	0.345				2.846	0.004
Learning focus [1]	1.374	0.180				1.503	0.136
Persistence	1.797		0.658			5.801	0.000
Planning [2]	1.694		0.260			1.797	0.077
Task management	1.347		0.258			2.599	0.009
Uncertain control	1.119			0.909		10.375	0.000
Failure avoidance [3]	1.137			0.229		1.423	0.149
Disengagement	1.266				0.737	5.115	0.000
Self-sabotage	1.266				0.417	2.509	0.011

Notes:
[1] Learning focus was retained – outer loading was 0.644 and significant (p<0.005)
[2] Planning was retained – outer loading was 0.780 and significant (p<0.005)
[3] Failure avoidance was retained – although outer loading was below 0.5 (0.494) but significant (p<0.005)
[4] Anxiety was deleted because of low and nonsignificant outer loading (0.197, p=0.184)

To assess if there are multicollinearity issues, the variance inflation factor (VIF) value of each indicator should be below 5.0 (Hair et al., 2014). Table 5 shows that the VIF values of all indicators were below 5.0. Thus, multicollinearity issues did not exist.

4.2.3 Structural model

The structural model was assessed next for significance of path coefficients between two constructs and coefficient of determination (R^2) of endogenous constructs (Urbach and Ahlemann, 2010).

A bootstrapping procedure of 5,000 sub-samples calculated the t-statistics of path coefficients between the exogenous and endogenous constructs (Gefen et al., 2000). Figure 2 depicts the final structural model (without showing anxiety as it was deleted).

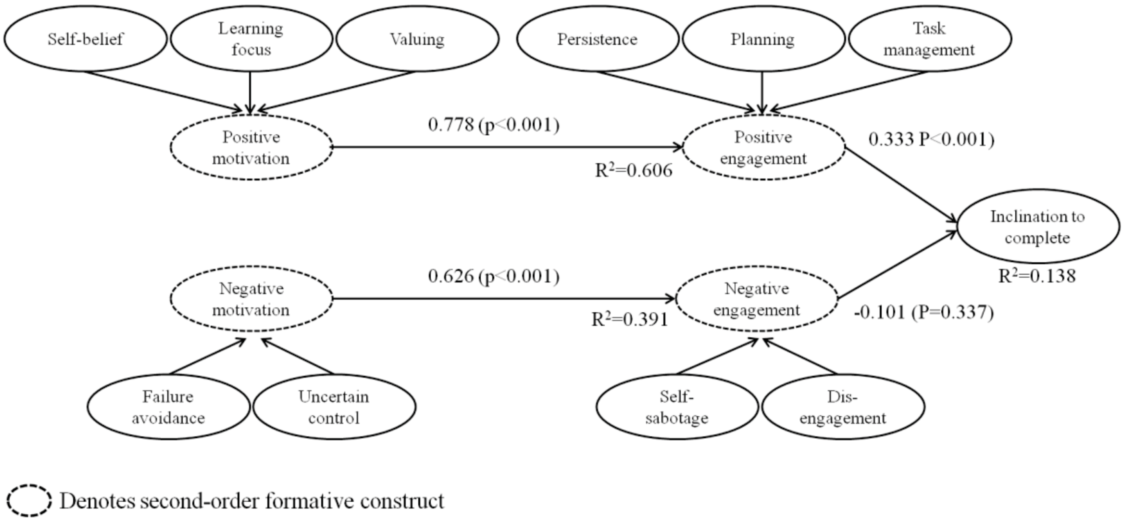

Figure 2: Final structural model

The relationships between positive motivation and positive engagement, between negative motivation and negative engagement, and between positive engagement and inclination to complete were statistically significant and positive. Although the relationship between negative engagement and inclination to complete was negative as hypothesised, it was not statistically significant (β=-0.101, p=0.337).

Positive motivation explained about 60% of the variance in positive engagement (R^2=0.606), while negative motivation explained about 39% of the variance in negative engagement (R^2=0.391). As the relationship between negative engagement and inclination to complete was not significant, without considering this relationship, positive motivation explained about 12.8% in inclination to complete (R^2=0.128).

5. Discussion and conclusion

Only about 6% of the respondents had enrolled in a MOOC in the past. This finding is quite similar to that of a 2015 online survey by Statista.com (2015), which found that only 9% of some 50,000 undergraduate students worldwide took a MOOC in the past year. In the same survey, it was also reported that 74% did not know what a MOOC was, and 17% knew what a MOOC was but had not actually taken one. In this study, it seems that the respondents had shown a general interest in MOOCs, with about 81.4% of them expressing an intention to enroll in a MOOC in the next one to 12 months.

Although a few indictors were removed from the first-order reflective measurement model, this study concurred with other studies (e.g. Martin et al., 2015; Martin et al., 2017; Martin et al., 2018) that the scale reliability and validity of the MES constructs were clearly evident. In addition, when used as an indicator for the second-order formative construct of negative motivation, although anxiety was deleted because of statistically nonsignificant outer weight and outer loading, the overall structure of the Wheel remained intact. In this case, the respondents did not seem to consider anxiety a key element to negative motivation as much as failure avoidance and uncertain control. It may be that the respondents were sufficiently self-confident to not worry too much about not being able to do well in assessment tasks.

The findings provide support for hypotheses H1 and H3 that positive motivation leads to positive behaviours in learners, which eventually promote a higher level of inclination to complete MOOCs. This concurs with Martin et al. (2017) that motivation is the driving force of engagement. Thus, for MOOC providers to improve completion rates of their courses, they should help learners to develop higher levels of self-belief, learning focus, and valuing, and provide learners with tools or technologies to support better planning, task management, and persistence in their pursue of MOOCs.

The findings also provide support for hypothesis H2 that negative motivation leads to negative behaviours in learners. Although the relationship between negative engagement and inclination to complete MOOCs was not statistically significant, the findings provide partial support for hypothesis H4 that negative engagement may contribute to a lower level of inclination to complete MOOCs. In this case, there may be negative behaviours; however, these negative behaviours may not have as significant an effect as that of positive behaviours on inclination to complete MOOCs. Thus, MOOC providers and learners should employ strategies to reduce levels of failure avoidance and uncertain control, and to refrain from self-sabotage and disengagement practices.

The findings from this study can help MOOC providers to better understand how to develop effective motivation and engagement strategies to encourage learners towards high levels of course completion. The findings can also serve as a springboard for learners to reflect on the importance of staying motivated and engaged, and to learn helpful motivation and engagement practices for high levels of course completion.

5.1 Research limitation

In this study, most respondents did not enroll in any MOOC in the past. Although it was still valid for the study to ask them for their opinions about their inclination to complete a MOOC if they were to actually enroll in one, their opinions might be different from those who have actually enrolled in one.

5.2 Future research directions

Two future research directions may be suggested. First, the same study can be conducted to target respondents who have actually enrolled in a MOOC and examine if there are significant differences between actual users and prospective users of MOOCs. Second, the same study can be replicated in other cultural and educational settings for comparison purposes in terms of learning motivation and engagement.

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Textbook Costs and Accessibility: Could Open Textbooks Play a Role?

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Abstract: Rising textbook costs have been highlighted as an issue for students in higher education (HE), particularly in North America. Less is known about the costs and forms in which books are available to students in higher education in Europe and specifically in Ireland. This is despite significant moves towards openly licensed books as a potential response via established open access publishing platforms. This research sought to address a gap in the scholarly understanding of textbook usage and the potential of open alternatives in Ireland. We present the results of an analysis of the accessibility, cost and licensing of textbooks in Ireland taking one higher education institution as a case study. We report here on the findings of phases one and two of this study, including the retail prices of over 500 books, the formats they are available in and those that are in the public domain. The next phase of this study involved the design of research instruments to use with staff and students as participants in research. These instruments were designed, with reference to the research literature on Open Education Resources (OER), such as Wiley's 5 Rs of OER, to examine the current usage and perception of educational textbooks with the overarching aim of determining the relevance of digital open textbooks in the Irish context.

Keywords: textbooks, OER, open textbooks, digital learning, research methods, focus groups

1. Introduction

Studies conducted in American universities in the last few decades strongly indicate that textbooks impose a substantial financial burden on students, putting an additional strain on their finances. Remarkably, textbook prices have increased by four times the cost of inflation in the last twelve years (Vitez, 2018). In response to this, the movement to create and encourage the adoption of Open Education Resources (OER) has gained momentum. OER are free and openly available online, and they can include open books. OER have been defined by UNESCO as related to ''The open provision of educational resources, enabled by information and communication technologies, for consultation, use and adaptation by a community of users for non-commercial purposes'' (UNESCO, 2002). Open textbooks are educational texts "with an 'open' copyright license allowing the material to be freely accessed, shared and adapted. Open textbooks are typically distributed online at no cost and can be purchased in a variety of either print and/or digital formats at a low cost, including hard bound copies" (Student PIRGs, 2017).

Open textbooks have been published through specific platforms, such as OpenStax. These providers typically are digital first, open access, and make books freely available online, under a Creative Commons licence (Hilton, 2016). Equally importantly, publishers of open textbooks have striven to ensure the development of high-quality teaching resources: firstly, through the academic expertise of authors; and secondly, by adding peer-reviewed processes. In March 2018, a substantial government grant, amounting to USD $5 million, was passed into law by the U.S. Congress, to encourage the adoption of open textbooks in universities, marking the first major investment in OER at this level (Allen, 2018).

While open textbooks are becoming increasingly widespread in North America, including Canada, in Europe their adoption is less noticeable. In the UK, a major project, the UK Open Textbook Project, was commenced in 2017 to investigate the possible adoption of open textbooks in UK HE, based on North American models. Research is currently ongoing, with an online survey on open textbooks being circulated among teachers (UK Open Textbook Project, 2018).

In Ireland, however, the OER movement is currently fragmented: the National Digital Learning Resources initiative was closed in 2012. The initiative had the aim of promoting collaboration, development and sharing of learning resources among Irish HEIs (McAvinia and Maguire, 2011). Started as a pilot in 2005, it graduated to a full project in 2010, before being closed, and the funding withdrawn, in view of the mixed results obtained.

Furthermore, recent Irish policy reports, such as the *Roadmap for Enhancement in a Digital World 2015-2017*, do not make much mention of textbooks; similarly, no reference was made to open textbooks in the Irish section of a recent European report describing open learning initiatives in 28 EU countries (Inamorato dos Santos et al, 2017; Brown, Costello and Nic Giollamhichil, 2018). Last but not least, a scan of the Irish higher education sector we conducted found little evidence of Irish open digital textbook initiatives, e.g. a Google Search typing the terms "open (digital) textbook", "Ireland" and "Irish higher education" yielded only one relevant result, a 2010 Twitter stream (Brown, Costello and Nic Giollamhichil, 2018). However, a 2015 study of OER was conducted with academic staff, librarians and technical officers from 4 different Irish universities. The study, which included a survey and focus groups, highlighted some confusion around OER, which were mainly used to supplement teaching rather than as primary resources. The chief recommendation emerging from the study consists of delivering a module on OER for all academics, as part of their professional development (National Forum for the Enhancement of Teaching and Learning in Higher Education, 2015). What all of the above highlights is that there is almost no discussion on textbooks, as one of the primary learning resources in higher education in open ed and specifically on their cost and what role open alternatives might play.

2. Formulating a response

In response to the dearth of OER initiatives, and to the lack of systematic knowledge and studies on textbooks in Irish higher education, we initiated a research project in the area. One premise we started from was the hypothesis that textbooks are as expensive in Ireland as they are in North America. If this was found to be true a second hypothesis would be that the adoption of an open textbook module could help alleviate the problem associated with textbook costs. The project hence aims to gather an understanding of the use, practices and impact of textbooks in Irish higher education, and to analyse perceptions of, and opinions about, open textbooks.

The research aims are as follows:

- To establish the lived student reality of textbook use, re-use and non-use in Ireland.
- To fundamentally question the role and value of textbooks in 21st century education in Ireland (Brown, Costello and Nic Giollamhichil, 2018).
- To gather data about costs of textbooks, considering that they can vary substantially across disciplines and courses.
- To gain an understanding of the importance for students and academics of traditional print versus digital textbooks.
- To establish the level of awareness, understanding and participation of students and staff with regard to OER, including open textbooks.

The project has been designed to comprise four phases. Each successive phase builds on the previous one. The first phase involved an initial literature review and desk research. The second phase involved an empirical investigation of prices of textbooks in one Irish higher education institution. The third phase, which is in progress, involves qualitative research on staff and student perceptions of textbooks and the potential implications of open textbook and OER practices and policies. The fourth phase involves a wide scale national survey.

It is envisaged that the results of this project will be widely shared with other education institutions. Without a doubt, other Irish higher education institutions will also benefit from the knowledge of textbook costs and practices and of open textbook awareness which the research set out to gather. Furthermore, it is very possible that other European countries will also benefit from an analysis of the data we have gathered and of the data we will collect, albeit with specific modifications, tailor-made to suit local contexts.

3. Overview of phases one and two: Textbook cost and availability empirical investigation

Phases one involved research that is more fully reported elsewhere (Brown, Costello and Nic Giollamhichil, 2018) but which we will provide a synopsis of here. This phase consisted of a comprehensive review of the extant literature and desk research on the state of play of textbooks and open education in Ireland. Something that is apparent from the literature is that there is very little hard empirical data on commercial textbook costs reported. In order to address this, we embarked on phase two of the project, by downloading the information from one Irish higher educational institution's course catalogue, that included the required and recommended textbooks for students enrolled in the institution. The catalogue was freely available, on a database powered by software known as Akari. Given that nearly 4,000 books were found, we needed a programmatic solution to generate more information on those books automatically. To this end, we used Google Books API, the interface to the Google Books database of over 25 million books. The Google Books API is forgiving of mistyped or misspelled search queries. We then developed and applied a Javascript middleware programme to process these results and analyse the 2,940 books that were found in the Google Book database. We made the software code and results obtained available under an open license on the Zenodo publishing platform for Open Science (Costello and Bolger, 2018). The architecture of the system is shown in figure 1 below.

Figure 1: System design (Brown, Costello and Nic Giollamhichil, 2018).

Of those 2,940 books, 71.5% were required readings, and 28.5% recommended. Prices were returned from the Google Books API for 596 books. They ranged from $0.99 to $452 with a median price of $40. For a summary of book prices, see Figure 2 below. There were an average of 3.96 books per course, and an average 8.05 courses were taken by students per year. Hence, we calculated that the total cost of new books—both required and recommended—could amount to $ 1,806.50 per student per academic year. Just under 40% of books had electronic versions. Only 0.18% (6) books had a version available under an open license according to the data available from Google Books.

Figure 2: Summary of book prices (n = 596)

In May 2018, we received ethical approval from our University Ethics Review Committee (Ref: DCUREC/2018/111) to conduct qualitative research with focus groups. Our aim is to help come to an understanding of students and staff practices regarding textbooks. It is planned to conduct the focus groups in summer 2018, and at the beginning of the 2018-2019 academic year.

The data gathered from an analysis of the focus group discussions will then inform a survey, to be circulated more nationally to students and staff in Quarter 3 of 2018. The survey will help triangulate findings from the preceding phases with a much larger sample of data and according to a well-informed research instrument.

Next, we are going to focus on the design of phase three of the project. We will discuss the methodological rationale to the use of focus groups in our research and the theoretical elements that informed the development of the research instrument i.e. the focus group schedules.

4. Design of phase three: Participant perception of textbooks

Phase three of the research project involves listening to staff and students about their actual lived experience of the use (or non-use) and perceptions of textbooks. To situate this, we will first introduce some relevant existing research in this area. Hilton (2016) in analysing the state of the art of research on open textbooks identified 9 peer-reviewed studies (of 50 participants or more) on student and staff perceptions of open textbooks or OER as textbook replacements. A potential limitation of this line of research, however, is the lack of detail on how the research designs were informed by a theory or model of open education (Dieman and Farrow, 2013). Typically, such studies, with good pragmatic reason, focus closely on perceptions of cost and quality. We too drew on these concepts, including on the wider literature on textbook cost (Silver, Stephens and Clow, 2012) in the design of our focus group interview schedule. However, we also sought to interrogate the actual basis of and for OER by testing more widely some of the OER principles that have been advocated.

There are various definitions of open education. It has been argued that the tradition of open education goes back several centuries in various guises (Peters, 2008) particularly if we frame it in a broad sense, related to increasing access of education as a public good (Peter and Deimann, 2013). Open Education may "be seen as a response to, or at least as part of, a broader social change made possible by digital technologies" (Weller, 2011). It was later elaborated by Weller (2015) to encompass a broad set of ideas comprising: the freedom to reuse; open access; free in cost; ease of use; digital, networked content; social/community approaches; ethical arguments for openness; and openness for efficiency. Whilst bearing these ideas in mind we also sought to include specific principles focused on open educational resource use that would be easily comprehensible to staff unversed in the traditions of open education. To this end we drew on the simple but powerful framework of the "5 Rs of Open Resources". The concept was first theorised by Hilton et al (2010). At that stage, however, only 4, rather than 5, Rs, were asserted as salient characteristics of OER; they go as follows:

- Reuse= the right to use content in a wide variety of ways.
- Revise= the right to adapt, adjust, modify and alter content.
- Remix= the right to combine a certain content with other content.
- Redistribute= the right to share copies of the original content, and/or of revisions or remixes.

(Hilton et al, 2010).

Latterly, Wiley (2014) added another R as a fundamental characteristic of OER:

- Retain= the right to make, own and control copies of the content.

This fifth R arose in response to commercial textbook publishers devising models of digital rental to students, where the rights to the rented copy would expire after a period of time.

4.1 What needs do lecturers have around textbooks?

In designing the questions for all the focus groups, we drew on the five principles of OER. Most noticeably, however, the questions for staff have been informed by all 5 Rs of OER. This is a reflection of the greater involvement of lecturers traditionally in the development or selection of learning materials and resources and the fact that some of the 5 Rs relate directly to content creation. Open educational practitioners have reported on, and advocated for, highly participatory models where students are actively involved in the development of books or learning resources (Hodgkinson-Williams and Paskevicius, 2011). Students may indeed be engaged in public scholarship to this end, developing their own open textbooks (DeRossa and Robinson, 2017). Students can, according to partnership models of education more broadly (Healey, Flint and Harrington, 2014), be co-creators of teaching approaches, course design, and curricula (Bovill, Cook-Sather and Felten, 2011). However, we expect that most lecturers will be more familiar with contexts where they themselves are the principal developers or curators of learning resources and materials for students. Hence, we specifically developed the following questions, addressed to academic staff, derived from the 5 Rs:

- a. Reuse. Do lecturers ever need to re-use something from a textbook such as a figure, an image, etc. in another context, e.g. on PowerPoint slides? (question 7 below)

- b. Revise. Would you, or lecturers you know, ever need to take something from a textbook and adapt or modify it? (question 9)
- c. Remix. Would lecturers ever need to mix content from multiple textbooks? (question 8)
- d. Redistribute. Do lecturers share any such adaptations beyond their classroom? (question 10)
- e. Retain. Is it important for students (or indeed staff) to have access to books beyond the life of a course/module? (question 11).

What needs do students have around textbooks?

Due to the lesser requirement traditionally on students in the development of learning resources, a different set of questions were designed for the student focus groups, though they also map to 3 of the relevant principles derived from the 5 Rs. The relevant questions are:

- a. Revise/Remix. What is one thing that lecturers can do to improve students' textbook experience? (question 8 below)
- b. Retain. Do students need to keep textbooks beyond the course/module? Or might they wish to? And what implications might this have? (question 6).

The full details of both focus group question schedules are given in Appendix A.

The other questions were designed with the aim of gathering general knowledge of textbook costs in an Irish third-level education institution, as well as of perceptions, attitudes and practices towards them, and also the use of hard copy versus digital versions of those books. We next introduce some of the research we drew on in formulating these questions.

In the last two decades, for the first time, books have been available in a new format: digital or electronic. Electronic books fall under two principal types: as scanned PDF copies of print textbooks, or as reflowable digital textbooks. The latter have the advantage of including interactive features, e.g. hyperlinks and discussions (Jhangian et al, 2018). Digital textbooks have increased because of their lower cost and convenience. Many studies have analysed the influence of textbook format on learning, with mixed results. For example, Daniel and Woody (2013) claimed that students' performance remained unchanged, regardless of whether they used electronic or print versions of the same textbooks. Significantly though, reading times were longer for e-textbooks than for their print counterparts, presumably because students were more likely to engage in multitasking while reading electronic textbooks than while reading print books (Daniel and Woody, 2013). It seems, however, that most students prefer print to digital versions, regardless of gender or of previous familiarity with computers (Shepperd, Grace and Koch, 2008; Woody, Daniel and Baker, 2010); an inability to take notes or highlight text were among the main reasons provided (Jhangian et al, 2018). It is thus unsurprising that e-textbooks are far from being as popular as e-books in general.

Nonetheless, the review previously mentioned, synthesising the results of 16 empirical studies, focussing on OER efficacy and perception among students and staff, based primarily in North America, indicates that "OER are comparable in quality to traditional learning resources" according to most students and academic staff (Hilton, 2016).

These findings may appear contradictory: on the one hand, e-textbooks seem to hold less appeal for students, because they require longer reading times, or because reading on screens puts a strain on students' eyes; on the other hand, both students and staff seem to like OER, because they are free, easily accessible and adaptable. The issue here is the separation between books' formats, i.e. print or digital and their type of licensing, i.e. commercial or open. Theoretically, both commercial and open textbooks can be accessed in both digital and print formats, though it may be that commercial textbooks are more often accessed in print format, while open textbooks are more often accessed in digital format. Our research will attempt to untangle these issues through dialogue with students.

4.2 Focus group design

We highlighted the importance in a previous section of the role students can play in Open Educational contexts with regard to their input to teaching scenarios. This can also be seen more widely in the context of moves to involve students as partners (DeRossa and Robinson, 2017; Healey, Flint and Harrington, 2014; Bovill, Cook-Sather and Felten, 2011). In keeping with this approach, our research methodology is informed by interpretivism and a concomitant dialogic approach where we sought to engage students in conversations about their learning. Focus groups are one useful research method for data collection that follows from this approach. Focus groups are relatively small, usually including between three and ten people per group (Sharp, Rogers and Preece, 2007; Krueger, 2002). Since participants should feel relaxed, and not be afraid of voicing dissenting or even troublesome opinions, it is recommended that focus groups include similar types of people (Krueger, 2002). Hence, we will form two separate focus groups for students and staff: if asked to talk about textbooks alongside lecturers, for example, students may feel uncomfortable because of power imbalances, and they may not disclose their real practices. The main benefit of focus groups is that they allow for diverse or sensitive issues to be raised in a relaxed environment (Krueger, 2002), within a social context. We will have two facilitators or moderators: a principal one, who introduces the session, asks questions, and brings the session to an end; and an assistant moderator, who is in charge of the logistics and takes notes. Focus groups involve a pre-set agenda posed by the moderator's questions; however, participants are at the same time free to suggest new ideas (Sharp, Rogers and Preece, 2007). We sought to develop open-ended questions, while avoiding dichotomous questions, which can be answered with a mere 'yes' or 'no'. Further we planned our questions to follow a sequence starting from the general, moving on to the more specific (Krueger, 2002). Finally, we aimed to design questions that could be addressed to the group as a whole, rather than to the singular individuals, e.g. "What do students think" rather than "What do you think?", to encourage a sense of participation, and so that students may feel willing to share the experiences of their fellow classmates rather than just their own.

Four focus groups will be assembled, three of which will be composed of students, and one of staff members. We have received permission from three Heads of Schools, as well as from the students' union president, to recruit students and staff for the focus groups and ethical permission from our institutional Ethics Review Committee to undertake the research.

The reason why we have decided to target primarily students rather than academic staff is because staff members have already been involved in an empirical research on OER in Ireland, in 2015, while students have not. Over 200 professionals have either answered a survey, or participated in focus groups, specifically on OER. It is important to bear in mind, however, that the study was limited, in that participants were self-selecting (National Forum for the Enhancement of Teaching and Learning in Higher Education, 2015).

Each group will include between six and ten participants. It seems that this is the ideal number of participants, as suggested by Sharp, Rogers and Preece (2007), and corroborated by the experience facilitating groups of similar sizes in tutorials and workshops by authors of this paper using methods such as World Cafe (Prewitt, 2011). A total cohort of between 24 and 40 participants will thus be formed.

The discussions from the focus groups will be recorded and then analysed according to thematic analysis by the research team. Thematic analysis—a term coined by Holton in the 1970s—is a method used to analyse qualitative data, common in psychology and social sciences. It "involves attention to the constructive role of language, and multiple and shifting of meanings", but retain a specific interest in *patterned* meaning (discourses) within the dataset (Clarke and Braun, 2014). It consists of the generation of codes and themes from qualitative data. The codes are interesting features of the data, of relevance to the research question; themes are then constructed from the codes.

5. Conclusion

Our project to investigate use and perceptions of textbooks in Irish higher education and about open textbooks is a work in progress. Through phase one, via literature review and desk based research, we firstly established that there was a lack of knowledge of the potential of open textbooks in Ireland to address issues of cost and accessibility for students (Brown, Costello and Nic Giollamhichil, 2018). We determined some extent of the scale of these textbook costs through the phase two analysis of a sample of textbooks either required or recommended as readings to students in Irish higher education (Brown, Costello and Nic Giollamhichil, 2018).

We are now taking steps to organise focus groups, with both students and staff, to gain deeper understanding of the real use (or non-use) of textbooks. This qualitative research will inform a survey, which will be circulated more widely among students and staff nationally in Ireland in Quarter 3 of 2018. It is hoped this study will pave the way to develop awareness of, and to encourage the creation and adoption (Costello, 2014) of, open textbooks in Irish Higher Education. We are reminded of the words of the British novelist, Mark Haddon: "Reading is a conversation. All books talk. But a good book listens as well" (Haddon, 2004). The same holds true for textbooks, as well as for research. It is only by listening to students and staff that we will be able to assess the practices around textbooks and OER in Ireland, thereby identifying patterns, trends, and areas for innovation and improvement.

Appendix A

Staff Focus Group Interview Schedule

1. As a university lecturer, do you prescribe textbooks?
2. What is your opinion of textbooks? Do you value them?
3. What are lecturers' perceptions of print versus digital forms of books?
4. What considerations do lecturers make to the cost of books for students?
5. How often do lecturers change textbooks?
6. What are lecturers' perceptions of textbook publishers?
7. Do lecturers ever need to re-use something from a textbook such as a figure, an image etc. in another context e.g. on PowerPoint slides?
8. Would lecturers ever have need to mix content from multiple textbooks?
9. Would you or lecturers you know ever need to take something from a textbook but adapt or modify it?
10. Do lecturers share any such adaptations beyond their classroom?
11. Is it important for students (or indeed staff) to have access to books beyond the life of a course/module?

Student Focus Group Interview Schedule

1. As a university student, do you use textbooks?
2. What is your opinion of textbooks? Do you use them and do you value them?
3. Do you buy or borrow textbooks? If you buy them, do you buy them from the campus bookshop or online? New or second-hand?
4. How much money do you approximately spend on textbooks per academic year?
5. Do students usually read hard copies of books, and/or digital copies online?
6. Do students need to keep textbooks beyond the course/module? Or might they wish to? And what implications might this have?
7. Are you aware of Open Education Resources?
8. What is one thing that lecturers can do to improve students' textbook experience?

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Matching Audience With Game Elements for Maximum Engagement

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Abstract: Gamification is a simple concept rarely used effectively long-term. The simplicity of concept belies the complexity in application. This paper suggests a sound understanding of the audience (game player in this instance) is required in order to construct an engaging application. It is suggested that understanding should follow typical 'know your audience' thinking and draws from literature in generational theory, behavioral sciences, education, and marketing disciplines. The literature was examined through the lens of 'motivation to engage' to facilitate understanding of how to effectively apply gamification elements across generational groups, with an emphasis on Gen Z (Homeland, iGen). Having identified common themes in relation to 'motivation to engage' in the literature, suggestions are made as to how to exploit generational characteristics in gamification applications. In addition to literature, qualitative interview data addressing generational characteristics was collected in case study fashion from experienced informed faculty and administrators from a university campus in the mid-south USA. This data was not used to create theory but rather to exemplify the literature findings and provide insight into generational motivators. Whist gamification can be used in a physical or virtual classroom, it belongs in the eLearning genre because it is 'e-facilitated learning' and is most frequently implemented with the aid of an online system.

Keywords: gamification, GenZ, education, 'motivation to engage', 'e-facilitated learning'

1. Introduction and overview

1.1 Background of research

This century has seen many advances in the teaching-learning space, such as personalized learning and learning style identification. In an attempt to improve education, personalized learning has received much attention (Yin & Wen, 2018). A cursory search of a small university library database revealed over 8,000 peer reviewed articles on this topic. There has also been considerable research on individual learning styles of students (Carter, 2018; Cooper, 2014; Cohen, 2011). A similar search revealed over 20,000 peer reviewed articles on this topic. However there has not been as much attention paid to specific motivators of student behaviour, especially in regard to class engagement. The literature on motivation factors is even more sparse when looking at motivators within specific generational groups. This is of concern as "Today's schools face major problems around student motivation and engagement" (Lee, 2011,p1) . The generic term 'motivator' has varied definitions but most center around the idea of 'something that provides a reason or stimulus to act or think'. It is suggested in this paper that an examination of student generational characteristics as they pertain to motivation, should play at least a small part in the design of the classroom, both online and on ground. This paper brings together two literature domains, that of generational theory and gamification, to begin discussions about how teachers may leverage generational motivators using gamification techniques. For example, if interviews or literature revealed the importance of 'self expression' as a motivator for Gen Z students, then this motivator can be exploited by using it in a class gamification scenario. Rewards to those who completed teacher specified tasks might be in the form of providing virtual spaces for 'self expression', perhaps in the form of a public collaborative piece of art, or music. This example is a simple reward based gamification element. Various motivators can be exploited by a range of simple or complex gamification strategies in order to achieve various teacher defined outcomes.

1.2 Aim and research questions

To identify possible generational characteristics in the form of motivators, amenable to exploitation by gamification elements.

Research Questions

- What motivates gen Z (and millennial) students to action?
- Are any of these characteristics amenable to gamification?

2. Research design

The research design was that of 'theory synthesis' based upon Pound & Campbell's 2015 paper entitled, 'Exploring the feasibility of theory synthesis: A worked example in the field of health related risk-taking' (2015). Their protocol for 'theory synthesis' consisted of a three step process originally proposed by Turner (1991). The stages include: (i) *synthesis preparation*, wherein parts of relevant theories were extracted and summarised; (ii) *synthesis* which involved comparing theories for points of convergence and divergence and bringing together those points that converge; and (iii) *synthesis refinement* whereby the synthesis was interrogated for further theoretical insights (See Figure 1). All stages of synthesis were complemented by descriptive data collected via interview. Interviews are regarded as a tool for generating rich data for scientific inquiry (Schultze & Avital, M 2011) and the subject (interviewee) is seen as an expert and a vessel-of-answers (Holstein & Gubrium, 1995).

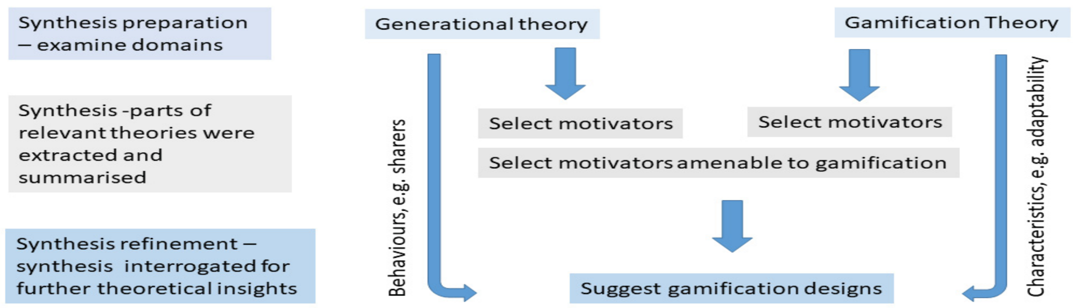


Figure 1: Research design informed by Porter & Campbell (2015)

The interview questions were informed by the research question rather than the literature to avoid bias. Bias may be created by suggesting to the interviewee, the existence of a particular characteristic. As mentioned above the intention was not to confirm the existing literature but to find examples of literature identified characteristics, and possibly extend the literature on millenial/Gen Z motivation. It was hoped that the open ended questions without any reference to what others have found, would in fact exemplify or explain literature identified characteristics. The additional dialog may also create understanding links or chain of reasoning between values, motivators and characteristics.

2.1 Data collection and analysis

Theoretical data collection followed the theory synthesis model presented above. In stage one: 'synthesis preparation', the domains of generation theory and gamification were examined. Current generational theory was exemplified and complemented by interview data. Stage two: Synthesis involved comparing the above theories and data for points of convergence. Stage 3: Synthesis refinement involved interrogation for further theoretical insights, such as refinement of game mechanics according to non- motivational contextual characteristics, or proposed causal links between characteristics of generations. Qualitative interview data collection employed a convenient purposeful sample. It was convenient as the subjects were at the researcher's university but purposeful as they were selected on the basis of reputation for subject matter expertise (Holstein & Gubrium, 1995). Their reputation included excellent rapport with students, outside class time engagement, excellence in teaching as demonstrated by awards, concern for student development and so forth. The interview sample consisted of faculty, student counsellors, student association leaders, student camp leaders, and a range of student support service providers.

Twelve interviews were conducted in keeping with resource constraints. As more interviews were conducted, the rate of new information declined, so twelve in this case appeared appropriate to the task as well as resource. Each interview lasted approximately one hour with interviewees being asked three open ended questions relevant to the research objective. The interviewees were asked to answer, focusing on the freshman sophomore classes, which was mainly comprised of Gen Z and to a lesser extent, Millennials. In summary, the questions were: List five descriptors of current students, what do they value, what do they do for fun? The first two interview questions were aligned with the research question one and the last with research question 2. For the first question interviewees were asked to list the first 5 words they thought of as descriptors of the current students. The first five that came to mind. If a single word could not be elucidated, a sentence was acceptable.

Further explanation was required in some cases. The second question "What do they value?" was intended to complement question one as values are descriptors and they influence behavior. The purpose of these two questions was to uncover important descriptors and behaviors that may also be considered motivators. The purpose of the third question 'what do they do for fun?' was to determine if any of these motivators could inform the 'fun' aspect of gamification design.

3. Synthesis preparation - literature review

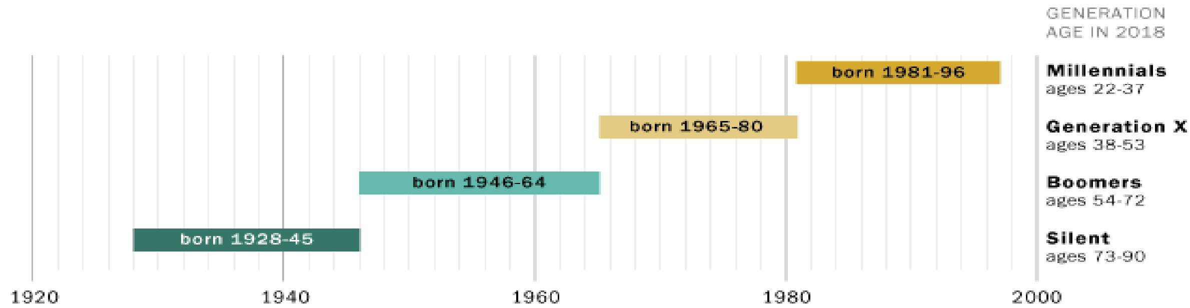
Two domains of literature, generation theory and gamification will be examined to identify articles that focus on motivation. As mentioned, above motivation refers to "something that provides a reason or stimulus to do something". The theories classifying types of motivation formation are not the focus of this study but some are referenced by various literature in the specified domains. For example, Richter (2015) refers to several theories that may explain motivation to participate in game play.

3.1 Research question 1 What motivates gen Z (and millennial) students to action?

Generational Theory

Theory of generations (later known as generational theory) is a theory posed by Karl Mannheim in his 1923 essay, "The Problem of Generations" and generally refer to the psychological and sociological dimensions of a generation or cohort, brought about by important historical, cultural, and political events experienced by the cohort. There has been some disagreement on the cutoff point birth years categorizing the current and previous generations. Below are the categorizations as defined by the pew research center.

Table 3: Generations and Age (2017) http://www.pewresearch.org/topics/generations-and-age/2017/



Millennials are said to be born between 1981 and 1996. Those born after 1996 are referred to as Gen Z, iGen or the Homeland generation (Cooper 2014).

Table 4: Generational differences. Source: Moore et. al . 2017

	Baby Boomers	Generation X	Millennials	Generation Z
Events	MLK, JFK, Woodstock, protests, Vietnam War	Cold War, AIDS, Clinton scandal, Challenger explosion, Fall of Berlin Wall	School shootings, September 11, Iraq War, "Great Recession"	Obama presidency, global terrorism, same-sex marriage, emergence of China
New technology	Television	Computers	Internet	Smart phones
View of self	Confident	Independent	Winner	Adaptive
Learning / teaching	Rote, hands-on	Self-directed, mix traditional with technology	Groups, lots of tests	Groups, lots of tests, on- line, "gamification"
Education	Freedom of expression	Pragmatic	Structure of accountability	Individualized
Trust	Low trust of authority	Low trust of authority	High trust of authority	High trust of authority
Career goals	Build a stellar career	Build a portable career	Build parallel careers	Build a fun, entrepreneurial career
Rewards	Title and corner office	Freedom, flexibility	Meaningful work	Social change
Parent-child involvement	Receding	Distant, divorce, latch-key	Intruding (helicopter)	Connected by technology, co-pilot

	Baby Boomers	Generation X	Millennials	Generation Z
Family life	Indulged as children	Alienated as children	Protected as children	Connected as children
Political orientation	Attack oppression	Apathetic, individual	Crave community	Progressive, equality

Given that the presence of generation z is just beginning to be felt, there is comparatively little original research available to facilitate understanding of this generation. There are almost as many ways of characterizing Generation Z as there are publications. Table 3 cites one approach. Some publications seek general descriptors, others attempt to extract characteristics that may impact buying preferences, while others seek to predict how factors may influence their education. However most simply list characteristics and seek to explain why these characteristics exist. It should also be noted that whilst characteristics assigned to a generation may not be unique to that particular generation, they are assigned because they exist in a higher proportion, or are exhibited more strongly than in previous generations.

McCrindle & Wolfinger (2015) book and dedicated web site http://generationz.com.au/ examines generation Z in light of 37 criteria. This site was examined to identify anything that may speak to values or motivation. When looking to attract and retain Gen Z, their values in the work include; ownership and individuality, positive reinforcement, recognition, life/work balance, tram focus, enjoyment, empowerment, support, flexibility, involvement, creativity, innovation and global working atmosphere. Motivation includes job variety and creativity, while influences over career choice include the Internet and peer groups. Perception and experience shape the career perceptions and views of Gen Z, while innovation and empowerment are important to them in terms of key management tools. Typical training style preferred by Gen Z is interactive and multi-modal, while their key communication tools involve hands on learning and participation. Their leadership style is through consensus and feelers, their influences and values are global and short-term wants, while their management approach is evolving and revolving around the statement 'here's what I think'. http://generationz.com.au/attracting-and-retaining/

From a marketing perspective Gen Z members value products that are, or make them feel socially connected, are fun and entertaining, cool and socially desirable, life enhancing, new and innovative. However, one downside to this is that in marketing to Gens Y and Z companies have to constantly refresh messages and techniques in order to maintain their attention. Because of the constant interruptions of a technological world, these generations have shorter attention spans. Finally, McCrindle & Wolfinger (2015) list of motivators include, not letting others down, advocating for something they believe in, making a difference for someone else, opportunity for advancement, earning credit towards something (typically larger goal, milestones).

A review of over 50 reported generation Z characteristics (see appendix A) revealed a shorter list of characteristics that may motivate behavior. This may include things they value or desire. Things they fear may also be considered motivators but are not considered ethical leverage in order to change behaviour. Table 5 lists characteristics (derived from the broader list) that may motivate a Gen Z student to act.

Table 5: Gen Z motivators

ownership	empowerment,	social connection
individuality	flexibility,	not letting others down
recognition	support	a cause or belief
positive reinforcement	involvement,	advancement opportunity
creativity	opportunities for innovation	credit towards something larger
enjoyment/fun	global working atmosphere	social desirability
social change	equality	balance of team and individual work
	FOMO	making a difference

Source: McCrindle & Wolfinger (2015); DiLullo (2015); Morre et. al. (2017); Carter (2018); Grace, M., & Seemiller.(n.d.)

Interviews

Over 80 separate characteristics were identified during analysis of the interview transcripts. Many of the characteristics were repeated in all interviews such as sharing, connected, distracted, entitled, stressed/anxious, vulnerable, caring, and empowered. The 80 characteristics formed around 5 natural theme related groupings. The groups included outlooks, behaviours, concerns, factors affecting critical thinking, needs, emotions and values (as in things that they value). As most of these characteristics are beyond the scope of this paper, only the characteristics that may be considered motivators were selected for presentation (see Figure 1). It should be noted that the researcher in conjunction with explanatory notes from the interviews, determined whether or not a characteristic was determined to be a possible motivator. Table 6 lists the characteristics obtained via interview that speak to motivation.

Table 6: Possible motivators of GenZ derived from interviews

Desire to fix the world	Desire to help specific needs	Motivated to help the individual	Save the planet	equality
justice	Connectedness driven	Looking for significance	Want to have fun	Want to act be involved
Want to be heard	Need an audience	Desire to know what's going on with everyone	Need constant stimulation	Seek to be known
Seek validation	Seek respect	Seek belonging	Seek intimacy	Seek independence
Freedom of choice	Need affirmation			

A comparison of the two sources, literature and interview reveals a number of areas of overlap. These include: cause driven – desire to fix the world, meet needs, making a difference; validation, recognition; enjoyment/fun; connectedness – belonging, intimacy, seek to know and be known. The main difference in the data appears to be in the specifics. The interview data revealed specific examples of literature cited characteristics.

3.2 Research question 2: Are any of these (motivators) characteristics amenable to gamification?

In order to answer this question we begin with a discussion of gamification

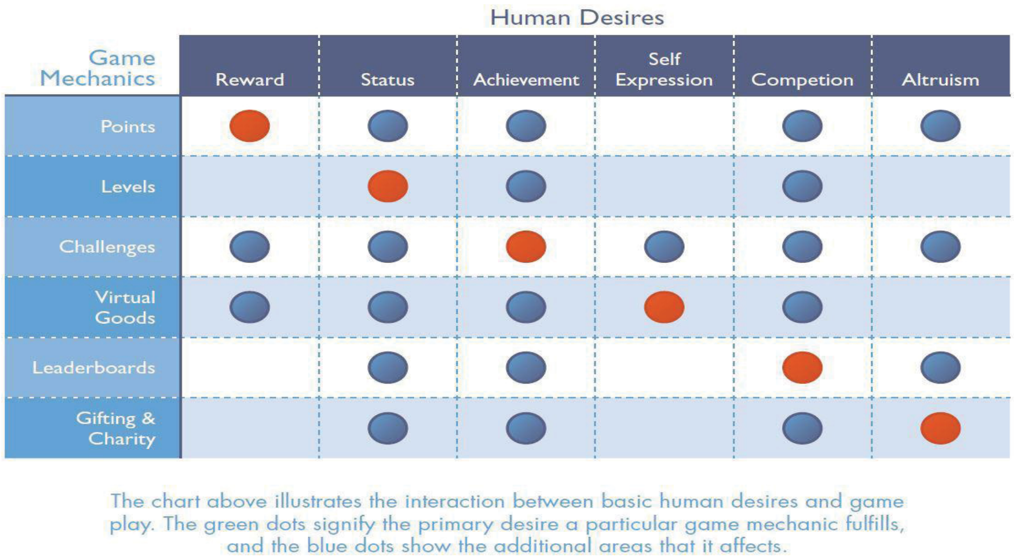
Gamification

As this field of study is in its infancy there are a number of definitions of gamification, but most involve applying game design thinking to non-game applications to make them more fun and engaging. The emphasis appears to be on 'game thinking' rather than games (as most understand games). According to Gartner research (2009) the goals of gamification are to 'achieve higher levels of engagement, change behaviors and stimulate innovation'. Burguillo, (2010) introduced the game mechanic of competition or Competition based Learning (CnBL), to motivate students and increase their learning performance. The combination of game theory with the use of friendly competitions was found to provide a strong motivation for students.

Gamification, defined as the use of game mechanics, dynamics, and frameworks to promote desired behaviors, has found its way into a number of domains including marketing, politics, health and fitness, with analysts predicting that it will become a multi-billion dollar industry (MacMillan, 2011). Industry has embraced gamification and a number of companies now offer gamification services and literature. One such company is Bunchball, founded in 2007 and now a market leader with publications in Forbes community voice (2017).

Bunchball's publication entitled 'Gamification 101' explain gamification as a system of 'game mechanics' and 'game dynamics'. "Game mechanics refers to constructs of rules and feedback loops intended to produce enjoyable gameplay. Game mechanics are the basic actions, processes, and control mechanisms that are used to "gamify" an activity. They include the rules and rewards (points leverages, challenges, leaderboards, virtual goods, charitable gifts etc.) that make up game play and create a compelling, engaging user experience. Game mechanics make the activity challenging, fun, satisfying, or whatever other emotion the game's designers hope to evoke. These emotions, in turn, are the compelling desires and motivations of the experience called game dynamics (rewards, status, achievement, self expression, competition, altruism). These gamified activities address and satisfy basic human desires, creating the addictive experiences that motivate users to take specific actions, and to return more frequently." (Bunchball) See Table 1.

Table 1: Human desires and game mechanic map. (Bunchball)



Basic Gamification has existed for a number of years in the form of frequent flyer points and a variety of other loyalty programs. It has grown in popularity and complexity, facilitated by developments in technology such as facebook and smart phones, and applications that run on both.

Whist Industry success has validated the methodology used by Bunchball, academia has explained that success, by mapping game elements to established social science theory to support Bunchballs's selection of 'human desires' described in the literature as 'motivators'. For example, Social Comparison Theory can explain the motivational effect of the leaderboard since it states that people tend to compare themselves with others, who they perceive as similar to them, in order to evaluate or enhance some aspects of the self. (Vassileva, 2012). Richter et al (2015) maps various game motivators against theories such as social motivation and needs based theories represented in the table below. Other theories include self-efficacy, personal investment theory (PIT) goal setting and expectancy value to conceptualize motivation. For a more in depth and complete analysis see Richter et al (2015).

Table 2: Theoretical base of incentives and rewards (Richter et al 2015)

Motivation theory	Incentives/rewards	Role
Self-efficacy	Audio/verbal/visual/music/ sounds effect	Feedback
	Progress bar	Feedback, achievements
Self-efficacy, goal-setting, PIT, expectancy value, need achievement	Points/bonus/dividend	Feedback, reward, status, achievements, competition, progression, ownership
	Mini games/challenges/quests	Reward, status, competition, achievements
Self-efficacy, goal-setting, PIT, expectancy value, social comparison	Badges	Status and reputation, achievements and past accomplishments, collection, competition, ownership
	Virtual goods	Reward, social, status, achievements, ownership, self-expression
	Leaderboard	Status and reputation, achievements, competition
	Rewards-choosing colors, power	Achievements

Motivation theory	Incentives/rewards	Role
Self-efficacy, goal-setting, PIT, expectancy value, need achievement, social comparison	Achievements	Collection, status, competition, discovering, progression
	Levels	Feedback, status and reputation, achievements, competition, moderate challenge
Social comparison, personal investment theory, expectancy value	Avatar	Social, self-expression, ownership

Gamification aims to create a sense of playfulness in non-game environments so that participation becomes enjoyable and desirable (Thom, Millen, & DiMicco, 2012). The desire, stated as 'human desire' (reward achievement etc.) by Bunchball appear as 'roles' (desire to be filled, or motivators) in Ritchie's classification. In other words humans have a desire to satisfy needs and are hence motivated to act.

Pappas (2018) in a publication from an industry based company, 'Elearning Industry', assert that gamification supports fun, social connection, training, personal development, greater fulfilment and even environmental sustainability. It tends to increase learners' natural desire for competition, goal achievement, and genuine self-expression, while also promoting interactivity, a quantifiable outcome. In addition it is suggested that gamification also has the elements of challenge, mastery, and socialization, which are the elements of games that can be leveraged to promote or motivate learning.

Leaning (2015), presents a different perspective and explains gamification as adding a different form of experience to an activity, adding a new layer to an existing process that incorporates a new level of meaning above and beyond the merely instrumental activity of the task. The new layer of meaning provides a greater experience for the user and encourages participation with the transformed activity. Hamari, et.al.(2014) suggest that games have three main parts: motivational affordances - the opportunities the actual activities give the subject which is the mechanics of the game, the psychological outcome being the resultant change in feeling about an activity during and after the activity, and the behavioural outcome being the change in behaviour following the gamified activity. In the educational setting, motivation would be in the game mechanics (the game story and reward system combined), psychological would be feeling produced by completing a teacher specified task (as opposed to completing that task without gamification) and the behavioral outcome would be improved task completion rates.

4. Synthesis refinement findings (research question 2)

This section examines how the identified motivators can be leveraged by gamification. Gamification is said to meet the human needs of reward, status, self-expression, achievement competition and altruism. These needs are exemplified in the motivators tables 5 and 6. *Rewards* are forms of positive reinforcement required by Gen Z and thus should be maximized in gamification. Rewards may also be in the form that satisfies other needs or taps into other motivators such as individuality and self expression. A gamification application could be a game where points could be earned to buy colors to complete a painting, notes for a piece of music, electronics for a circuit board and so forth.

Status aligns with the stated Gen Z motivator of recognition and significance and should also be a high priority in game design. Frequent multiple ways of determining status would be a requirement of successful design. *Achievement* aligns with need to advance and should also be present in Gen Z gamifications.

Self-expression aligns with individuality and could be leveraged as described above. *Altruism* aligns with many of the Gen Z motivators such as a rallying to a cause, making a difference, involvement etc. Altruism aligns with the highest number of motivators and as such should feature highly in Gen Z game design. An example of game strategy might see points earned by completing teacher assigned tasks be redeemed or exchanged for money donated towards a cause. Any number of scenarios that involved gift giving from one's own point store, to others in need either fictions (as part of the game story), or real as fellow players of the game. In either case the motivation to feel good about having 'made a difference' for someone is a powerful motivator for Gen Z.

Competition is the only game motivator absent in the GenZ in this study and would not be considered as high priority for game design. The opposite, that of team work and collaboration would be more in keeping with the findings.

Some preferences/behaviors that are not in the motivation list but are found in the larger list of Gen Z characteristics (see appendix A) can inform game mechanics. For example, Gen z students love stories, storytelling and visual communications such as memes. This suggests that time should be spent in developing the scenario or story line of the game or might include the use of memes. Combining behaviours and motivators in the gamification should enhance the desire to play and gain points, which of course is tied to teacher assigned tasks. Finally, all games need an avenue for sharing game experiences as sharing is an important to Gen Z students.

5. Conclusions and suggestions for further research

Whist this paper has addressed a number of concepts it has just begun to explore the notion of leveraging Gen Z motivators and characteristics to build successful gamifications that will drive engagement in class material. Much can be added as understanding of the Gen Z student develops. Some of the ideas suggested in this paper need to be tested, empirically validated evaluated and refined. It is hoped that well designed gamification can address in part, the problem of student motivation and engagement.

Appendix A

financially conservative	create “fake” identities	ownership	Like efficiency
pragmatic	non-verbal symbolic communication	individuality	Fun atmosphere
prefer to deal with root causes rather than symptoms	Wireless access on global scale	variety	Global working environment
desire to be involved with transformational rather than transactional activities	Entrepreneurial	creativity	flexibility
Z do well in finding ways to make money	Concerned about having enough money	Innovation	involvement
self- reliant attitude	Concerned about paying for college	empowerment	entertainment
Value face to face	love stories	Value opinions of peers and parents	connectedness
more cautious with their use of social media	Independent self paced opportunities to collaborate	Seek consensus, avoid conflict	Cool things
apt to use media tools in which information can be quickly deleted,	Choice, design own degree	feelers	Socially desirable
digital integrators	Visual/ memes	try and see	crowd source solutions
Mobile first	Progressive	Practical over cool	Quality over cost
sharing and forwarding	volunteerism	information gathering	like immediate
Inside vs outside	Social over academic	Short concentration span	hyperactive
withdrawn	Lack of critical thought	Media literacy	Lack of time management skills
Lack of self discipline	impulsive	demanding	Exclusive narrow specialists
Open-minded	responsible	determined	compassionate

Source: McCrindle & Wolfinger (2015); DiLullo (2015); Morre et. al. (2017); Carter (2018); Grace, M., & Seemiller.(n.d.); Sabaityte & Davidavicius (2017)

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A Supportive Web-Based Tool for Learning Basic Data Modeling Skills

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Abstract: Students often find it hard to learn the basic rules of data modeling using Entity-Relationship diagrams (ERD). Acquiring a level of proficiency in data modeling requires many hours of practice, preferably supported by teacher feedback and tutoring. To improve the teaching of basic data modeling concepts and skills, a web-based tool named LearnER is being developed at University of South-Eastern Norway (USN). The current prototype contains a set of predefined exercises of various difficulty, each having a model solution. Students graphically construct data models and may at any time check their model and receive elaborate formative feedback. Some elements of gamification are included in LearnER. In each exercise, one may achieve a predefined maximum number of points. Requesting feedback causes one to lose some of these points. Top results for each exercise and best overall results are displayed in leaderboards. The tool was introduced to approximately 300 students at USN and Westerdals Oslo ACT in 2017/2018, including some online students. Research has been conducted with the purpose of enhancing the value of LearnER as an educational tool. Research questions have focused on elements such as when and how students use LearnER, if exercises are considered interesting, useful and of reasonable difficulty, to which extent the formative comments give adequate feedback to students and if and how gamification elements may contribute to learning. LearnER seems well suited for acquiring basic skills, while more advanced problem solving requires more creativity and freedom of choice than the tool offers today. Gamification was considered motivating among many campus students and did also seem to stimulate collaborative activities. The gamification elements need improvements, and the assigned difficulty level of the exercises needs to be further evaluated. The feedback comments are sometimes too general and sparse to help the students to progress. Further development and research will be conducted, based on the reported experiences.

Keywords: entity relationship diagrams, ERD Tool, automatic formative assessment, automatic formative feedback, gamification in education

1. Introduction

Most IT students are required to learn data modeling as part of a database design course (Connolly & Begg, 2015). An Entity-Relationship (ER) diagram (ERD) is a visual representation of a data model, describing the information a business needs to store and how it should be structured.

Even though the syntax of ER is quite simple, students often struggle to acquire the level of proficiency needed for solving real world problems. In order to master the art and craft of data modeling, it is necessary to solve a broad range of exercises having increasing size and difficulty. Preferably, students should have the opportunity to compare their own models with high quality solution models – and receive tutoring and feedback on how to improve.

Feedback is an important component of formative assessment. Shute (Shute, 2008) defines formative feedback as “information communicated to the learner that is intended to modify his or her thinking or behavior for the purpose of improving learning”. Formative feedback should be nonevaluative, supportive, timely, and specific. The student should understand the achievement goal, where they are, and how to close the gap (Hattie, 2007).

With a rising number of students in higher education, it is easy to see the need for e-assessment tools. There is an obvious potential economic benefit. Automatic assessment will probably be more consistent than human assessment. Writing quality feedback on ERDs drawn by students is time-consuming. It is not possible to help all students *when* they need it or to the *extent* they need it. Assessment tools can give immediate and specific feedback to each student.

To improve the teaching of basic data modeling concepts and skills, a web-based tool named LearnER is being developed at University of South-Eastern Norway (USN). Students can draw diagrams in the browser, as solutions to modeling exercises, and may at any time ask for feedback from the system. Our focus has so far primarily been directed towards the process of *teaching* data modeling, more than *grading* data models. LearnER is not meant to be a game, but some gamification mechanisms are included to explore if this is motivating to students (Kapp, 2012; Attali and Arieli-Attali, 2015).

The first version of LearnER was introduced to students in three database courses during fall 2017. Criteria for developing this first version were based on many years of experience from teaching data modeling. The aim of the research is to further develop LearnER in a direction that can make it an even better educational tool. We defined the following research questions:

- 1. When and how do students use LearnER?
- 2. Do students consider the exercises interesting, useful and of reasonable difficulty?
- 3. To which extent do the formative comments give adequate feedback to students?
- 4. Do the gamification elements contribute to learning, and if so: in what way?

2. Related work

Computer-assisted assessment (or e-assessment) of diagrams has been researched for at least twenty years, exploring a broad variety of ideas, aims and approaches. It is useful to distinguish between work aimed at marking (grading) and work focusing on giving more elaborate formative feedback. Tools and approaches can furthermore be classified as either automatic or semi-automatic. Some tools allow for free-form diagrams, other supplies the student with a set of basic building blocks, maybe restricted by a single model solution or to a fixed set of labels (names). We have searched specifically for systems still in use today, that are offering tools for drawing and assessment of data modeling diagrams.

KERMIT (Suraweera & Mitrovic, 2004) was developed at University of Canterbury, New Zealand. It was designed to complement classroom teaching, where students already were familiar with the basic ER theory. An animated “genie” is used as a “pedagogical agent”, to present feedback using either audio or speech bubbles. After having solved a problem, KERMIT suggests a new problem at a suitable level. The tool is based on Constraint-Based Modeling (Ohlsson, 1994), and includes both syntactic checks and semantic checks comparing it to an ideal solution. EER-Tutor is an Intelligent Tutoring System (ITS) that has evolved from KERMIT. It is web-based and supports the Enhanced Entity-Relationship model (EER) (Zakharov, 20055). It has been commercialized and included into Addison-Wesley’s DatabasePlace Web portal.

Researchers from Loughborough University have through several papers described their process of developing a system for online drawing of diagrams of different kinds (e.g. ER and UML diagrams), offering functionality for semi-automatic online marking (grading). The motivation has primarily been to decrease the workload of assessors and to achieve a fairer marking (Batmaz et al, 2006, 2008, 2010). They use a method called “Scenario scaffolding” (Conati et al, 2000) to present a scenario paragraph by paragraph. In that way, students may pay attention to only one part at a time.

Open University is a large distance learning provider. Their research group has been involved in automatic assessment of diagrams over a long period of time and has also developed software tools which have been used by a large number of students (Waugh et al. 2004, Thomas et al. 2006, 2008, 2009). Their focus has been on automatic marking (grading) of imprecise diagrams, where students are allowed to draw “lines” and “boxes” quite freely. In their early papers, they focused on ERDs, but have in later papers tried to generalize their tools and methods to other kinds of diagrams (Higgins, 2006). They have also developed an online quiz engine, designed for drawing free-form diagrams as a response to quiz questions. This engine can automatically mark diagrams and provide either summative or formative feedback (Thomas, 2013). The quiz engine is interfaced with the open-source learning platform Moodle.

Dealing with labels is a particular challenge to e-assessment of diagrams. Such labels are crucial for interpreting the semantics of a data model. If students are given the freedom to choose labels, the assessment tool must handle spelling errors, abbreviations, synonyms, hyponyms, and so on. Jayal & Shepperd explored this problem by analyzing 160 student UML diagrams (Jayal & Shepperd, 2009). They found a large number of synonyms and concluded that the problem of dealing with labels is substantial. Techniques such as stemming, removing stop words, comparing the edit distance between labels to handle spelling errors, as well as attaching tailor made synonym and hyponym lists to a given model solution have been investigated, see e.g. (Thomas et al, 2009).

At King Fahd University of Petroleum and Minerals, a framework was constructed to guide students through the process of creating ERDs, to reduce cognitive complexity or cognitive load. The concept was based on providing automatic guidance and visualization of details, using animation. Based on students' feedback, the author concluded that the use of this framework was a better tool for learning ER modeling than the traditional manual method (Eid, 2012). Simanjuntak proposes another framework for automatic grading of ER diagrams, based on tree edit distance or machine learning (Simanjuntak, 2015).

KORA (Correia et al, 2017) is a web-based system offering an automated assessment tool. KORA is reported as being in its final stage of development and is supporting assessment of diagram exercises of many types. It uses both visual and textual feedback.

3. Introducing LearnER

LearnER is an online tool, offering automatic formative feedback. Compared to most of the systems described in section 2, focus is more on providing beginners with a supportive tool, than grading tasks. We have also included aspects of gamification, as an inspiration to solve many tasks.

The tool contains a set of predefined exercises of various difficulty, each having a model solution. A teacher may add more exercises. Students construct data models by using labels extracted from the model solution and may at any time check their model and receive elaborate formative feedback. A stylized version of the Graphical User Interface (GUI) in the ERD construction and assessment part of the tool is shown in Figure 1. The student is presented with a scenario text and can build a solution model by clicking on available labels listed in the middle of the screen. The upper right area present feedback and progress bars when requested.

In each exercise, one may achieve a predefined maximum number of points. Requesting feedback causes one to lose some of these points. A leaderboard (high score list) is generated for each exercise and for the total number of points achieved. A student is allowed several attempts at each exercise. LearnER supports three notations, namely UML and two variants of Crow's Foot – one distinguishing between identifying and non-identifying relationships. Furthermore, LearnER supports both high-level conceptual models and more implementation-oriented data models.

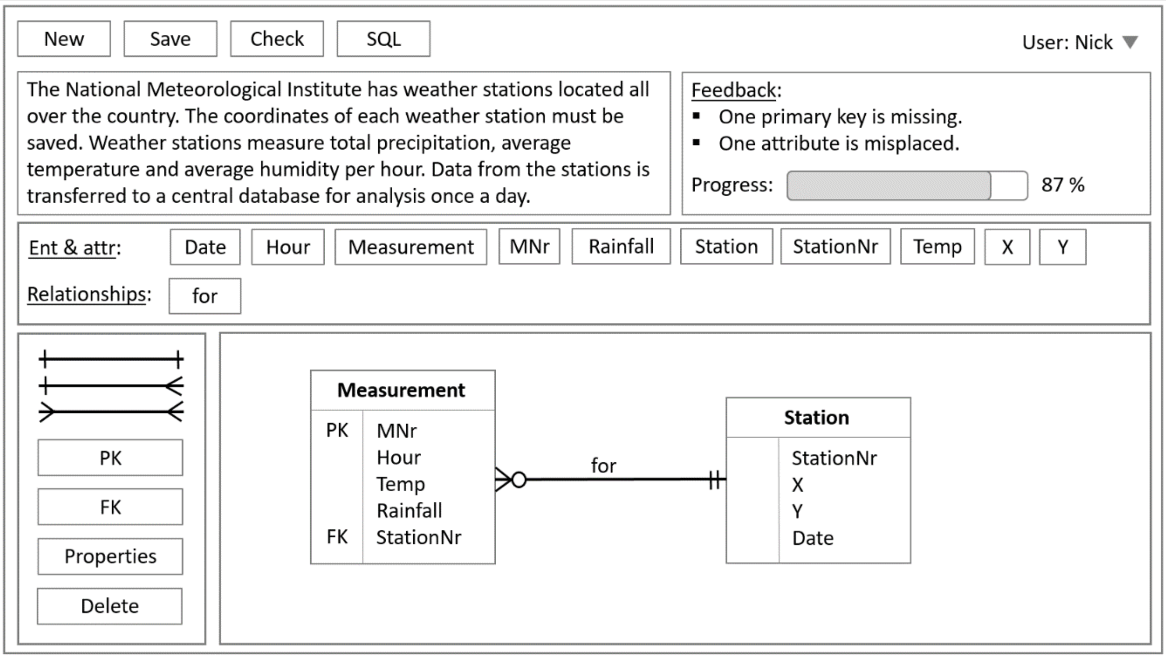

Figure 1: Stylized LearnER GUI

Here is a list of important requirements used as basis for the development. The application should

- run in the browser
- have a diagram tool letting students easily pick and place entities, attributes, relationships etc.
- support several notations, like Crow's Foot and UML
- focus primarily on inexperienced users
- include exercises at different levels of difficulty to challenge students to progress
- let teachers easily add new exercises and assign a difficulty level
- support both conceptual and more implementation-oriented modeling
- be more oriented towards formative feedback than grading
- show a description of the problem while working on a task to reduce cognitive load
- give students opportunity to get automatic formative feedback whenever needed
- include some gamification aspects to reward students for figuring out solutions by themselves
- stimulate students to compete against each other, by showing the best results on a leaderboard
- be able to forward engineer data models to SQL scripts to further motivate use of the tool
- let students create anonymous accounts
- have functionality for retrieving statistical data about user interaction

All the criteria are met in the version introduced to the students, which is continuously being further developed and improved. This paper is mainly concerned with pedagogical aspects related to the use of the system.

4. Method

A first prototype of LearnER was introduced as a pedagogical tool in two campus courses and one online course during fall 2017. Quantitative and qualitative research were conducted, to get data related to the research questions.

To be able to study the use and experienced learning effects of LearnER in conjunction with grades obtained on subsequent exams, permission to retrieve non-anonymous data was obtained from Norwegian Centre for Research Data (NSD) and the participating students.

4.1 Survey

A questionnaire was designed and distributed online through the institutions' LMS systems (Learning Management Systems). The same questionnaire was distributed to all courses. It consisted mainly of multiple choice questions but did also include a free-text field.

The questionnaire was distributed to 346 students: 216 at Westerdals, 86 in Porsgrunn, and 44 online students. 59 students responded: 36 at Westerdals, 16 in Porsgrunn, and 7 online students. The overall response rate was 17%.

The database modeling units of the three courses were introduced at different times, which may have affected the feedback somewhat. Due to some bug fixing in between the different surveys, some students were working with an application containing more errors than others. Several of these students told they were annoyed by these mistakes, which also may have affected their overall impression.

Students were given the option of revealing their LearnER nicknames and/or their student id or keeping their answers completely anonymous. All 59 students agreed to supply their student id in the questionnaire, which allowed for linking to exam data for the courses before anonymization. 42 students agreed to reveal their LearnER nickname. For those students, usage data were retrieved from LearnER to get an overview of the number of exercises the students solved, which kind of exercises they solved (level of difficulty) and what scores they achieved.

4.2 Interviews

The interviews were organized as semi-structured individual interviews. In total, 19 students were interviewed: 6 at Westerdals, 7 in Porsgrunn, and 6 online students.

Regarding the online course, the interviews were conducted online, whereas the other interviews were conducted on campus. All respondents accepted audio recording of the interviews. When transcribing the recordings, the respondents were anonymized, and the recordings thereafter deleted.

Since all the interviews were conducted in Norwegian, quotes were translated into English by the authors of the paper. The translated quotes are listed in quotation marks, although they are not language direct quotes.

5. Results

We have grouped our findings in accordance with our four research questions. First, we introduce some background data on our students. Finally, we include results on student suggestions for improving the tool.

The final exam in all three courses contained one question where the students should draw a data model, given a scenario text. Figure 1 compares the exam results for the respondents and for the entire student group. There is an overrepresentation of “high achievers” amongst the respondents. Combined with a relatively low response rate, we must be cautious when drawing conclusions from this dataset.

All three courses are introductory with no prerequisites, and few students have prior data modeling knowledge or skills. 76% of the respondents reported to have no knowledge about data modeling before taking the course, while the remaining students only had superficial or limited knowledge. 80% of the respondents had no experience with ICT based tools for drawing data models before the course, whereas 20% had only limited experience.

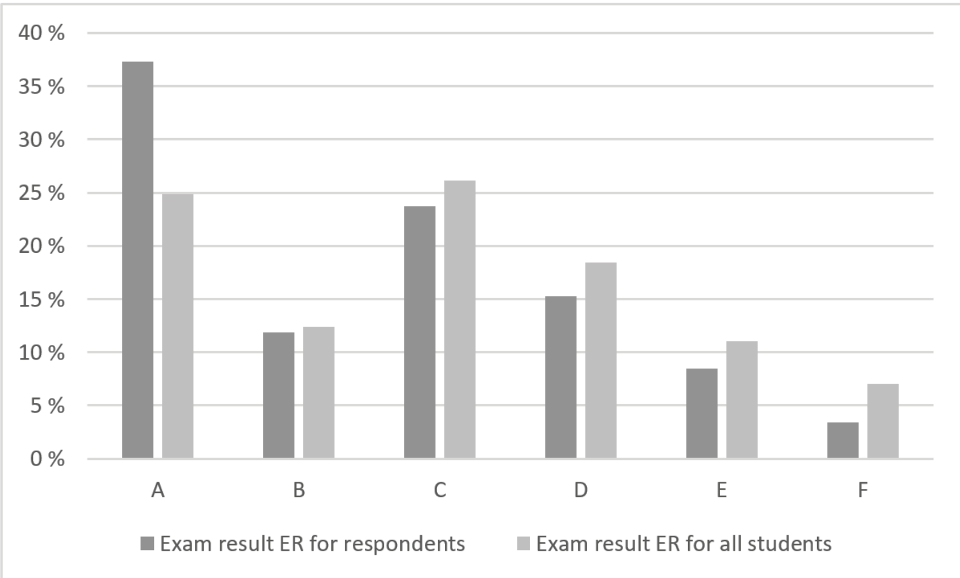

Figure 1: Exam results for the ER question at the final exam

5.1 Usage patterns – when and how do students use LearnER?

When students are introduced to a supportive tool for learning data modeling, we find it natural to investigate when and how the students choose to use it. The students who gave away their LearnER nickname had on average solved 8 exercises (stdev 4.3). 41% of the respondents collaborated with others to a large degree, 24% collaborated with others to a smaller degree, and 10% worked only in groups. 25% of the respondents, including all the online students, worked only alone. The students used the tool in different learning situations: 22% as preparation for lectures, 54% after lectures, 47% as part of an organized lab session, 37% as preparation for a lab session, and 20% as exam preparation.

One of the students puts it like this: “I have used it a little throughout the course, especially when working with the compulsory assignment. I think it was useful, especially to go through the simple exercises. How should I put it, I understood some simple ideas, got confirmation that I had done it correctly.”

In the standard setup, LearnER insists that you work in two phases by first building a high-level conceptual model before forward engineering into an implementation model with foreign keys. But it is also possible to build a model with foreign keys right away. 48% of the respondents used the standard setup with two phases, 7% used only the single-phase setup, and 36% tried both setups.

Beginners seem to find it easier to both design and read implementation-oriented data models, where foreign keys are explicitly shown in the diagram: “I thought it was useful to work with logical models and have the foreign keys as well. And sort of have the freedom of adding them as you go along.” Another student said it like this: “Yes, you see it more clearly, the structure, maybe.”

5.2 The exercises – are they useful and of reasonable difficulty?

LearnER exercises are labeled as “easy”, “medium”, and “difficult” by the teacher. The students used this actively to pick exercises: “Then I could try some of the easier exercises that I was able to solve. This gave me a sense of achievement and some understanding.”

During the interviews, we also asked the student if they agreed with the assigned difficulty levels. In general, they did, but not always: “sometimes I felt that the so called difficult ones were easier than those who were medium or easy.” Students sees the challenge of assigning difficulty levels.

The hard part was getting the relationships correct: “So, I think that the more relationships there are, the more difficult it gets.”. Several students got “stuck” by not being able to add the correct relationships. Also, some students struggled to interpret the scenario texts correctly: “the difficult part is [to analyze] the actual scenario text.”

5.3 Feedback comments – are they adequate and at an appropriate level?

83% of the respondents claimed to have read the feedback carefully (agreed or strongly agreed). They were not always able to *understand* the feedback, and *correct* the model based on the feedback, however. 47% found that feedback is easy to understand, and another 47% was able to correct the data model based on feedback. See Figure 2.

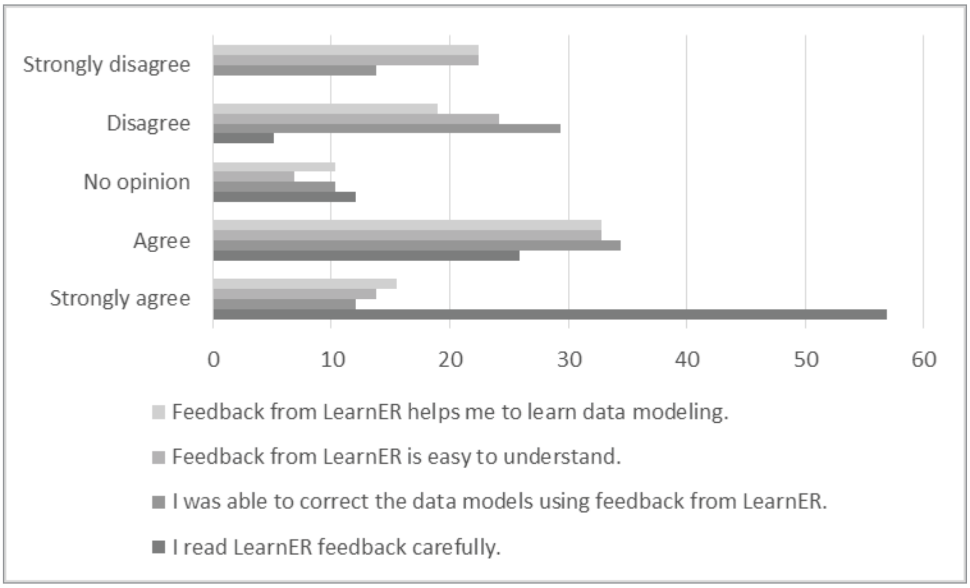

Figure 2: Usefulness of LearnER feedback

Typical feedback in LearnER states that something is wrong, maybe with a certain entity or attribute, but do not tell the student exactly what is wrong: “But when I saw the feedback, I realized what I had done … or what I had not added.”

But understanding the feedback, and even being able to correct the solution based on the feedback, is not the same thing as *learning*. As one of the students puts it: “Very easy to understand. Ahh, but not always, ahh, very explanatory. So, it said what you had done wrong, but it did not give much indication of what you could do to improve [the diagram]. But maybe that was the intention, that you should think about it yourself.”

In general, there may of course exist several “good” solutions to a data modeling exercise, but LearnER currently only allows for a single model solution. The challenge (for the student) is to “find” this solution. It is important that the students are aware of this “game rule”. Several students felt the tool was too rigid, they wanted it to allow more creativity: “If they for a given exercise added maybe 4, 5, 6 different answers, then it's okay. Because I do not think one database can have so many different answers. It depends on cardinality and relationships, and such. But there are probably 4–5 different ways to draw [the data model for] one database.”

5.4 Gamification mechanisms – do they contribute to learning?

LearnER has some simple “gamification” mechanisms built-in, e.g. students choose nicknames, exercises are marked with a difficulty level, exercises give maximal points and there are leaderboards. Many students are motivated by the simple gamification mechanisms in LearnER. 60% agrees or strongly agrees that it is motivating to get points for each answer, and 47% thinks that the way LearnER gives points is fair, see Figure 3.

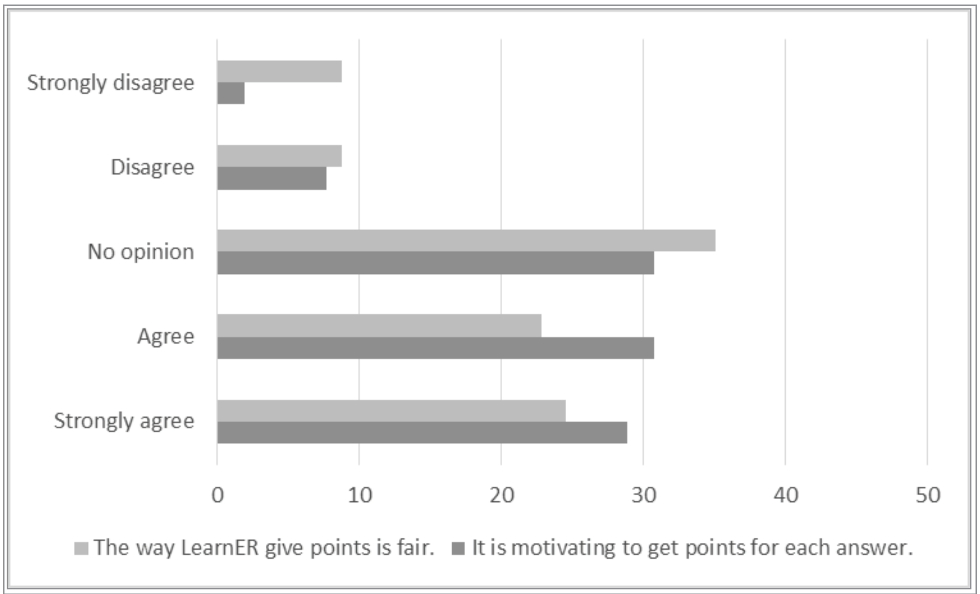

Figure 3: Motivation and experienced fairness

Competition can be demotivating when you lose, but fun when you realize that you can make it into the top list: “But when I started to understand more and got the hang of it, it was fun to try for as long as possible without checking the answer.” Gamification can be stressful but can also make assignments *more harmless*: “But it's certainly motivating, and more harmless in a way, in that it becomes a game in a way.”

The “check model” button is useful for getting feedback, but can also be (mis?)used for “getting it right” just by trial and error: “when I solve the exercises, I tend to use the «check model» button for help when I get stuck. But when I then get fewer points, I will do it again and get it correct on the first try, so I get the highest possible score. Because then I have an opportunity to prove to myself that I too can be up there [on the leaderboard].” One may speculate that doing exercises several times in this way can result in a false sense of achievement (shallow learning).

5.5 Suggestions for improvement

Students want more and deeper explanations: “some good hints to lead you in the right direction and help you understand.“ They wish to keep track of what they have achieved, and what they should work more with: “some sort of timeline that became, what should I say, colored according to […] how many exercises you had completed”. The same student also added: “And possibly what you should work more with, maybe?”

More simple exercises, with instructional videos, could help the students to get started: “Maybe include some incredibly simple tasks as well? Two tables where it was obvious what the relationship should be? So that you could get to know the tool and get a little introduction to everything.”

Several students mentioned that the system was “prototypical”: “Promising but needs to be extended much more.” Several of the Westerdals students mentioned bugs in the tool: “I think it was a pretty good tool, except that it was a little buggy.”

Some students like competing, maybe within time limits: “Perhaps you could have a countdown clock, in competition with others, so that you, for example, just have three minutes to solve an exercise.” Competing within groups, at school, was also mentioned: “We usually sit in groups and say: How many points did you get? What are you doing wrong and what are they doing wrong and so on? How did you do that? It starts some kind of competition internally in the group.”

6. Discussion

In this section we present some findings related to the four research questions:

- 1. When and how do students use LearnER? Many students found LearnER to be a useful tool. It seems well suited for acquiring basic skills, while more advanced problem solving requires more creativity and freedom of choice than LearnER offers today.
- 2. Do students consider the exercises interesting, useful and of reasonable difficulty? Students find the exercises interesting and useful, but the assigned difficulty level of the exercises need to be further evaluated. More exercises need to be developed, to challenge students at different levels.
- 3. To which extent do the formative comments give adequate feedback to students? LearnER’s feedback comments are sometimes too general and sparse to help the students to progress. Still, there need to be a balance between giving students solutions to problems versus stimulating them to find solutions by themselves. Students want to have the option to gradually get more thorough explanations of certain modeling aspects.
- 4. Do the gamification elements contribute to learning, and if so: in what way? Some students found gamification fun and motivating, while others, specifically the online students, did not consider it to be of particular importance. An explanation may be the fact that the online students on average were older than the campus students. Among campus students, the gaming elements seemed to motivate collaboration. Some students competed to get the best results, while others collaborated to work out common solutions. The gamification functionality is currently very simple and requires significant improvements.

We are currently working to improve and extend LearnER. The user interface will be improved with drag and drop functionality and visual feedback, more usage data will be collected, more exercises will be added, and video explanations will be included. The gamification mechanisms will be improved. Having only one model solution for each exercise is too rigid. This will be relaxed, e.g. by allowing for “don’t care” constraints in model solutions. Feedback will also be more adaptive and deeper explanations will be added to difficult parts.

LearnER is intended as a “research lab” for investigating different aspects of teaching and learning data modeling, and we will investigate the learning effects of the improved version of LearnER in a follow-up study. There are several interesting areas for future research. We need to get more students motivated to solve more exercises. Gamification and collaboration mechanisms seems to be promising in this respect. Data modeling is both a craft and a creative process. How can we best add gamification mechanisms that motivates students to use a tool such as LearnER, without reducing the user experience to a shallow “click” learning experience?

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Innovation Colours: The Iterative Design and Evaluation of a Web-Based Card Game for Supporting Soft Skills

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Abstract: The rapid technological progress requires quick implementation of innovative ideas more than ever before. Even though all of us can innovate, each of us has a unique way of achieving it. Innovation Colours™ is a card game aiming to help its players discover their way of doing through play. Another need that emerges while implementing an idea or any teamwork project in general, is assigning tasks and responsibilities in a way that they match each member's personality traits. When the game is being used by teams, all roles that need to be covered are noticeable and it becomes easier to distribute them according to the innovation talents of the members. This can ensure optimal collaboration and, consequently, a more efficient utilization of time. In this paper we describe the design, development, and usability evaluation of the Innovation Colours™ game in digital form, as a mobile and web application. The game can be accessed from different devices over the internet so that players can play anytime and regardless of their location. One of the primary targets of the game was to support players in understanding their unique talents while keeping their interest undiminished throughout. Therefore, iterative user-centred design was used to ensure high levels of both usability and user experience (UX). Formative evaluation was used after every design iteration; the changes to be incorporated were fed into the next design cycle, thus refining the game to its final version. Summative usability and UX evaluation of the game was carried out with 20 players through a mixed-method approach, combining observation of use with a think aloud protocol, interviews and questionnaires. All evaluation sessions were recorded and analysed thematically. Our findings provide insights to support our next steps, which include further evaluation with professionals in business coaching sessions prior to the game's imminent real-world deployment.

Keywords: card game, innovation talents, coaching support, soft skills gamification, iterative design

1. Introduction

In the past decades, digital games have increasingly been extended to application domains beyond entertainment, most notably in support of education and training (Klopfer et al. 2009). In business contexts, games with an educational purpose are being designed to meet the needs of different professionals, and to address a wide range of scientific fields offering practical training even on complex procedures (Rice 2007). Although games-based learning solutions are widely used for such purposes, it is observed that their educational agendas mostly refer to the development of vocational skills and factual knowledge, i.e. hard skills training. Technical competencies are necessary for the successful completion of a project, but may not be enough for an individual's personal and professional development within their work domain and a company's potential to innovate.

The importance of character traits, affect, interpersonal relationships and, overall, collaborative attitudes and behaviours constituting soft skills, is increasingly highlighted in the modern work environment. Soft skills are considered to have a supplementary role to that of technical knowledge required for the completion of a project and can constitute a key factor for success, both at an individual and a team level (Ahmed et al. 2012; Heckman and Kautz 2012). Moreover, contemporary work environments require communication and collaboration skills among people with different backgrounds who, in many cases, may even be located in different geographic regions. The need to acquire soft skills is growing over time, as globalisation and the evolution of technology make it possible to work internationally by obliterating the boundaries of the past, while increasing the complexity of the work environment (De Villiers 2010). It is thus easily understandable that to complete any project successfully, effective communication mechanisms between team members should be maintained (Petersen and Ekambaram 2016). Leadership, negotiation, and other such behaviour-changing soft skills in business and industry can be effectively acquired through serious games that provide an ideal environment for practice, and can accelerate learning through visualisation.

On a technical level, serious games for professionals have benefited from the evolution of technology, especially the ubiquity of mobile devices and the development of responsive web technologies to support them. The availability of digital games on multiple different platforms can remove restrictions that traditional games have, for example by not requiring from players to install applications nor limiting them to a specific location or device.

In this paper, we describe the design, development and evaluation of a web and mobile based card game for individuals and groups called Innovation Colours™. The game aims at providing its players with insights on their character and soft skills, with the ultimate goal of contributing to the development of team spirit and facilitating the implementation of innovative ideas. The initial brief was to create a digital version of the traditional paper-based card game used by The Innovation Consultancy™ in their business coaching sessions with corporate users, both at an individual level and in groups[1]. Hence, our primary goal at the outset was to keep the basic elements of the game but also ensure that the players' overall experience (the game's "playability") remains engaging throughout. In other words, the goal was for players to gain knowledge about themselves so that they can apply it to their work and everyday life and, at the same time, to enjoy gameplay.

The paper is structured as follows: after a presentation of related games, we describe the iterative design and implementation of the digital Innovation Colours™ prototype, its first summative evaluation with users, and the implications for further design, evaluation and refinement required to turn the game into a final product.

2. Related work

Despite the significance of developing soft skills, many higher education curricula do not emphasize enough the cultivation of these skills, making it more difficult for graduates to be recruited (Shakir 2009). The advent of the internet, however, has provided access to a variety of information and educational material to bridge this gap (Aresta et al., 2013). Furthermore, a number of relevant serious games in the form of simulations have been developed, leveraging the potential in the area of management and training (Connolly et al., 2012). Nevertheless, such games are mostly information driven and very few use the card game format.

Countless different card games exist and, whether for education or entertainment, share similar design principles. The Innovation Colours™ as a physical game of cards has been used extensively in team building, executive education and innovation workshops with corporations and NGOs. Business coaches and educators in business schools are regularly using these cards to teach team dynamics and to improve quality and speed of innovation. The physical game, is played in a similar way to the online game described later in this paper. It is based on extensive research in organisational tools, such as Myers-Briggs (Briggs Myers & Myers, 1995), Jung (1976), Belbin (2010), and Innovation Poker (Shapiro, 2010). It has proven effective in stimulating a dialogue in teams about how different team members bring diverse skills, building first an understanding and respect for other people's skills and their value that these bring in all stages of the innovation process. Most significantly, it provides teams with an interactive, sociable way to discuss how their different strengths can complement but also sometimes clash with the strengths of others and how to turn this potential conflict into a creative force for innovation.

In the digital realm, Little Alchemist[2] is a mobile strategy card game in which players combine cards in their hand to defeat their opponents. Even though the game's concept is completely different from the Innovation Colours™, the need to interact with cards in a simple way is a common objective. Hearthstone[3], another card game, offers an example of keeping the players' cognitive load low when dealing with many cards. The players are required to build a deck of thirty cards. Many of the cards offer special abilities, so players must use specific strategies. Therefore, they need to be able to view cards already in the deck while searching in their collection for the rest.

Closer to our case, At my best[4] is a web application that intends to help users discover their strengths through cards. The players are asked to pick the sections they want to focus on and then the "strength" cards that they most identify with. As an extra feature, the player can invite friends to give feedback and discover their strengths that are mostly appreciated by others. The Innovation Colours™ differs by emphasizing traits in a business

[1] The Innovation Colours™ card game, http://www.theinnovationconsultancy.com/shop/ (accessed June 2018)
[2] Little Alchemist, http://www.kongregate.com/pages/little-alchemist-on-mobile (accessed June 10, 2018)
[3] Hearthstone®, https://playhearthstone.com (accessed June 10, 2018)
[4] At my best® strengths cards and more, https://atmybest.com/ (accessed June 10, 2018)

collaboration and management context, and providing an interpretation of each player's dominant colour with specific tips in accordance to the underlying theory.

Although the card game genre is primarily two dimensional in nature, the appropriation of such games for digital delivery presents its challenges; to name a few: the absence of the tactile sense of the card, the problem of representing the actions of drawing from a tabletop, dealing, exchanging with others, etc. The digital Innovation Colours™ game has built upon the strengths of the aforementioned examples and many others reviewed during the design process, to address these challenges. In the following section we describe the game and lay out our approach.

3. The design of the digital innovation colours

The main goal of Innovation Colours™ is to help players discover their unique talents that enable them to interact effectively with other people and unlock the potential of their group to innovate. At the core of the game is the notion that everyone has the ability to innovate, each person in their own way. Knowing, therefore, and reflecting on one's character traits, can support an individual in using them to better contribute to a team; teams can explore and combine their talents, work better together and deliver results.

The original, paper-based card game consists of a deck of fifty unique cards, each representing a personality trait. In the beginning, each player is dealt five random cards. Then, the player is called to sort her cards, to exchange cards with her teammates and finally to swap cards among those remaining in the deck until the most representative set of 5 cards is reached. The final deck of cards collected by the player is then interpreted by the human coach according to the colour(s) that dominate the collection. In the digital version of the game, this interpretation is offered along with a visualisation of the results presented to the players, through which they can discover the innovative talents of their character, as well as the talents that they can bring to the table when cooperating with other team members.

The game is accompanied by a model, which stems from research in innovation management. Optimal collaboration requires proper communication between team members, and effective communication requires the simultaneous presence of four key elements within the team. The coexistence of all these elements is examined through the successive stages of the game. In particular, each card bears a feature that can contribute to innovation. The Innovation colours™ model maps out the relationship between colours to the four stages of innovation: blues to analyse business opportunities, greens to create ideas on how to capture a business opportunity, reds to engage the ecosystem needed for this innovation to happen and yellows to manage the innovation delivery. In more detail, the basic colours in the card deck are:

- Blue – represents the ability for strategic thinking, and recognition of opportunities.
- Green – includes the talents of producing new ideas and proposing solutions to existing problems.
- Red – talents in this category relate to interpersonal relationships and inclusion of people on new work models.
- Yellow – includes talents concerning team leadership, plan creation, and implementation of actions in the framework of a team.

This model is often referred to as the four Ws of Innovation: Why? What? Who? hoW? (Shapiro, 2010).

The digital game consists of three phases (Figure 1) through which players try to find the trait cards that are closest to their temperament. The phases are:

- "Ready" – In the first phase, players get the five cards dealt and sort them, placing in a higher position the cards that better represent their character.
- "Set" – Players exchange cards with each other (or the system), trying to keep those closest to their character. The card each player offers for exchange must be agreed upon by both players in order to complete the exchange.
- "Go!" – Players swap cards with those presented in the deck. The players can make adjustments to their final set by selecting cards that fit their character and releasing those that don't. The final set of cards reveals the player's prevalent and secondary colours, which correspond to elements on how best to work with others and what tasks can be done more effectively.

The challenges faced in designing the digital counterpart of an existing game-like business tool were more than initially met the eye, on both a conceptual and a human-computer interaction level. The initial separation of cards into groups, for example, had to be made in a way that was understandable to players without, however, referring to gambling, which would contradict the ideology of the game. An additional difficulty relates to the important requirement of addressing responsive design, i.e. adjusting the interface and interaction to different, form factors and modalities (e.g. clicking, tapping, displaying tooltips, etc.). The game elements and actions were numerous, competing for the user's attention and challenging our attempts at minimalist design.

In the following section, we present the process of designing the game, from low fidelity sketches to a working prototype.

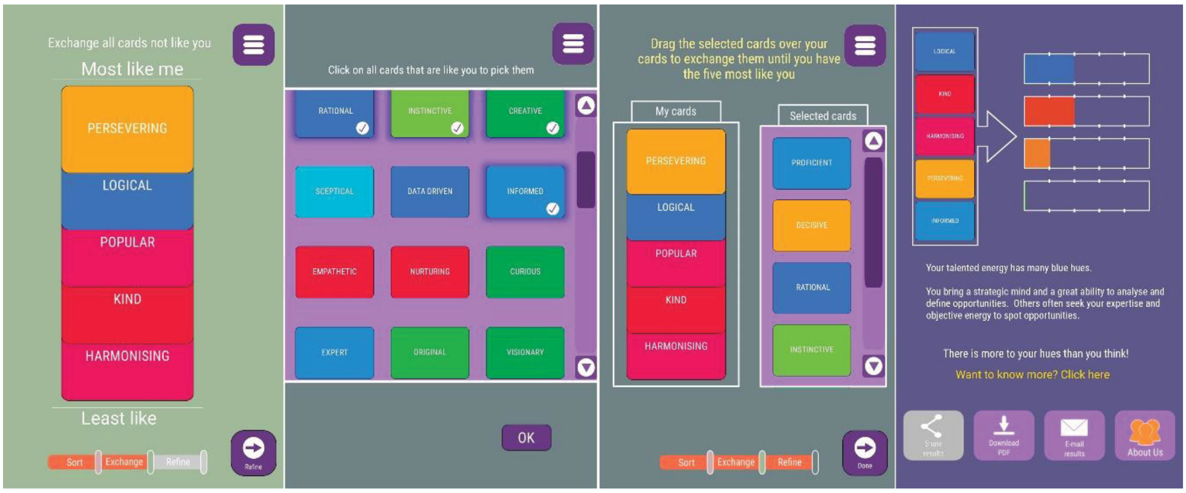

Figure 1: Screenshots of the final prototype showing different phases of the game

3.1 Design iterations

The success of the digital version of the game, or any product for that matter, is directly related to its usability, including its learnability, but also to its playability (user experience or UX). For the digital counterpart of Innovation Colours™, we followed a user-centred design approach in which the users' needs are taken into account from the start and remain central in shaping the final environment. In our case, the users we had to work with were both the consultant who has conceived and uses the game in her practice, and her clients, the players of the game. Hence, to ensure that all stakeholders' needs are properly met, we built on the considerable expertise of our client (the consultancy) in administering the paper-based card game with their clients.

Working closely with the consultancy, we first elicited their requirements and expectations from the digital product. We then painted the picture of the end-user, i.e. the player that the digital game targets, by creating a persona. A method utilised in the design and evaluation of digital products, personas are essentially fictitious individuals constructed by designers to represent a typical end-user (Roussou et al., 2013). Rather than simply creating an average user (Chang et al., 2008), we created one persona with a unique combination of characteristics, which, however, are based on real data provided by the consultancy according to the profiles of its corporate clients.

The use case scenario for our persona was then developed and formed the basis for the creation of the first low fidelity prototype, i.e. the initial mockups made to outline the various design options, the basic game mechanics, and the elements that play a key role in integrating players into the meaning of the game. In a true iterative design fashion (Schell, 2014), we practiced multiple design-evaluate-redesign cycles to continually evolve this first prototype through measuring and iterating.

The development of further game prototypes was done in four iterations (Figure 2), checked at the end of each phase against usability heuristics (Nielsen 1994) as well as with end-users, whose comments triggered a new design cycle to correct any problems that occurred. Because the game can be divided into distinct phases, these prototypes allowed for formative evaluation to take place during the design of each stage.

In the earlier design phases, our focus was on resolving usability issues identified during the heuristic evaluation, aiming to reach a working prototype with the best possible usability levels. In parallel, numerous user interface and interaction elements were examined, such as a carousel, or a card sorting mechanism incorporated into the player's "hand".

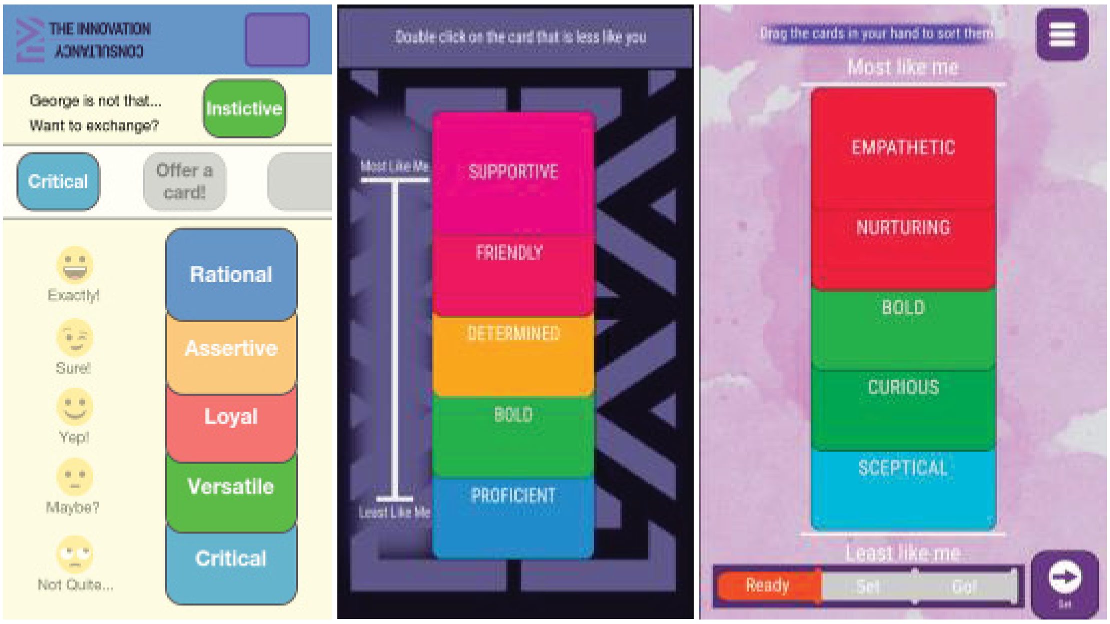

Figure 2: From left to right, screenshots from three different iterations, showing different approaches for sorting cards

The results of the formative evaluation at each stage quickly highlighted design choices that deviated from our initial decisions. In summary, some indicative changes made as a result of the design-evaluate-refine cycle of iterations include:

- Understanding instructions. Initially, some players took more time to understand the instructions presented in each phase. They relied on specific elements to understand each goal and sometimes they had to read the text more than once. Thus, we proceeded to simplify instructions while keeping them short.
- Distinguishing gameplay phases. Many players had a hard time correlating the names given to each phase with the respective goal. So, the phase names were changed from the more general "Ready", "Set" and "Go!" to the more specific "Sort", "Exchange" and "Refine". Additionally, the static bar indicating the phase in which the player is in was distracting and some tried to interact with it, so it was changed to look more like a progress bar.
- Feedback. The progress bar was "filled" as the players moved from one phase to the next in the game and served multiple purposes: to communicate the name of each phase, the percentage of completion and the next phases to come. The bar was initially placed on the top of the screen but our tests showed that most players did not notice it or understand its purpose. It was thus placed next to the phase transition button so that there would be a rational grouping, according to the Gestalt principles of design[5].
- Interaction feedback. Some players omitted a phase by mistake when clicking on the phase change button multiple times. The transition from one phase to the other was not easily perceived due to the lack of sufficient colour contrast on the screen. The addition of a different background colour as well as sound effects during transition were the changes implemented to deal with this issue.
- Changes from physical to digital. During the "Refine" phase players had to exchange cards between the frame on the right and their "hand" so that they could keep the cards they considered to be a better match. The exchange was performed by dragging a card from the right to the left and the new card always replaced the last one on the player's hand. This way of exchange reflected the way the physical game is being played on a tabletop, but it did not seem to resonate with players in the digital version as they had to re-sort their

[5] Interaction Design Foundation, https://www.interaction-design.org/literature/topics/gestalt-principles (accessed May 24, 2018).

cards every time. The solution we implemented was to perform the exchange by dragging the card from the right frame directly over the card eligible for exchange. This exchange mechanic was preferred by most users in subsequent evaluations so it was kept.

- Presentation of results. The results had to be instantly visible, so the players could reflect on them and complete the game with immediate tips on how to increase their productivity. The initial approach of presenting the results was via a bar chart, with each bar depicting the quantification of each color that the player had in hand when finishing a game. Under the bar chart there was a text that explained the importance of colours and the way players could exploit their character's traits for a more efficient synergy and achievement of the group goals. Most players felt that this form pf presentation was more general and expressed their preference for something more to the point, i.e. customized to their particular result. The presentation was thus modified to refer to the two most dominant colours of the player. The rest of the colours were also shown but in a secondary manner.

These and other changes had a considerable positive effect on the experience and the overall perception of the game by the users.

The low fidelity prototypes were developed using a commercial wireframing tool while the high fidelity working prototypes were created using the final HTML5 platform used to implement the game Construct 2 by Scirra Ltd. and JavaScript. In addition to an online version of the game, an executable has been produced for Windows, Mac, and iOS.

4. Evaluation

For the summative evaluation we compiled a mixed methodology to assess both usability and user experience (Moreno-Ger et al. 2012), including observation of each player during game play, a post-experience interview, and a questionnaire. The interview was semi-structured so, depending on the observation, the interviewer emphasized aspects of the experience that users found difficult and omitted questions that were already answered (Gürkök et al. 2011).

4.1 Participants and procedure

The evaluation was performed with 20 users, 13 male and 7 female, aged from 22 to 50 years old, in a quiet office environment simulating a naturalistic setting (Figure 3). Nevertheless, we realize that in a real-world deployment, the application may not always be used in such ideal conditions, a fact that was taken into account during the results' analysis and a limitation of our study which must be addressed in future evaluation efforts.

An introduction to the purpose of the study and the agenda was communicated verbally to each user, and users were asked to sign an informed consent form. Users' demographics and familiarity with technology and gaming were also inquired at this stage. In addition, there was an explanation of the observer's role to clarify that there would be the least amount of intervention. Players were also asked to use the think aloud protocol while playing (Ericsson & Simon 1993). Most of the observer's interventions were done to remind players of the said protocol.

The players were given approximately 20 minutes to play the game. After playtesting, a semi-structured interview / discussion followed. In this post-experience de-briefing, the participants were asked to describe their general impression about the game and identify what they liked and disliked about the experience. The interviewer's questions focused on usability issues and specific game mechanics, and were adapted according to what was previously observed. Finally, participants filled out a post-questionnaire.

Each user participated in the study individually, and the entire session, including the introduction, playtesting, interview and questionnaire, lasted approximately 1 hour. All participants were observed and interviewed by the same researcher (the primary author of this paper). Each play session and subsequent interview were recorded with the players' consent to facilitate later analysis.

4.2 Method

To measure usability, we used a modified version of the System Usability Scale (Sauro 2016). We were particularly interested in measuring the user's degree of understanding of goals and instructions, the existence of sufficient feedback after each user's action as well as the possibility of error recovery. The users' answers were noted on a five-grade Likert scale.

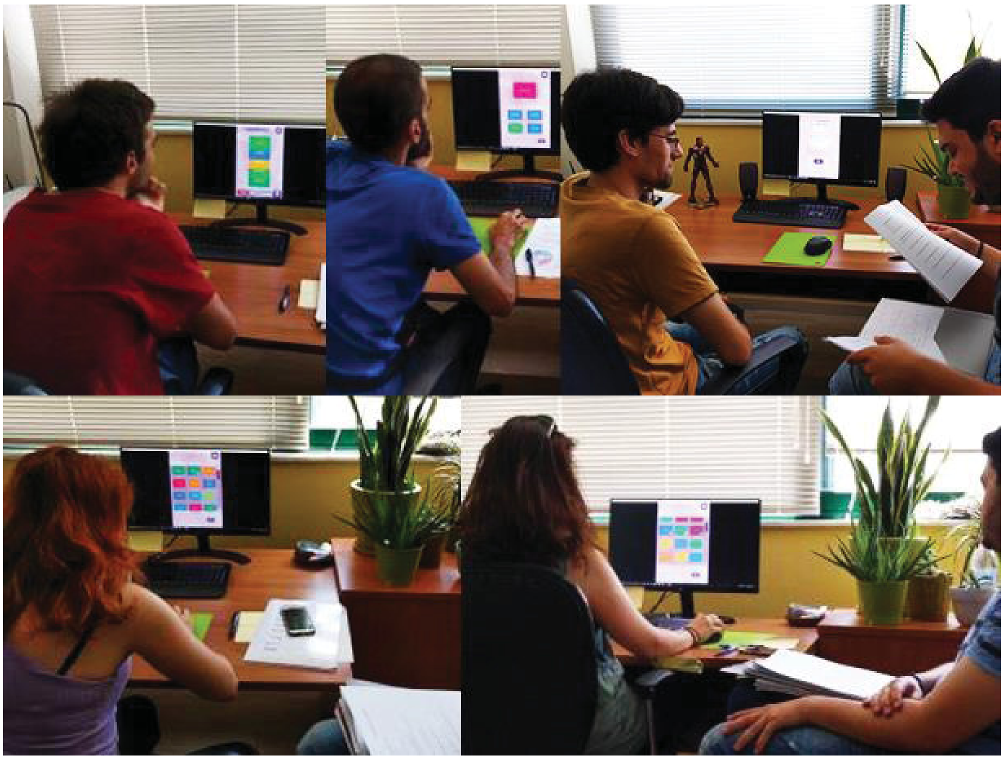

Figure 3: Some of the players that took part in the summative evaluation of the Innovation Colours™ game

To gain insights on the players' experience, we used a modified version of the Game Engagement Questionnaire (GEQ), designed to measure engagement in games (Brockmyer et al. 2009). As an example, we kept questions such as "I play without thinking about how to play", "I play longer than I meant to", "Things seem to happen automatically", etc. The user experience measurement can be complicated for many reasons. Initially, the entertainment perception differs among users. In addition, the measurement cannot be done using strict numerical limits and such an effort may bring misleading results (Wilson 2013).

4.3 Findings

The observation notes, interview discussions and responses to the questionnaire by each player were collated and organized thematically, following a qualitative methodology. Even though our sample of 20 users is a reasonable number for performing statistical analysis on the results (Nielsen, 1994), at this stage, our focus was on gaining a deeper understanding of the users' experience with the game and not merely to collect usability metrics. Overall, the evaluation results reflect the robust iterative design methodology which emphasized the eventual elimination of most usability issues by the time we reached the final prototype. All players managed to finish the game in the allotted time and nearly all reported that they clearly understood the main and side goals of the game and of each phase. Players became familiar with the game mechanics without difficulty. Most importantly, our results from the qualitative analysis indicate that most users had gained the fundamental elements of the Innovation Colours™ concept after finishing the game, and they were able to describe the way they could apply the results in their everyday life.

Table 1 presents a few indicative questions with their collected number of responses.

Table 1: Indicative usability evaluation questions from the questionnaire along with collected number of responses

	I strongly disagree	**I disagree**	**I don't disagree neither do I agree**	**I agree**	**I strongly agree**
The game captures my interest.	0	0	5	7	8
There are no elements that distract me from the goal.	0	0	0	8	12

	I strongly disagree	I disagree	I don't disagree neither do I agree	I agree	I strongly agree
There is feedback on my progress throughout the game.	0	0	5	9	6
There is a feeling of control with all aspects of the game.	0	0	0	11	9
The workload in the game is reasonable.	0	0	4	2	14
The goals are presented in a clear way.	0	2	4	8	6
The instructions are comprehensible.	0	1	0	15	4
There is the possibility of correction if I've made the wrong choices.	0	4	0	9	7

5. Conclusions and future work

Research has shown that digital games in workplace e-learning can impact positively on problem solving skills, broader knowledge acquisition, motivation, and engagement (Ahdell & Andresen 2001). In this paper we described the design and evaluation of a web-based card game with a goal to give its players the opportunity to discover aspects of their character that will help them cooperate with others more efficiently and boost their productivity.

The importance of taking the user into account from the beginning has been a key driver when designing the game. We thus adopted user-centred design methods, such as the development of personas and the design of prototypes in successive iterations, which were continuously informed by formative evaluation sessions with experts (heuristic evaluation) and end-users. Furthermore, we designed a mixed method summative evaluation approach, combining observation, an interview and a post-questionnaire, which was compiled by adopting well-known measures. We have found that this user-centric methodology coupled with continuous evaluation activity is critical to reaching a working prototype that meets all stakeholders' desires. And although the iteration phase is the longest stage of product development, it is well worth it when the intention is to launch an actual product that will be used by industry.

Our next steps will be to continue the evaluation of the high fidelity working prototype in the real-world context of the Innovation Consultancy™, i.e. with actual clients involved in business coaching sessions. Plans are already in place to evaluate the current game with 30 professional designers using a participatory design methodology, who will be engaging in the design of a variation of the game for the creative industries. Additionally, we plan to extend the evaluation in a real-world context with online users.

On a technical level, even though the game can already be used by team members, an important axis of future work will be to further develop the multi-player version, where the team can play simultaneously and explore the latest innovation and leadership theory in depth. Such a development presents a number of interaction and technical challenges, e.g. it would require conceiving and implementing an appropriate communication sub-system to help with the card exchange, as well as extensive usability testing.

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A Cloud Management Case-Based Teaching System for Radiology

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Abstract: The paper deals with the design and development of a Cloud Management Case-Based Teaching System with Case-Based-Reasoning (CBR) and Big Data Technologies. "Cloud management" is the management of cloud computing products and services. "Cloud Computing" or "Cloud Learning" is an "Online Learning", or "eLearning", that is available in the Cloud; this means that resources are stored in a virtual environment, accessed from various forms of web-enabled devices. In radiology, "Cloud Computing" is a web-based image sharing platform. It centralizes the radiology infrastructure, imaging software, data storage, and the network configuration delivered to any internet-based computer as a service based on user demand. It will allow a fast deployment of radiology imaging solutions to any user and flexibility in imaging. The flexibility of anywhere, anytime access to medical data allows radiologists to report remotely from outside the hospital. Case-Based Reasoning (CBR) is the process of solving new problems based on the solutions of similar past problems and structured as cases. The medical diagnosis is based on the experts' expertise (past experience). This experience is under form clinical cases. These cases are examples resulting from real situations. This process is similar to the daily practice of experts. Case-based Reasoning is appropriate to medical field. A cloud management system combines software and technologies in a design for managing cloud environments. The paper proposes a case representation model for cloud management grouping clinical and radiological cases and define similarity functions according to the CBR approach. We will illustrate the case representation model by an example on medical field (breast cancer).

Keywords: CBR, cloud computing, cloud management, big data, radiology

1. Introduction

"Cloud Computing" or "Cloud Learning" has attracted many educational institutions and use it as a replacement or supplement to their traditional teaching practices. It represents a means of reducing expensive IT costs while providing a service that is easily accessible from any kind of device (Arina, 2011). McCarthy was the first to touch on the idea of "Cloud Computing". He proposed in a speech that computing be delivered as a public utility. The idea didn't take off at the time because the hardware, software and infrastructure were not in place. McCarthy is most noted for his work on artificial intelligence (Duane, 2015).

"Cloud Computing" and storage solutions provide users and enterprises with various capabilities to store and process their data in third-party data centers (Haghighat, 2003). It relies on sharing of resources to achieve coherence and economies of scale, similar to a utility over a network. Many proponents claim that "Cloud Computing" allows companies to avoid upfront infrastructure costs, and focus on projects that differentiate their businesses instead of on infrastructure.

In radiology, "Cloud Computing" is a web-based image sharing platform, including web-based Radiology Information System (RIS) and web-based Electronic Health Record (EHR) modules. Using the various components of a Cloud, such as applications, client, infrastructure, storage, services, and processing power, "Cloud Computing" will help imaging units rapidly scale and descale operations and avoid huge spending on maintenance of costly applications and storage. On the other hand, radiologists can efficiently manage multimodality imaging units by using the latest software and hardware without paying huge upfront costs (Kharat et al., 2012).

An online learning guides junior and expert radiologists in the learning management process. It will provide them an individual education for everyone. Through an online pedagogical tool expert radiologists can help their students to create video recorders, blogs and shared project spaces, and inspire them with online films, discussion forums, polls and surveys. It can propose them an allocation library including a wide selection of educational apps games and resources.

Case-Based Reasoning (CBR) is an Artificial Intelligence (AI) approach which utilizes the specific knowledge of previously experienced, concrete problem situations (structured as cases). A case is a pair of a (problem, solution). A new problem is solved by finding a similar past case, and reusing it in the new problem situation (Kolodner, 1993). CBR includes four main phases. *Retrieve,* the most similar case(s); *Reuse*, the case(s) to attempt to solve the problem; *Revise*, the proposed solution if necessary; and *Retain*, the new solution as a part of a new case.

The challenges with a CBR system are modeling the cases and designing the case base (CB) to support effective retrieval of cases. CBR is a machine learning method that can efficiently utilize the knowledge to assist new clients in finding the appropriate services for their applications. CBR can search this knowledge base and find similar cases to the new case and retrieve potential solutions. The adaptation process in CBR systems provides the ability to adapt existing solutions to new problems presented to the system. New cases can then be incorporated into the case base, which extends the effectiveness of the system. CBR can also handle the missing and unexpected inputs because it searches for similar cases instead of exact matches. Also since each case is a discrete and independent knowledge unit, cases can be dynamically added or removed from the case base. Case organization, similarity measures and adaptation methods are important aspects to the performance of a Case-Based Reasoning system. While the organization of cases can affect the response time and complexity of the system, similarity measures and adaptation impact the precision of the recommendations. In the following, we explore each of these aspects in detail and justify our choice on methods in each one.

CBR is used in different areas of cloud computing for automatic enactment and on-demand resource allocation (Maurer, et al., 2013), personalized recommendation service (Hu et al., 2010), management of autonomic services (Bhakti et al., 2012), and resource configuration and cloud infrastructure management (Maurer et al., 2010, Minor, et al., 2010), (Schulte, 2014).

CBR can be beneficial for cloud users in choosing the cloud platform that best fits their application requirements, even when lacking complete knowledge about their application or features offered by cloud services. With the given set of cases of previously deployed applications on the cloud and the users' requirements, preferences, and their feedback on the quality of the provided services, can reduce the search space. CBR can efficiently handle heterogeneous attributes that characterize cloud services and the requirements of cloud applications and multimedia and data imaging. An "image" may be seen as an heterogeneous structure that may include all or part (aggregation of various elements) (image, image series with or without spatial and / or temporal and / or intermedia relationships, textual elements describing the image, textual elements not belonging to the image but related to it such as the age or other information such as an associated pathology from the patient record, audio elements such as a radiological interpretation report,…).

CBR integrates users' preferences through assigning weights to these attributes. It has the ability to find matching services based on both system requirements, and the quality of the previous deployments. CBR derives benefit from using the previous experiences and the knowledge of the medical experts reflected in the decisions and thus, juniors could thereafter benefit from their expertise.

In this paper, we will provide needs and requirements allowing the development of a "Cloud Computing" system in radiology. This research project is in progress and already has some results. The paper is organized as follows:

- Section 2 describes the purpose of this research work;
- Section 3 describes the components of "Cloud Computing" and its classification;
- Section 4 elucidates needs, requirements and benefits of "Cloud Computing" in radiology;
- Section 5 describes the design of the CBR Cloud System;
- Section 6 provides a discussion and a conclusion of different concepts and techniques used in this research work.

2. Objectives

The purpose of this research work is to develop needs, requirements, benefits and advantages to use the "Cloud Computing" services and techniques combined with the Case-Based Reasoning (CBR) approach in radiology to develop a CBR system based "Cloud Computing". It is dedicated to junior and expert radiologists to learn and train via a flexible platform.

"Cloud Computing" allows for context-based communication and collaboration instead of a standard point-to-point communication practice that is used in traditional practices. The radiologist is able to take this information to personalize and customize his/her learning experience to meet his/her own personal needs. The radiologist is able to increase connections, interactions and sharing in a "Cloud Computing" environment which allows for effective learning.

As a Cloud-based learning tool, the tool will be fast to set-up, simple to maintain and inexpensive to run. On the other hand, radiologists in different departments can benefit from the cloud in different ways, (Kharat, 2012), (Patel, 2012):

- It will offer a cost effective and flexible solution;
- It can be adapted in other aspects of healthcare such as data storage and processing in medical cancer imaging research and telemedicine;
- Access patient data, billing, insurance, reports outside the hospital;
- Radiologists and physicians can use data instantly when a new exam lists on the Picture Archiving and Communication System (PACS);
- System maintenance, performance, and security managed by professional agencies.

The four steps of CBR, called the four "RE"s, are *retrieve, reuse, revise and retain*. In the *retrieve step*, a new problem is compared to cases in the case base and one or more similar cases are retrieved. The solutions of the *retrieved cases* are *reused* for the new problem. The suitability of these solutions to the new case is evaluated and stored. If a proposed solution does not satisfy the new problem, *revision* is carried out (REF).

By combining Cloud Computing with CBR, CBR can be beneficial for cloud users in choosing the cloud platform that best fits their application requirements, even when lacking complete knowledge about their application or features offered by cloud services. Considering all providers and their offerings, and the possible combinations of offerings, the search space for cloud customers is large and, hence, the decision making complex. Having a set of cases of previously deployed applications on the cloud and their requirements, users' preferences, and their feedback on the quality of the provided services, can reduce the search space. CBR can efficiently handle heterogeneous attributes that characterize cloud services and the requirements of cloud applications. CBR has the ability to find matching services based on both system requirements, and the quality of the previous deployments. CBR derives benefit from using the previous experiences and the knowledge of the experts reflected in the decisions. We use case-based reasoning for service selection to derive a benefit from its capabilities, (Soltani, 2016).

Section 3 describes the main components of the Cloud and its categories.

3. Components and classification of "Cloud Computing"

3.1 Components

The main components of the Cloud adapted to radiology are as follows:

- Application: which is the component that end users will spend most of their time using, is hosted on severs that are remote from the user and can be run in real time from a thin client that hosts the application through a web browser;
- Client: he/her refers to the web browser. It is the medium which end users use to access the Cloud via the Internet. this can be a computer or a smartphone;
- Infrastructure: it consists of computer hardware and servers which run the software and store data;
- Service: in radiology, a service can be either web-based PACS (Picture Archiving and Communication Systems) or web-based film library;
- Storage: it concerns the entire database of cases and years of data can be stored in the form of documents and DICOM (Digital Imaging and COmmunication in Medicine) image libraries;
- Processing power: it provides infinite processing power at a very low cost;
- The Cloud platform: it refers to the way that applications can be deployed, most likely the name derived for by Platform as a Service.

Figure 1 illustrates the components of the Cloud.

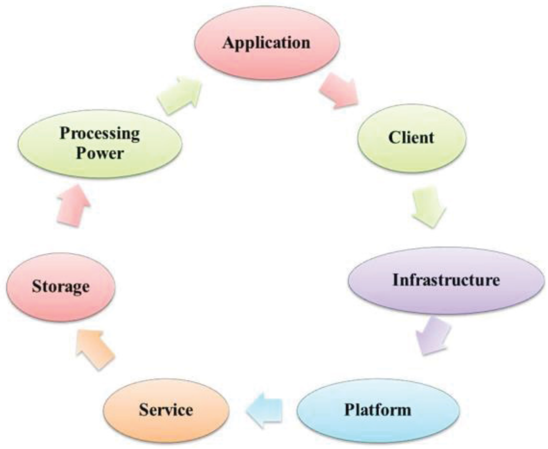

Figure 1: Cloud components

3.2 Classification

"Cloud Computing" is classified into four categories: public, private, hybrid, and community.

- Public: Public Clouds are for general use and the hosting is done by the vendors. They are flexible and scalable but they have data security problem;
- Private: Private Clouds are strictly for in hospital use and are more secure as they deal with confidential patient data. Hosting is at the vendor or the hospital premise. They present the advantage in rapid deployment but don't insure the privacy;
- Hybrid: Hybrid Clouds allow noncritical information hosting on public Clouds and critical/confidential information in the private domain. They have unforeseen service failures;
- Community: Community Clouds allow information to be shared by the same community. They have the advantage to reduce capital costs and increase the system efficiency. But they are limited inter-cloud operator and portability viruses and bugs.

Figure 2 illustrates the "Cloud Computing" classification.

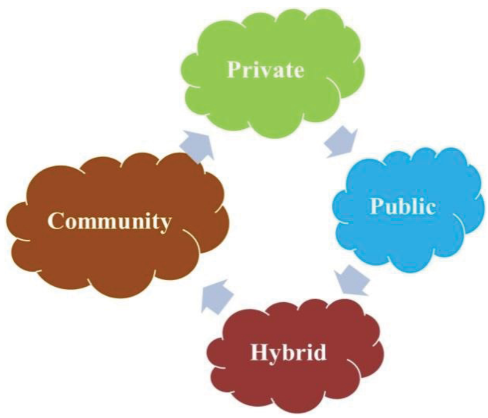

Figure 2: Cloud categories

Section 4 describes benefits and advantages of Cloud Computing in radiology.

4. Benefits of "Cloud Computing" systems in radiology

- Knowledge of IT: radiologists in imaging departments have total control over its IT infrastructure. "Cloud Computing" allows radiologists to use these IT-related services without knowledge or control over the infrastructure that supports and maintains it (Krissi, 2008);
- Costing: "Cloud Computing" allows radiology end users to use costly hardware and software stored remotely over the Cloud-based systems. There is no requirement of purchasing them by paying upfront costs, but rather use the pay-per-use model;

- In "Cloud Computing", various radiology and medical applications are delivered as a service over the Internet and this is known as a software as a service (SaaS)/on-demand software;
- Integration: A Cloud-based system provides a software platform for RIS (Radiological Information System), PACS, remote image review software, advanced 3D workstation software, and billing software and this is actively accessed by end users remotely by using computers or tablets over the Internet.

4.1 Representing complex data using a cloud approach

The impact of cloud computing to the healthcare industry will result in:

- Record and protect patients' information safely: patients' information contains both confidential as well as non-confidential data that need to be protected at all times. Cloud computing, in its initial state, has had issues regarding security, but today it provides security;
- Store data with less cost: many healthcare buy an additional storage system for data backup aside from the storage space where they have the resources to use. Cloud storage costs is nearly ten times lesser than any other server space and hardware materials as well as training of human resources to maintain and support the system in daily operations;
- Share records to authorized people: getting access to the hospital system is prohibited unless allowed by the authorized radiologist or authorized physician in charge. But visibility and login details are not given to patients in normal cases, to avoid misuses of data. With the use of cloud computing, data are available in the cloud, patients can any time log on to the system to refer to the prescription fitted to their ailments;
- Less risk for data loss: cloud computing applications for healthcare would have constant updates, which give way to raising the bar for security. While hackers are trying to get into the files data in the current application, the system updates its current security measures and goes on for the higher protection. Cloud technology perform updates without affecting system and does not cause any downtime and possible data loss in real time. This helps to match the efficiency requirement of hospitals and other healthcare organization to run and access their networks for 24/7;
- Mobile Device: Unlike the usual intranet-based systems utilized in hospitals which are mostly: desk top dependent, cloud computing systems offer convenience and much mobility to its all users. The cloud structure allows healthcare professionals (or trainees) as well as authorized patients to access files on their smartphone, tablet as well as other mobile gadgets without special permissions and settings, (Dubey et al., 2016).

4.2 Representing of raw data using a cloud approach

Patient data can be easily stored in virtual archives that are accessible by different healthcare providers, thus facilitating data sharing and significantly reducing local storage requirements. Privacy issues arise from use of cloud systems for confidential personal data. However, there are significant advantages in the interpretation of complex clinical cases when employing cloud computing services. Experts from different medical fields can consult on the diagnosis from around the world.

Continuing education and teaching efforts can be facilitated by the cloud. Teaching files can be accessed by several institutions, and training courses can be co-organized to provide shared access to learning tools such as software, presentations, and medical images of clinical interest.

However, the size of medical imaging studies, especially CT and MRI, is growing considerably faster, increasing storage requirements from 10% to 25% annually.

Cloud storage prices have been dropping faster than enterprise storage prices, and this trend will likely lead to faster cloud adoption for medical image storage, (Kagadis et al., 2013).

An important driver of cloud storage is the observation that as CTs and MRI studies increase in size, longer times are required to transfer them to imaging workstations. Rendering imaging studies from the cloud to zero footprint viewing applications provides imaging studies anywhere they are needed. These factors are significant drivers of the move to cloud PACS, including storage, (Kagadis et al., 2013).

The potential driving forces for the increased use of cloud computing in medical imaging are raw data management and image processing and sharing demands, that require high-capacity data storage and computing.

Medical image reconstruction is a rapidly evolving domain for different imaging modalities, which will require accurate quantitative analysis of reconstructed images. Quantification will be achieved, in part, through improved understanding of various biological processes that influence the quantitative analyses of medical images. It will be improved by considering these biological influences within the same reconstruction framework, for each of two or more imaging modalities. The development by the heavy computational workload of reconstruction processes and associated correction algorithms, leading to long execution times that are incompatible with their use in clinical practice. One such example is the use of Monte Carlo modeling approaches in tomographic reconstruction to accurately account for effects associated with the physics of the detection process, considering both detector and patient interactions.

The potential solution to this computational efficiency challenge is the sharing of computing facilities through the use of cloud infrastructures. In this context, advantages can be expected in the case of reconstruction algorithms and incorporated correction methodologies that can be executed in a multi-threading fashion with high potential for parallelization.

The potential issue with this approach concerns the raw data transfer, which must occur over a high-speed network to exploit the speed advantage of a cloud computing infrastructure. This is a crucial factor in quantitative image reconstruction in the clinical setting, although it may be less critical in research applications.

Section 5 defines the design and modeling of the CBR Computing System.

5. Design of the CBR Cloud Computing System

5.1 General architecture of the system

Figure 3 illustrates the general architecture of the CBR "Cloud Computing" system in radiology.

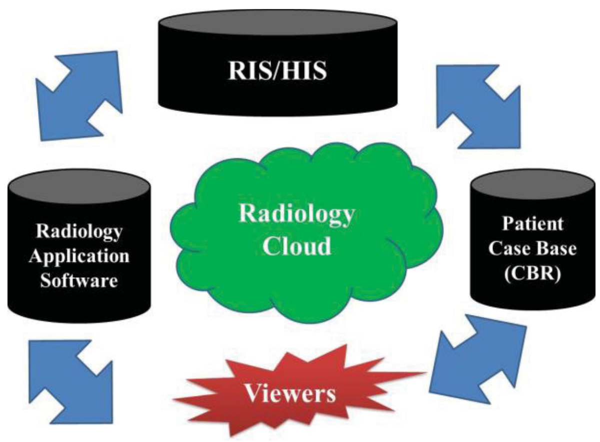

Figure 3: General architecture of the CBR "Cloud Computing" System in radiology

5.2 Design of the CBR Cloud Computing System

Before developing the CBR "Cloud Computing" system, we have analyzed users' requirements and designed the system by building a "case base" storing the radiological knowledge. We have organized data of patients under clinical cases according to the Case-Based Reasoning (CBR) approach. CBR offers a natural translation of Cloud status information into formal knowledge representation and an easy integration with the MAPE phases). CBR is the process of solving new problems based on the solutions of similar past problems and structured as cases. Data are structured as cases. A case is a couple of a problem and a solution. In medicine and radiology, the problem is the diagnosis and the solution is the problem to be diagnosed. It has been proven that students learn best when they are presented with examples of problem-solving knowledge and are then required applying the knowledge to real situations. The "knowledge base" of examples and exercises capture realistic problem-solving situations and present them to the students as virtual simulations (Demigha, 2015). CBR is appropriated to medical domain.

5.3 Methodology

CBR is a general problem-solving or decision-making framework, which revolves the processes of case retrieval, reuse, retention, and maintenance.

The first step in the CBR process is similar to the knowledge creation phase in the KM process, "building the actual case base". The "case base design" is characterized by a considerable knowledge engineering effort involving specialists and knowledge engineers. Once the design is completed, the CBR process is controlled by the processes case retrieval, reuse, and retention, and case base maintenance, (Demigha, 2018).

The ability of case-based reasoning to reason from individual examples and its inertia-free learning makes it appear a natural approach to be applied to big-data problems such as predicting from very large example sets. Likewise, if CBR systems had the capability to handle very large data sets, such a capability could facilitate CBR research on very large data sources already identified as interesting to CBR.

5.3.1 Case organization and modeling

Figure 4 illustrates the hierarchical organization of breast cancer knowledge.

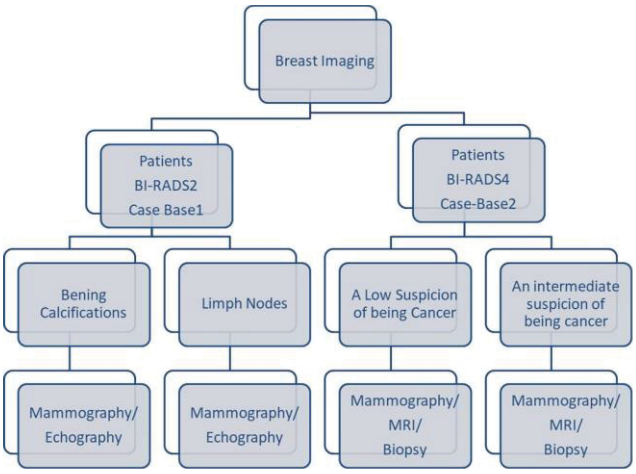

Figure 4: A shared feature network for breast cancer

The cloud model provides the ability to rapidly acquire, provision, and deploy new IT platforms, services, applications, and test environments. With cloud capabilities, months-long IT hardware procurement processes can be eliminated, reducing time spent on such tasks to a matter of hours or even minutes. The cloud model also helps ensure that university networks are available and secure, regardless of the circumstances.

"Like Data Bases search, retrieval of cases from a case library can be seen as a massive search problem - but with a twist (Kolodner, 1993)." No case in the case library can be ever expected to match a new situation exactly, so search must result in retrieval of a close partial search. Partial match algorithms are quite expensive. Because of the expense, retrieval must be directed in some way so that matching is only attempted on those cases with some potential relevance in the new situation.

Because partial matching is so important, the algorithms used to search a database won't in general, work for searching a case library. Database algorithms require the fields of a query to match items in the database exactly or to be instances of the types specified in the query.

There are several different organizations for cases, and along with each, the algorithms required for retrieval and update and its advantages and disadvantages. Some structures are hierarchical; others are more flat. Some structures discriminate coarsely; others discriminate more finely; some algorithms are inherently parallel; others are serial.

We distinguish six types of organizational structures:

- Flat memory; serial each (optionally augmented by shallow indexing or partitioning);
- Shared feature networks, breadth-first graph search;
- Prioritized discrimination networks, depth-first graph search;
- Redundant discrimination networks, breadth-first graph search;
- Flat memory, parallel search;
- Hierarchical memory, parallel search.

Organization of the cases in the case base has a direct effect on the complexity and response time of the case-based recommendation system. With the fact that the market of cloud services is rapidly growing, which implies a fast growth in the case base, we need a case organization that can support efficient retrieval from large case bases (Soltani, 2016). The flat memory model, (Bichindaritz, 2008), (Tsatsoulis et al., 2000) is the simplest one as it organizes all the cases in the same level. It is a good choice when the number of cases in the case base is relatively small, since during retrieval the CBR engine compares the problem case with each of the cases in the case base. This model provides maximum accuracy, easy maintenance and easy retention, which explains its wide use in many applications.

When a case library is large such as in radiology, there is a need to organize cases hierarchically, we adopt the hierarchical organizations of cases: Shared-Feature Networks for our system design. Only some subset needs to be considered during retrieval. This subset, however, must be likely to have the best-matching or most useful cases in it.

5.3.2 Similarity functions

Matching is the process of comparing two cases to each other and determining their degree of match. *Ranking* is the process of ordering partially-matching cases according to goodness of match or usefulness. When we match cases, we can produce a score that signifies degree of match, or we can simply determine if yes, a case matches sufficiently, or no, it doesn't. The main idea is: "if you can cluster together cases that are similar to one another and figure out which cluster best matches the new situation, then only items in that cluster need ne considered in finding a best-matching case." Hierarchies are found when clusters are broken down into subclusters and so on, (Kolodner, 1993).

Inductive clustering methods generally look for similarities over a series of instances and from categories that based on those similarities. *Share-feature networks* provide a means of clustering cases so that cases that share many features are clustered together. Each internal node of a shared-feature network holds features shared by the cases below it. Item without those features live in or below that node's siblings. Leaf nodes hold cases themselves. In (Demigha, 2015b, 2015c), we have presented concepts and techniques used to develop a Data Mining system particularly in medical field and imaging. The application of information mining techniques to the medical domain are very helpful in extracting medical knowledge for diagnosis, decision-making, screening, monitoring, therapy support and patient management.

To retrieve a case from a shared-feature network, a sort of breadth first search is done. The input (new situation) is matched against the contents of each node at the highest level in the graph. The best –matching node is chosen. If it's a case the case is recurred. Otherwise, if it is an internal node, the same thing is repeated among its descendants. This continues until a case is returned. Table 1 shows the algorithm. After clustering the cases this way, the tree can be incrementally updated using the algorithm (see table 2) as new cases are added in the case library.

Table 1: Retrieving a case from a shared-feature network

```
Let N = the top node.
Repeat until N is a case.
Find the node under N that best matches the input
Return N
```

Table 2: Clustering a shared-feature network

Choose a clustering method.
Create a top node for the tree. Call it N.
Let C be the set of cases needing organization.
Put any features shared by all the cases in C into N.
Partition C using the clustering method. Create a node for each partition, attaching each as a successor to node N.
For each partition.
Create a node N_i.
If it contains more than one case, then repeat step 4, with N= N_i, C = the cases in the partition.
Else, put the features of the one case into node N_i.

For breast cancer, data items may be grouped according to logical relationships or senologist (expert-radiologist in breast cancer) affinities or preferences. Due to the complexity of medical data, it will be better in certain projects or diagnoses to adapt existing algorithms or optimize their use to obtain better results (Iavindrasana et al., 2009. The heterogeneity of the medical data such as: volume and complexity, physician's interpretation, poor mathematical categorization and canonical form motivates medical data miners to develop new approaches to analyze data, (Iavindrasana et al., 2009).

To remediate to these deficiencies it will be advisable to create standard vocabularies, interfaces between different sources of data integrations, and design of electronic patient records. In (Jesneck et al., 2006), the authors propose a strategy "decision fusion" for the classification of imaging data from multiple modalities, multiple sources and having various types of features (Tusch et al., 2008).

5.3.3 Knowledge acquisition

We distinguish between 5 categories of data: Clinical features, Radiological features, Histological features, Image Data features and Digital image features.

5.3.4 Knowledge representation

Object-oriented based retrieval represent one way to represent cases is in the form of objects where each of the attributes could be of a simple type, like integer or string, or of type object. This forms a hierarchy of the object structure within which cases in the same classes of the hierarchy can be compared. The issue with this type of structure is when the target case and the case in the case base are not objects of the same class. Using this type of retrieval, not all the cases are compared to the target case, so it is faster than K-NN. Also this method is tolerant to missing attributes. If values are missing for the target case, the higher part of the hierarchy is searched, resulting in more retrieved cases.

We have organized data using CBR. We have structured the fifth categories of features as cases (CBR). We have modeled these cases with the object modeling, (Bergmann, 1998).

5.3.5 Illustration

Table 3 is an example of a scenario proposed for a training session for junior radiologists. This scenario will place the junior-radiologist in a situation where they will perform a learning session. It will require them to learn targeted knowledge and skills, (Demigha, 2015a).

Table 3: A scenario example

The junior radiologist is provided with a case library of videos of experts telling their stories, strategies, and perspectives that might help them with their task.
When they achieve their goal, they ask a question of the case library, and an appropriate video is retrieved and shown.
A story proposes a topic to radiologists (juniors) they should learn more about or a skill they need to learn.
A story tells how that expert dealt with some difficult issue the student is addressing.

6. Discussion and conclusion

In this paper, we have presented functioning principles of "Cloud Computing" or "Learning Computing". We based our attention on a profound analysis and study on "Cloud Computing" systems in radiology in order to develop the CBR Cloud Computing" system in radiology. These research papers help us to have a general view on their architecture and design. We have a research viewpoint and will base this development on high methods of design and implementation. For the design of the system, we started to design the "knowledge base" of the system. We used the Case-Based Reasoning approach which still a very innovative approach and applied fluently in the domain of artificial intelligence and knowledge-based systems. We have tested this "knowledge base" on some clinical and radiological cases. Results are very encouraging.

By using the cloud, researchers can access the resources needed for executing large-scale clinical trials involving multiple institutions. The emerging technologies of cloud computing have already attracted several researchers, clinical administrators, and software developers to move medical image archives such as PACS onto the cloud, in order to improve manageability, accessibility, and storage availability.

Cloud computing provides a cost efficient platform for many applications, but due to the number of available options and fast growth of this industry, the selection of a suitable service or a set of services for an application becomes a challenge for cloud customers. Case-based reasoning is a viable option to assist cloud customers in finding the best service for their applications based on previous experiences of other customers and experts.

The system is under development and needs some revision and performance tests. The future steps will concern the development of the CBR tool and its implementation. The implementation will be considered as evidence concepts put forward in this work. It displays a scenario of use of the overall tool which helps understanding the concrete role that such a system can play in a real medical environment.

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Using a Paper Based Simulation: Preparing Students to Engage in Online and Blended Group Based Learning

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Abstract: This paper presents a paper based simulation of a discussion space intended to provide learners with a foundation for a blended experience using a wiki and discussion forum as part of their group based learning. Through the simulation students were presented with an opportunity to reflect and better understand the barriers, opportunities and challenges of interacting online. Students were given a scenario based upon communicating remotely in teams provided with the paper based simulation and required to role play the online experience. This practice was delivered by a large teaching team to 240 undergraduate students during small group tutorials. Evidence of the effectiveness of the simulated discussions employed is in the form of students own contributions to the simulated space and qualitative data analysis of their answers to a series of questions intended to encourage students to reflect on the pros and cons of working together in groups using social technologies. Furthermore, effectiveness is measured using the students own learning through engagement in the simulated online experience with other students during the group based task. This was captured by an observer, a student allocated as a scribe who documented their observations of the individual students and group behaviours whilst engaged in the discussion simulation, this includes insights into the challenges of communicating without talking and the student's own solutions to these as well as the students behaviours whilst engaged in the simulation experience. Learners were also encouraged to participate in a *knowledge exchange* activity where students were invited to highlight the knowledge and support needed and offer knowledge and support to their peers. This provides valuable insights into the learners existing knowledge and skills of engaging in teams, use of collaborative and collaborative technologies and the necessary support required is also presented.

Keywords: simulation, blended learning, discussion space, collaborative technologies, group work

1. Introduction

This paper reports an intrinsic case study of a class based simulation of a discussion space as an example of practice; to help prepare students to transition online whilst they undertake assessed group work. This builds on Doolan's (2011; 2011a; 2013a) research on 'understanding the role of the tutor whilst preparing learners to engage in collaborative learning using a Wiki blend' and other collaborative technologies and developing 'pedagogy'. To progress student engagement in group work; learners were provided with access to a blend of technologies which included a Wiki to work collaboratively and a discussion forum to support cohort discussions and the sharing of resources. From the outset of the module students were encouraged to use these resources in whatever way they thought best to support their group work. However, it was essential for students to engage in the online discussion forum which was housed on the university virtual learning environment. The collaborative technologies were initially seeded by the module leader to provide an example of possible use and to encourage student engagement. Additionally, this provided a reference point for learners to revisit. The discussion forum was used on a weekly basis, at times, to extend the class based discussion, as a medium to engage in discourse through posting and responding to questions around a specific topic and/or related to the assessment. This was also intended to familiarise students with and further promote the ethos of 'learn and share' through designing learning activities which required students to engage in discourse and share artefacts.

The learning environment both class based and technological was purposively designed to progressively encourage learners to interact with individuals within groups and across groups hence, promote knowledge sharing inter and intra the whole cohort of 240 peers and engage as active inquirers and develop their group work knowledge and skills. Access to the simulated discussion space within class provided opportunities for these second year undergraduate students to communicate with peers and consider the challenges as well as the opportunities of communicating remotely to understand the potential of the technologies to collaboratively develop the knowledge and skills such as team building required to complete the group based assessment. Furthermore, the simulated activity was intended to encourage learners to role play in a safe environment and to share knowledge through a '*knowledge exchange* activity' designed to promote the concept of 'share and learn' a phrase used throughout the module and noted on all learning activities.

Overall, the paper based discussion simulation and the knowledge exchange activities were intended to encourage students to work with their peers in preparation for their group work and transitioning online to using a Wiki and discussion forum.

2. Theoretical framework

Preparing students to go online using an in class paper based simulation as presented in this paper is quite unusual as evidenced by the lack of literature in this domain. That said, simulation as a pedagogy in learning has been used by Auman (2011) who describes the development and implementation of a simulated pedagogy to engage students in collaborative learning in class through gaming. Much of the literature describes computer based simulations use in blended and online learning environments. For example, Beckem & Watkins (2012) report on the use a digital media pilot simulation in a blended learning mode which resulted in increased student engagement and promoted deeper learning. West et al (2009) reports on simulated case scenarios to support decision making. Simulations are commonly used in the health care professions for example, within the nursing curriculum (see for example Beragan, E (2011)). In Computer Science computer based simulations are used to test behaviour in software environments (Shallaw et al, 2017).

What is common between game based simulations and the paper based simulation used in this study are learners were provided with opportunities to participate and actively engage in the simulated discussion space rather than passivity in this way "students then reflect on and discuss what they are doing" (Harrism, 2017:71) connect their actions to outcomes and gain insights into the consequences of such actions; both positive and negative. Learning is viewed as an "active" process of constructing rather than acquiring knowledge, it is not imparted miraculously by the tutor rather their role is to support student engagement with the learning activities. To be plausible to the student activities set need to be authentic. In this study students through using the paper based simulation were engaged in an authentic "real world" setting without "real world" consequence such as potentially the loss of marks for the group based assessment. By introducing the simulation in this way learning took place in a safe environment bounded by the classroom walls helping students in meaning making. In this context the teacher role shifted to one of facilitator and orchestrater of learning" (Doolan & Walters, 2016:166). For learning to occur, it has been shown that activities need to be plausible to the student and presented to engage the student in a meaningful context (Canole 2002; Schuell 1992; Biggs, 1999; 2003). Lave & Wenger (1991) describe this 'meaningful context' as learning through social practice. By this they refer to learning as that which takes place in a social setting and which is situated. For example in a classroom. In this way, learning also occurs through the participant's engagement in the practice; Lave & Wenger (1991) refer to this as 'legitimate peripheral participation' which is one of belonging in the social learning context. They describe how this is crucial for learning to take place. The 'peripheral' suggests that there are varied ways to engage with others and indeed the participation in itself is empowering and vice versa. The authors present an analytical view shifting the focus on learning from the individual "in one's head" to the participation in and with the social world.

Such theories are based fundamentally upon Vygotsky's (1978) social constructivism theory which supports the claim that learning is constructed socially through participation (language in social discourse) with others in social contexts leading to higher order cognitive function.

Providing opportunities for learners to work together in social contexts on and offline through engagement in group work using collaborative learning practices is described by Doolan (2011a, 2013a; 2013b) who demonstrates how learner's together problem solve, share ideas and co-develop knowledge and skills through engagement in active learning environments. The consensus among these theorists is the importance of embedding learning in context, focusing on the learner and group of learners; specifically their experience. This is presented in the following sections.

3. The case study

An exploratory qualitative case study design was applied in this study and commonly used to undertake qualitative inquiry (Silverman, 1993; Robson 1993; 2002; Denzin and Lincoln, 2005). A single intrinsic case study is presented which aligns with real life experience where "one wants a better understanding of this particular case" (Denzin and Lincoln, 2005:444). In this study of social phenomena learner experiences are interpreted in a naturalistic inquiry. Insights into the students "lived experience" (Van Manen, 1990: 35) were gained by analysing the primary data source the learners' contributions written on the post-it notes which acted as their input to the simulated online discussion space (A1 White Paper). Some students wrote directly onto the online discussion space (A1 White Paper) this too was subject to thematic analysis.

In addition the observations noted by the scribe, a student who volunteered to observe the group activity and behaviour were also analysed using the same method. Opportunistic sampling (Silverman 1993) and a pragmatic approach was adopted where sampling is determined by access (Stake 2000). Thematic analysis as a method helps to draw out and report on the students lived experience (Boyatzis, 1998) essential in this study.

- On the first pass through the data the researcher was consciously reading, scouring the texts to become familiar with the data content.
- A second and third pass through the data comprised of using colours and letters to link data with categories.
- The data used was a unit of text; a phrase, a sentence or multiple sentences such as "*"Cannot talk or socialise together",…"*
- The categories were colour coded and letters were used such as P and S reflecting Problem and Solution respectively. The categories are provided in Table 1.

Note: some of the questions and answers posted to the simulated discussion space were brief and therefore, are presented verbatim.

Table 1: Simulated activity

Category	Description
Coping	A coping strategy employed by student to compensate for being unable to talk
Communication	Problems (P), Solutions (P)
Behaviour	Dominant, Submissive types
Technology	Problems (P), Solutions (P)
Teamwork	Problems (P), Solutions (P)

240 students undertook this study within 8 tutorial groups which comprised between 20-25 students each facilitated by a tutor, some tutors were responsible for more than one tutorial group. For the simulated activity (outlined in table 1) the students were required to work together in groups of between 4-6 students. Each activity was overseen by one tutor.

Table 2: A group based simulation activity

Students were presented with a scenario based upon communicating remotely in teams and were given the simulation and required to role play a discussion based online experience. The objective: to encourage students to act as if they were remotely online using a discussion space and post and respond to the following two questions related to the scenario. 1. What problems does working remotely cause for team working? 2. What can be done about it? Students within their group were required to engage in discussing answers to the above questions without talking as this activity was a simulated online discussion. Groups were provided with two A1 size white papers and required to make a note of each question on one A1 paper. Additional resources included a book of post-it notes and a number of coloured felt tip markers. The students individually were required to write on the post-it notes and post their contribution to the A1 paper which simulated a discussion board. The content on the post-it note acted as a post or a response to a question posted by another member of the group. One contribution per post-it note was required per student.

Engagement in the simulated discussion was captured by an observer, a student allocated as a scribe who documented their observations of the individual students and group behaviours whilst engaged in the discussion simulation. Prompts were provided for the scribe such as: did anyone talk? How students tackled the questions? Who dominated the discussion (who posted the most?).

Furthermore, learners were encouraged to engage in a *knowledge exchange* activity where students were invited to highlight the knowledge and support needed and offer knowledge and support to their peers. This strategy was previously trialled as part of a staff development activity to provide a support network for teachers when they returned to their workplace when implementing blended learning designs (see Doolan & Guiza, 2015). In this study, this involved inviting students to highlight the knowledge and support that they needed and to note what knowledge and support they could offer to peers. Not dissimilar to activity 1 in table 1 learners were presented with two boards comprising sheets of A1 white paper and entitled "knowledge and support that you need" and "knowledge and support that you can offer".

Learners were required to use the post-it notes provided, and on each post-it note to write the following:

- Knowledge and support that you need
- Knowledge and support that you can offer

4. Findings and discussion

Evidence of the effectiveness of the simulated discussions employed as part of activity 1 in table 1 is in the form of students own contributions to the simulated discussions and qualitative data analysis of their answers to the two questions intended to encourage students to reflect on the pros and cons of working together remotely in groups using collaborative technologies. Furthermore, effectiveness is measured using the students own learning behaviours demonstrated through engagement in the simulated online experience with other students during the group based task as captured by the scribe (student observer).

The scribe provided interesting insights into the challenges of communicating without talking and the student's own solutions to these as well as the student behaviours whilst engaging in the simulated discussion. There was a group who appeared reluctant to engage when presented with the activity. The students posted S1 *"whose going first?"* S2 *"Not me!" S3 "not having the conversation it is hard to start!"*.

Different identification strategies were employed by students in the discussion, predominately group members used different colours to identify themselves whilst writing their posts and responses, others used numbers to identify themselves and noted this number on each question posted and responded to. A number of student groups drew cartoons as identifiers for their posts and responses. Some students wrote their own name on their posts and responses. A student group used shapes i.e. star, square, triangle and hexagonal as an identifier.

There was evidence of students adopting coping strategies to compensate for being unable to talk throughout the activity given the nature of the simulation. Some students frequently posted jokes that clearly demonstrated their difficulties faced when unable to communicate verbally. The use of jokes seemed to lighten the mood and created a sort of team spirit and a sense of relatedness. There were a few students engaged in conversations off topic i.e. S1 *"r u going home after this?"* S2 *"yes but might stop over at a friend's house you?* S1 *"Am catching da bus all the way to…yup!"*

Emoticons too were frequently used by many student groups and some used images of funny faces. Others expressed themselves through writing messages on the post-it notes such as *"now we are stuck because we can't communicate" "what else could there be?"* Exclamation marks were used by some group members to communicate and emphasise a point. An observer noted the challenges of working as a group without verbal communication *"it was hard to work as a group, we found it very difficult to communicate without talking".* This issue was commonly cited. Other student quotes on this theme included*: "people lost interest very quickly because it was abnormal being in the same space and not being able to speak".*

Some student groups failed to follow the instructions as they posted multiple questions on one post-it note, this appeared to cause difficulty with turn-taking the students appeared disorientated and lost the thread of the discussion. For some, it was difficult when responding to other students' posts in the simulation, maintaining the conversational thread was problematic. Such students failed to write on the post-it notes and/or to write each question on the white paper as instructed in table 1, hence, lost the thread which was evident in the posts and responses to the two overall questions posed as part of the simulated activity. The observer noted *"no one took turns there was no co-ordination, different response times, and slower reactions to responses, in general many similar comments without knowledge of others".*

Other students went off topic and got bored with the simulation; the observer noted this was as a result of being unable to talk: S1"*Do you reckon this could be boring?"* S2 *"it gets boring when we can't talk!!"*

It was also noted that some students participated more than others and others contributed less to the simulated discussion. There were individual students who influenced others responses by applying dominant behaviours such as: frowning, staring/ keeping direct eye gaze, these students overall used predominately eye and hand gestures. Other students expressed dominant behaviours by spreading out across the desk and at times, patting other group members on the arm. The use of capital letters in this analysis was also interpreted as a sign of dominant behaviour. Submissive behaviours was also a theme in this study. There were some student groups who demonstrated submissive behaviours by seeking approval through facial expressions and using emoticons, multiple question marks and specific phrases when contributing posts and responses such as "I really don't know if it would help but…".

Student's responses to the two questions in table 1 notably (1) what problems does working remotely cause for team working? (2) What can be done about it? were intended to encourage students to reflect on the pros and cons of working together remotely in groups using collaborative technologies. Some overarching themes identified across groups included: Communication, Technology and Teamwork. Overall, there were more problems identified than solutions, the majority of problems cited related to Communication and Teamwork whilst using collaborative technology.

Examples of common problems cited regarding Communication include:

> *(S1) "Cannot talk or socialise together", (S2) "questions won't be directly answered"*
>
> *(S3) "It's easy to misunderstand texts and emails", (S4) "it is easy to get side tracked and lose track of exchanges"*
>
> *(S5) "it might be hard for an individual to communicate their point of view to a number of people and for them to understand it and give good feedback. This may cause delay in decision making…"*
>
> *(S6) "it is a lot more time consuming than face to face chat as you have to wait for the other person's response which might be in an hour or a week" (S7) "language barriers and using abbreviations in text".*

Predominately the solutions cited to these concerns from across student groups included:

> *(S10) "communicate through instant messaging and video conferencing", (S12) "have chat enabled so you can make contact easily"*
>
> *(S23) "ensure people know the ground rules for emails etc.", (S34) "make sure to meet face to face at least once a week/month", (S60)"email feedback to colleagues".*

Citations of common problems regarding using Technology (incl. of Infrastructure) identified across groups include:

> *(S9) "If there is a network communication failure then all contact between users is lost, and so work will be temporarily disabled"*
>
> *(S22) "some people may not be comfortable with technology" (S33) "not secure to send private and important communications online"*
>
> *(S40) "software and hardware i.e. conference program, broadband or video conferencing may not be compatible"*

Overall a lack of trust with the robustness and connectivity of the technology and concerns about security and loss of data were commonly cited as problematic. Solutions to these included:

> *(S22) "ensure to save the data on CDs, USBs etc. agree a format for data tracking"*
>
> *(S40) "Use standard reliable equipment such as video conferencing and that this is efficient and does not break down"*
>
> *(S54) "make sure technologies are compatible, discuss requirements and agree these, get resources needed"*

(S60) "use chat rooms that store messages and allow users to respond no matter what time it is that way data will be saved"

Examples of problems cited which related to Teamwork include:

(S1) "you may not be doing as much work as other members", (S22) "don't know what others have written is actually from them"

(S30) "not much motivation if working remotely alone", (S46) "one or more group members might be slacking behind, yet the rest of the group wouldn't know cos they don't meet up regularly for meetings to show progress"

(S50) "distractions and perhaps less of the feeling to input to the team project as you will not see the reactions of the let-down team members"

(S56) "isolation as can't see people's reactions and gestures, less discussion as a result, difficult to brainstorm ideas"

(S70) "Using online discussions group meetings will take longer than face to face as have to wait for a response and will disrupt team rapport i.e. "what do you think?" then waiting for the typed response"

(S78) "lack of social skills, be boring by yourself, no interaction with no one".

There was evidence of a lack of trust with working remotely and the using technology to support team working. Concerns regarding boredom and feelings of isolation were common. It was assumed that "remotely" implied "working from home" and that the majority of people would take advantage of this situation by not doing the work and also incur distractions. Therefore, would not be productive and contribute to the teamwork. There was a consensus regarding the need to be "supervised" in some way and for team members to be accountable.

Suggestions of solutions to these perceived issues included:

(S10) "arrange weekly team meetings in person to talk about work undertaken on the project"

(S42) "install a webcam so that individuals can be monitored"

(S61) "make specific times so that group members can be contacted"

(S83) "use peephole type technologies to make sure members are working"

(S90) "have a manager team leader that sets deadlines for tasks and regularly telephones group members for updates"

The *knowledge exchange* activity provided valuable insights into the learners existing knowledge and skills of engaging with collaborative technologies. Also, the necessary support required by students to engage online in group based work was identified in addition to, the technologies that are currently in use by these learners as presented in table 2 and 3.

Table 2: Knowledge and support needed by learners

People to collaborate with me who will do the work
How to reference, what is the Harvard Referencing System?
How to write i.e. essays, reports?
How to do abstraction?
How to work well in a group?
What to do if students in my group don't do the work?
Time Management
Confidence
Communications with people you haven't met
How to keep track of my work?
Face to face communication I am better online
How to discuss in the potential problems which might occur in a project?
Express feelings and actions to each other

Interestingly, the majority of contributions made by students regarding the knowledge and support needed relate predominately to study skills and dealing with people as well as themselves i.e. developing confidence as shown in table 2. In contrast, table 3 highlights the technological skills and applications/technologies that students are familiar with and can offer support in.

Table 3: Knowledge and support on offer by learner

Camtasia
Smartphone use, all applications
Podcasting and video production
Scratch programming
Visual Basic and Java programming
Games
WhatsApp, Skype and Google Drive, Google Docs etc.
Wordle.com, to create Word Clouds
Moodle, EBay
Multimedia Production
Video Production, Multimedia material, web design
Blogs, Podcasts, Video Streaming
FaceBook, instant messaging
Flickr
Instragram
Smugmug, Shutterfly
Google Photos
LinkedIn
Skype
Leadership and Management
Photography, web design

5. Conclusion

Advances in technological development are evolving to accommodate changes in the Higher Education landscape. Educational practice has been slower to respond to the pace of change, which potentially creates a gap between the educator and the learner that in turn may be failing to meet the expectations of learners. This paper has shared student's own use of technologies and highlighted skills that they can offer to support others in their learning, as well as offering an insight into the academic skills and knowledge necessary for these learners to help succeed in academia.

The findings presented of the learners lived experience of a class based paper simulation of an online discussion space intended to prepare students for an online group experience will go some way to help understand learners better. Universities are under increasing pressure to respond to the needs of the 21st century learner whilst at the same time, provide affordable and sustainable learning and teaching approaches that prepare learners to learn and encourage them to engage more fully in their learning.

The paper simulation presented is reusable, scalable and cost effective requiring limited resources and has been shown can support and encourage students to reflect on the potential pitfalls and ways to resolve these prior to working in an online collaborative learning environment. And, has done so through a "realistic" authentic learning experience without "real" consequences i.e. loss of marks. The simulation can be used to help students in the transition to online learning environments such as a wiki and/or discussion forum which requires students to interact and engage with others.

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Digital Pedagogical Signature: Enhancing the Pedagogy of the Profession

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Abstract: This paper explores the role of the pre-existing pedagogical philosophy in a given educational context when aiming at co-developing a learning design. It relies on a design-based approach to a learning design that links educational programs to expanded learning opportunities across various action and learning spaces using web-based technologies. The learning design has been co-created together with teachers in a university college offering further education to in-service professionals. This educational setting adopts a distinct pedagogical philosophy in providing practice-oriented programs, emphasizing the integration of learning and work. The analysis draws on previous work on signature pedagogies in education in order to understand the way the underlying pedagogic philosophy links to the profession so that we can align the emerging learning design in ways that leverage the quality of professional learning. The co-creation approach to the design development promotes both creative collaboration and co-involvement of the teaching staff, and a feeling of ownership to the emerging design. The innovative potential in co-creation has resulted in an enhanced version of the pre-existing pedagogical philosophy in the form of a digital pedagogical signature – a conceptual prototype for specific learning designs. The digital technology leverages the learning philosophy to support the development of professional competences directly in the context of practice, in unprecedented ways. The result has been a hybrid learning design, which relies on digitally enhanced communication and learning spaces to facilitate learning and action across institutional, social and practice-related physical contexts following individual opportunities for learning into the profession. Having been through a process of iterative conceptual design development in the context of a particular educational program, we are now at the stage where we can reflect on design-based theory at a more abstract level. The paper will thus examine the impact of pedagogical philosophy underlying specific signature pedagogies in the co-development of a learning design as a means to facilitate professional learning. Hopingly, these findings will serve to inform similar design approaches in other educational contexts.

Keywords: learning design, signature pedagogy, hybrid learning

1. Introduction

Digital and web-based technologies can potentially revolutionize the approaches to teaching and learning as they open unprecedented possibilities to design for learning in new, integrative ways. Arguably, designing for learning needs to build on thoughtful pedagogical considerations that reflect the needs and aims of learning to its context. The educational and pedagogical philosophy prevailing in a given educational context contain rich clues as per how to promote learning. In addition, the work on signature pedagogies in education contributes to linking the learning outcomes closely to the professions, which is the aim of education at large.

Designing for learning does not only rely on the underlying pedagogy with its professional connotations, but also on teachers and their pedagogical creativity and design competences.

This paper presents the findings related to the co-creation of a digitally enhanced learning design using a design-based (DBR) approach with regard to the significance of the underlying signature pedagogy in a specific educational context. The learning design has been co-created together with teachers in the context of a university college (UC), which offers further and continuing education to in-service professionals with the aim of improving work performance. This educational setting is known for its distinct pedagogical philosophy in providing practice-oriented programs.

The research question this paper is addressing is: *Which considerations need to be taken when developing innovative learning designs that enhance the integration of education and work life?*

The question will guide us through assessing the contribution of the pre-existing learning philosophy in the light of signature pedagogies in this educational setting; and how technology can help re-thinking the learning design such as to bridge the gap between education and real life work situations. We will furthermore consider the impact of adopting a co-creation approach to design development as well as try to extract theory points in that we learn as we go, subscribing thereby to a design-based approach to theory development. Based on this, we will finally reflect on the implications for further design iteration in the specific context.

2. The case for digitally enhanced learning designs

We live in a time when information is readily available and easily accessible online and where new socio-cultural practices arise through social, mobile and creative technologies and online networks. This is expected to revolutionize the role of formal education institutions, including the organization of teaching, towards increasingly decentralized, digitally supported, dynamic learning environments (Horizon Report 2016). Traditional teaching roles as knowledge providers are challenged by the need of innovative pedagogical that create adequate learning conditions for students' sustainable learning in a technologically advanced, hyper-complex society (Qvortrup 2014). It can be disconcerting just navigating the immense creative potential of the digital world while abiding within the constraints of local settings, interests and varying capacity to seize opportunities that arise in the wake of technological development.

Not surprisingly, we see a rapidly expanding research and development (R&D) field that brings digitalization, pedagogy and design practices together in an effort to systematize new achievements in innovative learning designs. Methodologically, the present paper relies on the broader sphere of educational design research (McKenney and Reeves 2012) which emphasizes the interactive reciprocity between theory development and design development in practice stressing "the role of theory in informing design and the role of design testing in refining theory" (p 11). Design-based research (DBR) is a closer methodological reference, with its explicit interventionist aim of addressing a problem in practice accompanied by empirical examination that can further theoretical conceptualization in the domain and inform future actions. With this dual aim, DBR has spread particularly in the area of technology interventions to improve learning outcomes (Anderson and Shattuck 2012). The main task of R&D in digital learning design is a repositioning of teachers- from knowledge providers, being overtaken by technology, to learning designers, with technology, and the spread of a "teacher-as-designer" culture in the educational world (Mor and Craft, 2012). This aim is reflected in the present paper, which offers initial practical experiences with a digital learning design as it examines underlying theories and methods that support design development.

Any pre-conditions for design development constitute so-called affordances, which describe the relation between the objective qualities of the surroundings and the subjective ability of the people involved to act herein (Dohn 2016). Contrary to affordances in natural environments, various design-based approaches can help expand the affordability of a situation according to a standing definition of design as "..the human capacity to shape and make our environment in ways without precedence in nature, serve our means and give meaning to our lives "(Heskett in: Dohn 2016, p 52). Even from a natural environment perspective, humans seem to be able to renegotiate situational conditions: "[w] ithin limits, the human animal can alter the affordances of the environment but is still the creature of his or her situation" (Gibson 1986, p 135). Affordances are not static but rather expressing a dynamic relationship between artifact and user, which is conditional to the skills and experiences that the user has developed. Affordances are thus relative to culture, experience and skills (Dohn 2016, p 35).

This paper provides an account of a concrete case on working to find ways to harness some of the promises brought by technology in the context of university college (UC) program of 10 ECTS [1] in *Process Leadership and Co-creation*, as part of a 60 ECTS diploma in Leadership. The initiative to develop a new learning design is a response to current strategic focus on innovative forms of education that more fully support this UC's educational philosophy, to train "for praxis and together with praxis"; and to provide "modern educational programs that are close to praxis". Similarly, the UC's strategy includes a sub-strategy for digitalization, which stresses the intention to further new learning modalities to increase student appeal through digitally attractive, contemporary and experimental education and learning environments. Thus, the UC organization advances explicit expectations to faculty to explore and advance the field of teaching and learning with technology.

The writer was approached by the course responsible teacher with a wish to redesign the module in order to accommodate the integration of learning and practice, as well as provide increased flexibility and blended mode of delivery. The project was thus to create a design-for-learning (Goodyear and Dimitriadis 2012) in the form of a digital pedagogical design that corresponded to both the prevalent teaching philosophy and to the learning reach of the participants, public service officers in leadership roles. The teachers involved expressed the need for participants to not only learn about vo-creation, but also to co-create – as part of the program, and in that

[1] 10 ECTS (European Credit Transfer and Accumulation System)= 1/3 of a study year of graduate diploma

way achieve co-creative competences through co-creating in their respective organizations. Incidentally, this intention corresponded to this writer's intentions on the behalf of the teachers involved, to not only inform, but co-create the new learning design.

3. The role of pedagogical philosophy in designing for (online) learning.

Pedagogy is at the same time a theory of education and a theory of praxis and its aim is to put theory into practice. The theory-practice relationship reflects the essential unity between the two, the fact that education cannot abstract itself from the intended practice that it educates to. Education is thus an ongoing project of bringing the individual closer to the world of practice and the educationalist is ever in search of means to realize this promise in best possible ways. According to Gadotti (1996, p 7), "[i]n pedagogy, the practice is the horizon, the aim of the theory. … Pedagogical theory attempts to educate individuals as a point on the horizon but never a finished process because education is really an unending process."

From an educational philosophical perspective, Biesta (2015) holds that education has three main functions. The first is *qualification*, which provides learners with the knowledge, skills, and understandings, as well as with the attitudes, forms of judgment to 'do something'. A second major function of education is that of *socialization*, which initiates learners into existing social, cultural, political and professional understandings. Most importantly, education impacts on the human person, performing the function of *subjectification*, that is, of becoming a subject of agentic action and responsibility rather than an object of external demands. It is suggested that these three functions act as "three different domains of educational purpose; that is, three domains we can – and in a sense ought to – take into consideration when we try to articulate what education should be for" (p 257).

Underlying the notion of pedagogy for praxis, and aligning well with the three domains of education, the term *signature pedagogies* (SP), introduced by Shulman (2005) connects education to the professions. SP's are referred to as "the types of teaching that organize the fundamental ways in which future practitioners are educated for their new professions" (p 52). While pedagogy usually focuses on information and ways of doing, characteristic of the professions that the courses educate for, SP's stress the importance of engaging students in authentic tasks and knowledge creation. SP's thus naturally aspire towards ubiquitous forms of teaching and learning as they target student capacity of being able to think and act with integrity as a professional. Shulman (2005) identifies three dimensions that characterize SP's.

- 1.a surface structure of "concrete, operational acts of teaching and learning, of showing and demonstrating, of questioning and answering, of interacting and withholding, of approaching and withdrawing" (pp 54-55).
- 2.a deep structure of "assumptions about how best to impart a certain body of knowledge and know-how" (p 55); and how an aspirant learns to think like a professional.
- 3.an implicit structure, also referred to as the "hidden curriculum" (p 55), covering "a moral dimension that comprises a set of beliefs about professional attitudes, values, and dispositions" (p 56)

While SP's obey by the best teaching ideas from the profession, they also risk limiting the field by relying on habitual ways of representation that "persist even when they begin to lose their utility, precisely because they are habits with few countervailing forces" (p 56). Shulman points at technology enhanced teaching and learning using the Internet, online information seeking, computer-mediated dialogue, collaboration and feedback; and rich representations of authentic examples of professional reasoning, judgments and action – all creating an opportunity for re-examining the fundamental signatures that are taken for granted (p 59).

It can be difficult to assess the SP in leadership education as participants come from mixed backgrounds. Nevertheless, leaders are expected to perform across various domains in a global society. Jenkins (2012) suggests that educational environments in leadership programs should model inclusiveness by utilizing inclusive pedagogies. To this end, SP in undergraduate leadership education should favor discussion, projects and presentations, self-assessments and critical reflection.

Competent teaching staff at UC is defined by the extent to which they can establish and conform to a teaching philosophy, which harmonizes with the prevalent educational philosophy, and create synergy among self, discipline, and institutional context. Schönwetter et al. (2004, p 84) suggest that a teaching philosophy is based on a "systematic and critical rationale that focuses on the important components defining effective teaching and learning in a particular discipline and/ or institutional context". The teacher, in the present case, was driven by a wish to adopt more integrative approaches to grasping opportunities for learning and action across educational and work settings. Technology would serve to facilitate both access to knowledge, connection among participants, and mobility between various spaces.

4. Towards a digital pedagogical signature, DPS

The learning design was developed co-creatively with mainly two teachers from the particular program, but the process was informed more widely by data collected by the researcher across the department for further and continuing education at the UC. The design process went through several iterations, each focusing on a specific stage, corresponding to Heskett's prescription: "Design is to design a design to produce a design" (quoted: in Dohn 2016, p 50).

The first level was one of actively constructing a conceptual learning design that represented a digitally enhanced signature pedagogy according to the prevailing educational philosophy. In this way, the original signature pedagogy of integrating learning and work was made possible by digital mediations between the two contexts. At the second level, the conceptual learning design materialized in a so-called *Hybrid Interaction Model*. The hybrid mode provided continuous digital pedagogical support throughout the learning course across various environments and situations promoting active collaboration and creative learning in context. This particular design, too, build on a pre-exiting pedagogical model, the so-called study-activity model (see below), providing active support to maintaining the learning momentum.

Thus, the hybrid learning environment design consisted of physically and digitally mediated resources and interactions that coexisted and complemented each other in both physical and virtual environments promoting continuity, timeliness and presence. The pedagogy changed from being teacher and institution-centered to being work / life-based and learning-centered.

At the third level, the Hybrid Interaction Model was used to produce a particular learning design, i.e. adapted to serve the purposes of a specific education, namely the Co-creation module in Process Leadership.

The conceptual design of a digitally enhanced learning space was called the digital pedagogical signature (DPS) stressing the tight link to the prevalent signature pedagogy, which would guide the design of various UC programs in a digitally expanded learning environment. The DPS design was informed by interviews with educational and leading staff in the department. I found that, besides foundational pedagogical claims of close adherence to practice, the educational philosophy that informed most pedagogical actions in this particular UC was based on a set of semi-formal values relating to four types of approaches to teaching – all aimed at qualifying the learners to act competently in their practice. These were respectively the *reflective*, the *knowledge-based*, the *experience-based* and the *relational* approach to teaching. Learning aimed at the development of action competences in practice and involved the interaction between experiential work, systematic reflection and theoretical inspiration, as well as by creating rapport and collaboration. A meaningful interaction between these dimensions would result in enhanced competences for action.

This philosophy echoes the qualifying, the social and the subjective functions of education mentioned by Biesta (2015) – the latter in the strong emphasis on the unitive value of action competence. The teaching focuses on deep learning through active learning and focus on application, problem solving, relation to practice, and not least on processing new and difficult knowledge through dialogue and reflection. Subsequently, the new experiences must be integrated into the professional context of the participants and help qualify and develop their practices. However, this is far from easy to realize, partly due to efficiency constraints on class time and partly due to the division between school and work.

Another actively used tool to guide teachers organize their courses in the UC was the so-called *study-activity model*. It was a structuring model marking the division of learning activities taking place respectively in- and outside class, individually- or in groups; and whether they were student- or teacher-initiated. The main concern being to qualify student learning outside classes and supervision meetings, which were teacher-centered, and thus stimulate students' independent learning and the ways they interacted with the learning material on their own and with peers. Despite the effort to promote a full-cycle learning experience, the model remained an ideal in lack of a comprehensive learning platform to mediate between various spaces.

It could this far be assessed that the flexible online medium combined with digitized learning materials proved a viable extension of current pedagogical practices. With reference to the research question, one precondition for the coming into existence of the new learning design was that it reflected and enhanced the specific educational philosophy and the pedagogical signature of the UC programs, all aimed very specifically at the professions.

4.1 A hybrid interaction model for learning with praxis

Digital pedagogical design has been defined as process design for learning (Jahnke 2016), where the design dimension triggers a greater creative potential for configuring pedagogical structures that support learning. When pedagogical design unfolds in a digital environment, the learning affordances are significantly enriched and innovative pedagogical thinking takes shape. The digital is not just an addition, but changes the design perspective towards a new paradigm expressed through digitally mediated designs for learning. These unfold in hybrid, multimodal and multiple locations, and the learning from being teacher and institution-centered to being student and learning centered, i.e. follows the student's learning process in the potential learning situations that can be activated in the student's own life and work context.

In our work with the digital pedagogical signature (DPS), we focused on designing for learning through digitally mediated social interaction in three different learning spaces; the aim being to promote fluid mutual relations between knowledge dissemination, knowledge processing and production of knowledge in close relation to practice. This was guided by the Hybrid Interaction Model (fig.1), to emphasize the integration of digital and physiological presence modalities across learning and action spaces. The model was - internally at the UC- also referred to as DPS as it supported its signature pedagogy and the strategic intention to provide practice relevant education through new learning methods.

DPS realized this intention by expanding the participants' affordances of learning through digitally mediated dynamic interactions between the pedagogical components, where knowledge building and application in practice were continuously integrated and supported by the learning design. Following the Hybrid Interaction Model, learning activities were structured at three levels. These corresponded to the three dimensions of signature pedagogies (SP):

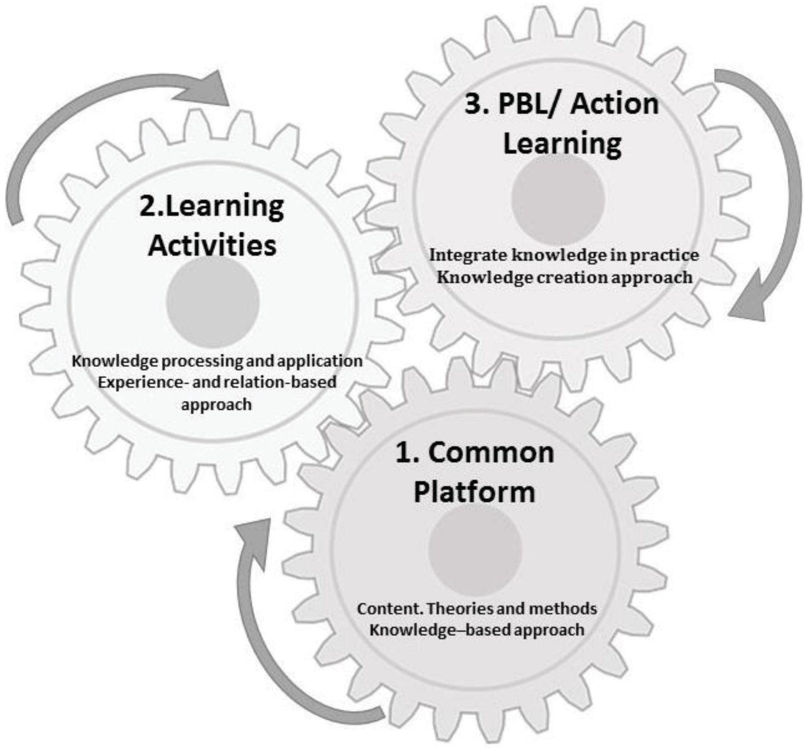

Figure1: Hybrid interaction model

1. At the first level of interaction, we find the content oriented platform aimed at *accessing* knowledge using digital learning materials to introduce concepts, methods, etc. as well as feedback on common tasks. One example of such technology is the use of educational podcasts (Gnaur and Hüttel 2016). Podcasts allow educators to share information via prerecorded transmission of disciplinary content and processes. A podcast can guide a student through a process, preparing for practice and understanding of a concept at her own pace in an on-demand format, replacing tutor centered contact. This counts as surface learning because it demonstrates how instructors frame and deliver information and processual knowledge. This transmission or guidance is an operational act of teaching and learning.

2. The second level of interaction is based on digitally supported collaboration for *processing* knowledge in context. Network groups can meet physically and/or virtually and perform various problem solving tasks and inquiry based activities related to practice. The focus here is on knowledge and skills training, where the teacher has a facilitative function. This type of interaction promotes the deep structures of problem solving, higher order thinking and collaboration among students, who connect in a hybrid space around common issues.

3. The third level of interaction pertains to *co-creation* of knowledge, where students identify and learn from engaging with real life problems in their respective work contexts. Problem based learning (PBL) and action learning are used to promote learning through interaction with participants' respective workplaces, which they investigate applying prior knowledge in co-creative ways, that generate new practice related knowledge. This knowledge is mediated digitally in the form of (video) *reality case stories* in the first common learning space, thus shared with all. The focus here is on action competences and blending one's own and others' competences. The role of the teacher is as that of a mentor and co-creative action researcher.

This level of interaction corresponds to the implicit or hidden structure, containing more complex elements of SP as they involve questioning, judgement and morality. Discussing professional attitudes and engaging in formative assessments of their work-in-progress has been found effective in online environments, as well as incorporating peer feedback - including coaching in how to give effective peer feedback - in order to cultivate a sense of what is considered valuable (Eaton et al. 2017).

The Hybrid Interaction Model triggers a number of dialectical, iterative and creative processes. These relate to the ongoing balancing of the digital possibilities and limitations, as well as the consequences that cross-action and learning space-activities have for learning. For how will the learners make use of the digital learning tools and activities and how will they act in digitally mediated social relationships and roles? How does the teacher design for learning in changing action spaces and social constellations, which is beyond the reach of teaching? Which forms of communication are best in the various learning spaces? How to design for building functional knowledge in relation to the learners' practices? How to create engaging activities and social interaction and networks? And how is learning designed in relation to the participants' professional contexts to generate new, practice-based knowledge that can develop and possibly transform practice? Such questions can only be answered in the context of a concrete case constituting "the set of practices involved in constructing representations of how to support learning in a particular case" and where design id different from development, being "the practice of turning these representations into real support for learning (Goodyear, 2005, p 82). The learning design requires the continuous creative involvement of the teacher as designer of learning (Laurillard, 2013). Invoking creative thinking and co-creative engagement in the design team with respect to satisfying the signature pedagogy at both surface, deep and implicit levels, are the main considerations at this stage, i.e., when adapting a design prototype to a specific educational design.

4.2 A co-creative design for learning

The third stage in the design-based research project - after the initial conceptual design (DPS) and its concretization in the Hybrid Interaction Model - has been to employ the learning design in a particular educational program, the Co-creation-oriented Process Leadership module. Together with the program teachers, we considered the learning goals of the program against the participants' learning needs and expectations as the backbone of the intended learning objectives as "[w]ithout clearly defined goals, educational design becomes more exposition" (Laurillard 2002). In this case, the program aimed at action competences and creativity, and so the emphasis was on designing for learning through action and reflection. Co-creation was of particular interest to the target learner group, public sector professionals. Co-creation refers to a new welfare paradigm co-involving the stakeholders, across administrative and professional divides (Sørensen and Torfing, 2011). The future process leaders were expected to develop competencies to identify and mobilize potentiality for co-creation, which required complex skills and the ability to spot innovation opportunities.

In order to cultivate this type of implicit capacities, the hybrid learning design has been enriched with a reflexivity component that supports self-reflection and self-assessment as well as other forms of continuous, shared reflection and process evaluation. Thus, the design contains an individual reflection tool in the form of an electronic process portfolio with supportive reflection tasks. Students are organized in groups and provide peer feedback on each other's activities. Main learning points can be reflected upon, in an electronic logbook, alongside other forms of group activities, such as assignments, activity logs, cases from practice, etc. Reflection supports the innovative and creative forms of learning and the implicit judgements underlying decisions.

The co-designing team has been particularly aware of promoting participation through communicative activities, where participants are presented with easily accessible content, such as daily short video reports to create a living communication platform; then gradually starting to contribute, guided through structured initial e-tivities (Salmon 2012) to establish an online identity, both as an individual and as a group. Communication in the first learning space is teacher initiated in the form of shared information, content and task instructions. As the learners participate in activities of applying knowledge and problem-solving, communication becomes gradually more participant initiated, with the teacher providing feedback. To stimulate the interest and engagement we favor multimodality, for example, there is particular focus on video dissemination such as video podcasts for various purposes, sometimes also produced by participants, as *stories from the field*.

The hybrid learning design has subsequently undergone further adaptations with regard to the degree of blended learning involved. It can thus be varied from mainly digitally supported to mainly physical seminars. The latter seems to be the preferred one by the participants, which may be due to reciprocal expectations when formal learning is involved.

However, the design has maintained its structure and distinctive elements, which alternate between face-to-face meetings preceded by preparatory online learning, and are likewise followed up by online 'action tasks' for application in practice. The learning design is described with a *journey* metaphor. As we go through various *learning stations* – online or class-based - we collect knowledge and tools for the journey, often as online learning units. At each of the two *bootcamps*, i.e. weekend seminars, we all gather to appoint *group missions*, which cover targeted *learning expeditions* aimed at data collection, analysis, action and reflection in authentic work contexts. The product can be a written report or brief video accounts, 'stories from the field', so-called *reality case stories*. Along the way, participants communicate with fellow students and the teacher as a learning partner. The course ends with a third and last *bootcamp*, which is an open exam conference day, where participants present their learning results using various digital formats.

Designs are and should not be static, yet they will confront the status quo and habitual patterns of activity in any context of practice. Designing for learning in close adherence to the underlying pedagogical rationale can be a way to make innovations stick. Nevertheless, designs need to be continually re-created in order to remain innovative and evolve practice.

5. Conclusions and lessons learnt

We have described a design-based research experiment, guided by the research question: *Which considerations need to be taken when developing innovative learning designs that enhance the integration of education and work life?* The learning design has, in our case, evolved through three stages: the initial conceptual learning design based on the prevalent educational philosophy and particularly on the signature pedagogy concept. This was deemed important given that pedagogy educates for practice and more precisely, for the profession, as is the case with our context, the continuous education within a university college. This stage has been crucial as the new learning design needs to be recognized by the practitioners, to the extent that it represents a technology enhanced version of the signature pedagogy, a sort of digital pedagogical signature, as it were.

The learning design has, in this context, benefitted from preliminary considerations of the signature pedagogy regarding both surface-, and particularly deep and implicit structures, when designing for learning. The second stage of the learning design has been an outcome of the conceptual design, which materialized into a basic design prototype, called the Hybrid Interaction Model. This capitalized on the existing pedagogical model, i.e.

the study-activity model, offering a viable alternative to fulfil the initial intention to provide a full-cycle pedagogical support for learning. The hybrid environment accommodates various types of activities at different levels while maintaining a sense of continuity when mediating learning across institutional and work boundaries. A third element, which is worthwhile considering is that any learning design will first become alive in the context of a specific educational program. At that point, it should entice the fantasy of the teacher as designer, joining forces with resourceful others, in order to explore the affordances of the particular pedagogical landscape. The learning design may be altered or supplemented, as required by the particular intended learning outcomes for the course.

Design based research offers viable ways to cross the boundaries between educational design experiments and theory development, with the relative drawbacks of partiality with regard to both. This translates in our case to the non-finality of the learning design and the fact that it will change many times from the intended design to implementation. In our case, the learning design was well received, to start with, yet two years later, it has lost some of its novelty value and tends to be replaced by more habitual expressions of the signature pedagogies. Theoretically, this paper has tried to capture some initial findings with regard to the significance of rigorous pedagogical thought and considerations when designing for learning when technology is involved. Arguably, the underlying pedagogical philosophy and the tenets of the signature pedagogy need be surfaced and actively capitalized upon, when designing for learning with respect to any particular context. The extent to which teachers engage in co-creative processes together with resourceful others will affect the affordances of the learning design to integrate education and work life.

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Building a new Community Around a Platform for Developing PBL Competences

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Abstract: PBL Exchange is a new web-based platform intended for competence development for supervisors of problem-based student projects at Aalborg University. In this paper, we analyze how PBL Exchange can be used as a means for building new communities of practice and extending the informal communities that already exist.

Keywords: community building, crowdsourcing, problem-based learning, competence development, higher education

1. Introduction

Problem based learning (PBL) is not a new learning philosophy, nor is it universally accepted. New members of academic staff at universities that adopt PBL usually have little or no experience with this pedagogical approach, and even if they do, it is important to develop a systematic approach to PBL practices and help this understanding grow.

There are many small, informal communities of practice (CoP) within university departments in which discussions of teaching take place. PBL-based universities such as ours are no exception. However, there is a real danger that these informal communities become isolated.

The Internet enables the members of a much larger CoP to exchange professional experiences and ask for advice. When it comes to professional development within PBL, which favours questions rather than answers, online social facilitation appears to have large potential. However, it is important to understand what influences academic staff participation in online environments and what motivates them to seize online opportunities for continuous professional development (CPD) within PBL. It is our hypothesis that we need online technologies that create an incentive to engage more members of the community in creative development of meaning and practice. Crowdsourcing is such a technology, namely an open resource that employs a peer-generated approach to collaborative knowledge building based on the participants' own questions and answers, which shifts the responsibility from course designer to participants.

In this paper we explore how to create a wider CoP at Aalborg University by mobilizing academic staff to use PBL Exchange. PBL Exchange is an online platform built on a crowdsourced interaction model for aggregating expert knowledge, meant to support PBL competence development among academic staff at a PBL university. After earlier development iterations involving potential users and improving technical functionality, we are now particularly concerned with building a large and stable community of active users. We thus inquire into recent developments with regard to managing crowdsourcing, i.e. promoting ways to tap into collective knowledge by means of collaborative participation.

The research question that we ask is: *How can we mobilise and increase participation in an online community of practice that uses crowdsourcing to develop the PBL competences of academics?*

The approach that we take is design-based and stresses the reciprocal interaction between theory and design development, allowing theory to inform design and to be refined through design testing. We are particularly keen on identifying motivational factors that are context-sensitive, and elements that are critical in promoting social engagement and move individuals to work collaboratively toward shared purposes. Since the motivation for using PBL Exchange is non-commercial, participation has to be driven intrinsically or by inherently engaging tasks. We explore how the questioning methodology in PBL can be emulated in order to ignite a sort of digital activism or crowd engagement concerning real questions and problems encountered, that will appeal to a wide variety of both experienced and less experienced staff.

2. Competence development through communities of practice

One of the major problems in academia is that of competence development in teaching due to different perspectives on the type of expertise this implies, as compared to the disciplinary research expertise at the heart of academic identity. Despite top-down strategies for teacher professional development, researchers seem to reproduce tensions between their own domains of expertise and the development of the quality of their teaching (Clegg 2003). This restrains the adherence to professional communities others than those pertaining to their respective specialization (Crawford 2008). However, the necessity of establishing a *community of practice* (CoP) for teaching has been recognized as crucial in gathering participants' informal contribution to the continuous development of their pedagogical competences (Knight and Trowler 2001). The notion of CoP is due to Wenger (1998) and originated in his influential work on situated learning. Others have explored the need to anchor professional development in the site of practice, as non-formal, personally configured learning that is a part of daily work activities (Eraut 2000).

CoP's have existed throughout human history; they can evolve spontaneously and informally or be the result of a deliberate effort. Velasco et al. (Velasco et al., 2014) conducted a survey among university lecturers from Spain, Brazil and Malaysia, and it indicates that CoP's for teaching are seen as very important for developing competences in the area. Several initiatives now aim to establish online CoP's for discussions for teaching in higher education. They include teachingmedia.org (Teaching Media, 2018) for teachers in undergraduate degree programmes in media studies and the Mathematics Educators forum at StackExchange (StackExchange, 2018).

Many official initiatives at individual institutions that aim to develop pedagogical competences make use of organized CoP's. However, they are limited to fairly small groups of educators and only last for a limited period of time. An example is the compulsory pedagogical qualification programme for assistant professors at Aalborg University; all participants are encouraged to share and discuss their experiences in collegial groups. The duration of a cycle of the programme is 18 months, following which the collegial groups cease to exist.

Establishing good CoP's can be difficult since modern-day academic careers are often short. A sizeable proportion of teaching in higher education is carried out by PhD students, teaching assistants, assistant professors and external lecturers. In their short careers they may gain important insights into teaching, but when they leave academia, these insights are lost.

Another challenge is that practice in e.g. PBL supervision often appears to be tacit. The Danish government imposed a ban on the traditional form of group-based oral exams for PBL projects in 2007; when the ban was lifted in 2013, it turned out that there were few written accounts at Aalborg University of the practices relating to group-based project exams and it became a major effort to re-establish a practice that had central to PBL pedagogy for 33 years.

Many CoP's in academia tend to focus on a single discipline. However, besides discipline-specific topics of interest, an institution of higher education such as Aalborg University, that claims to espouse the guiding principle of PBL in all its educational activities, needs to create a space for user-led concerns that are part of their PBL practice, irrespective of subject, e.g. issues of problem analysis, group formation, conflicts within groups and other aspects related to the project process itself.

PBL Exchange began as part of a university-wide incentive to further the development of PBL at Aalborg University in the light of current challenges and opportunities, such as the use of technology in teaching. In the PBL Exchange project we seek to establish a wider community of practice through a *design-based approach* using *crowdsourcing*. This is both a research effort and an effort to change pedagogical practice through new ways of thinking about competence development.

3. PBL and the challenges of developing PBL supervision competences

The challenge of developing PBL supervision competences is a special one. Aalborg University is one of the two Danish universities (Roskilde University being the other one), where problem-based, project organized learning is central to all degree programmes. Throughout their education, students will collaborate on a problem-based project in small groups. The project is usually carried during a semester alongside other teaching activities, and it involves interaction with a supervisor who is a member of the teaching staff. Projects are diverse, since the initiating problem is usually chosen by the students themselves. At the same time, the student body is very diverse.

PBL supervision competences must therefore also be diverse: They involve knowledge of the subject area but also interpersonal skills, a process-oriented view of problem analysis and the methodological aspects of problem solving. These competences tend to evolve from the experience gained from exposure to a vast array of situations that reflect this diversity.

A competent project supervisor is able to address the situation and the problems that she faces in her supervision. Illeris (2012) sees competence as the ability of applying knowledge and skills in new situations and to new problems. In other words: PBL supervision competence is itself a problem-oriented competence related in spirit to the approach that students should follow, and a competence development strategy therefore also ought to be problem-based. In our case this means that supervisors can develop their competences by posing concrete problems in their supervision practice and by trying to solve them.

4. Design-based research (DBR)

DBR has attracted both researchers and various layman groups, mostly within the area of technological interventions to improve learning outcomes (Anderson and Shattuck 2012). DBR is driven by a double aim, conducting an intervention to address a problem in practice accompanied by empirical examination that can further theoretical conceptualization in the domain and inform future actions. While this dual commitment of improving practice and advancing the field of practice is central to DBR, one may ask how this is to be realised. While committing to mixed methods used widely in educational research (McKenney and Reeves 2012), leaning onto design principles and driven by research and development concerns and practitioner-researcher partnerships, similar to action research (Ørngreen 2015), DBR claims its raison d'être from its dual aim, to advance both theory and practice in novel areas of potential interest to both parties, e.g. technology and learning.

There are however inherent weaknesses in DBR with regard to practicability of the designed interventions, as these are often developed in lab-like environments, detached from the messiness of real learning ecologies, which may impair the transfer process (McKenney and Reeves 2013; Ørngreen 2015). Similarly, it can be difficult to assess the real value of the theoretical outcomes, partly due to the ongoing, iterative pattern of design interventions that makes it difficult to report actual impact on practice; and the relative limited amounts of studies reporting actual theoretical deliberations as a result of design based interventions., The value of DBR rests perhaps not with concluding, but with opening up the field by means of novel interventions and initiating theoretical discussions based on preliminary findings and ongoing analysis. In this vein, we present preliminary theoretical reflections on the basis of an ongoing intervention, in its third iteration.

5. The design of PBL Exchange

The PBL Exchange platform uses the crowdsourcing approach that is also behind the StackExchange platform (StackExchange, 2018): Users together build and evaluate the contents of a knowledge base centered around a specific topic, which is that of PBL.

One may discuss how many active participants it takes to speak of a 'crowd' at a single institution. But crowdsourcing is increasingly associated with certain forms of participatory activities that tap into collective intelligence and is widely applied to almost any Internet-based collaborative activity (idem). It is important to understand what generates the motivation for this type of participation and how it can be stimulated when initiating crowdsourced projects such as ours. We reckon that PBL Exchange relies upon social engagement as a way of individuals working collaboratively to achieve the common goal of developing their PBL practice.

There is a gamification aspect built into PBL Exchange, also reminiscent of StackExchange: Users can upvote questions and answers that they like and downvote those that they do dislike. In this way, users can obtain and lose points. The total score of a user affects his/her rights at the PBL Exchange site; a sufficiently high point score will enable the user to obtain certain rights to administer content posted to the site. The gamification aspect of PBL Exchange serves two purposes: Firstly, it establishes a quality criterion for content that is related to the notion of peer reviewing that is common to the academic community. Secondly, the existence of privileges that can be obtained through sufficiently many points acts as an incentive for activity and recognition.

The PBL Exchange platform has been through three iterations since its initial launch in the autumn of 2016. The first version was directly based on the existing Question2Answer open source software (Question2Answer, 2018) and involved a small user base of 40 project supervisors at Aalborg University. We conducted a survey among the users; the comments were generally positive.

The next version used a revised version of the Question2Answer codebase and was launched to the wider community of semester coordinators at Aalborg University at a general meeting on 23 August 2017. This version was well received by the participants, but also served as a platform for collecting constructive feedback for the further development and application of a crowdsourced facility for continuous professional development in PBL. Meanwhile, a completely new version of the system was under development in order to deal with the poor quality of the original PHP codebase. This last incarnation of PBL Exchange is implemented using the Django framework, and was launched at the Day of Teaching at Aalborg University in May 2018.

The new version of PBL Exchange has been enriched with various features, such as engaging in special incentives introduced by the project owners. In particular, we introduce *challenges*: Specially selected users are asked to pose questions to the community about relevant themes in PBL (such as examinations or group formation); the best answers will then receive points; in this way, new points are injected into the system. Moreover, users can set up *bounties* by asking a question that is of particular importance to them. The best answer (as selected by the creator of the bounty) will then be rewarded a certain amount of points. The points are subtracted from the score of the user that set the bounty.

There are still relatively few active users of PBL Exchange at the time of writing. The important challenge is to increase the number of users to the point where a crowdsourced cross-campus community of practice becomes a reality.

Our focus is now on building and maintaining the community as part of our digital activism strategy. We have already visited several departments at AAU and will continue to interact directly with existing CoP's within and across institutional divides.

6. From online crowdsourcing platform to crowdsourced community of practice

It is important not to confuse an online forum with a community of practice. However, if PBL Exchange is to become the infrastructure of a new community of practice; we must first understand how well it satisfies the principles that characterize good CoP's. Wenger et al. (2002) list seven principles for cultivating a CoP based on an extensive study of a wide variety of such communities:

- Design for evolution
- Open dialogue between inside and outside perspectives
- Invite different levels of participation
- Develop both public and private community spaces
- Focus on value
- Combine familiarity and excitement
- Create a rhythm for the community.

Our forum supports these principles to a large extent.

PBL Exchange is designed for evolution: The knowledge base of the system will develop as it is being used. The system is *open*; its codebase is released under the GPL 3.0 software license with the intent of continuing its development.

One may argue that PBL Exchange does not directly address an explicit dialogue between inside and outside perspectives, since the user base is the well-defined group of PBL supervisors at Aalborg University. However, PBL Exchange is intended to be taken up by new PBL supervisors coming from other academic traditions, so in some sense the inside/outside dichotomy is internalized within the system – supervisor with little or no experience can interact with experienced supervisors. Likewise, the fact that one can either participate actively with questions or answers (or both) or simply choose to read existing content, points towards different levels of participation.

PBL Exchange supports both a general discussion space and specialized fora for specific degree programmes and semesters, so there is a focus on public as well as private community spaces.

The gamification aspect of PBL Exchange is central: Users can upvote/downvote content that they like/dislike, and in this way there is a built-in, crowdsourced notion of quality. Users with sufficiently high scores obtain privileges in the form of the right to administer certain features of the forum. In other words, there is a very explicit focus on value.

The notions of challenges and bounties are tied in with the gamification aspects. These aspects are meant to both ensure quality and create excitement, and by making challenges a regular feature, these can also help establish a rhythm for PBL Exchange. This of course requires a willingness from a particularly dedicated group of users to start such a practice.

Since PBL Exchange relies on crowdsourcing, there are further principles that the forum can support that many communities of practice do not support well. In particular, the written format allows insights to be preserved for posterity (since they get written down and are preserved in the database of the system). Moreover, the principle of crowdsourcing itself allows for the co-production and negotiation of meaning and practice in the setting of PBL.

Two critical aspects of any CoP are those of *access* and *transparency*: Anyone within the community must have access to its internal communication in order for the community to function as intended, and the communication must be transparent to all users. PBL Exchange is open to all project supervisors at Aalborg University. On the other hand, the gamification aspect leads to a difference in power between users with few points and ones with enough points for them to have administrative rights – in this sense, not all users have equal access. Counter to the principle of transparency is the right to *anonymity* Users can ask anonymous questions and provide anonymous answers. This was not a feature of the initial version of PBL Exchange but was requested by the users, as it was felt that certain aspects of project supervision (such as intra-group conflicts) can be particularly fraught with sensitivity.

7. Reconciling PBL Exchange with existing informal CoP's

The main challenge for any crowdsourcing approach is that of obtaining critical mass – getting the number of users necessary to make the gamification aspect create a self-regulation form of quality control and an incentive to remain active.

Another challenge is that of public *visibility*. Findings from recent research (Pendry and Salvatore, 2015) indicate that there are sensitive issues related to being visibly present in an online forum.

But a major challenge when creating new, well-defined CoP's with formalized modes of interaction is that of recognizing the importance of the already existing, informal CoP's. Whenever we have presented PBL Exchange to colleagues across Aalborg University, they have often remarked that talking to certain colleagues whenever facing a challenge in their project supervision was a well established practice – so why set up a web-based forum? However, this perspective is seemingly predominant among senior PBL-practitioners, whereas the younger adepts are more inclined to embrace additional means of seeking informed perspectives in PBL matters, which is significant from the point of view of access to expert knowledge in a CoP context.

Nevertheless, this is a valid concern. We must ensure that PBL Exchange is not rejected by potential and senior users on the grounds that it runs counter to existing communities of practice that the members are embedded in.

There are by now quite a few studies of how organizations have attempted to set up new CoP's and with varying success. Pyrko et al. (2016) have studied what it takes for a community of practice to thrive, and they formulate the notion of "thinking together" as being the important one. It is precisely by "thinking together" that the members of a community of practice mutually guide each other through their understandings of recurrent problems in their practice, and this is how they indirectly share their tacit knowledge. As Pyrko et al. (2016) write:

> *Simply deploying knowledge in the form of casual information exchange rather than mutually engaging in more intensive knowledge development … cannot sustain a thriving practice .... It calls for a view of knowledge sharing where knowledge is not transferred in a literal sense like an object, but it is re-recreated by knowers during those very acts of knowing ... At a conceptual level, the transpersonal process of thinking together is necessary for CoPs to thrive.*

In other words, PBL Exchange must recognize and potentially enhance the existing dialogue and "thinking together" about PBL supervision by seeking to integrate itself with these activities, while showing that there is additional insight to be gained by inviting multifarious perspectives on any issue of interest or concern, and furthermore, at the time and place discretion of the user, as well as anonymity - a great concern for the users during the initial design iterations.

A way to generate thinking-together practices, would be to elicit experts' active participation and contribution to the online community behind the development of PBL practices. That is to involve them in formulating *challenges*, acting as challenge owners and moderators. At the moment of writing, about a month before the exam period, we, the writers and project owners, have launched the first challenge concerning evaluation and exam practices in PBL - the shift from PBL-supervisor to that of examiner. Similarly, we intend to invite senior PBL practitioners to suggest and discreetly monitor future challenges deemed of importance to the general practice of PBL.

Another way of encouraging participation in co-creative thinking would be to make use of the gamification element for bounties, whereby users invest personal points in harvesting rich answers to areas of particular interest.

A third way to boost the community spirit in PBL Exchange is to maintain the focus on securing a critical mass of engaged users, committed to exploring and partaking of the potential and upcoming exchanges. According to Butler et al. (2014), two community characteristics are important in order to sustain an online community: one is *community size*, and the other is *community resilience*, meaning the ability to persist as community members in spite of the variability and change in the topics discussed. One of the concepts introduced in this context is that of *topic consistency cues*, that refers to the way a community signals consistency in terms of what topics may appear in the future with regard to what it has hosted in the past. The focus in coming iterations needs to persist on community building focusing on increasing the mass of users and their engaged participation over time indicating stability of exchanges around PBL.

8. The importance of permanence

One way to indicate consistency is by capitalizing on core aspects of PBL that are important now and will remain important in the future. In fact, an aspect of PBL Exchange that drastically improves on existing informal CoP's is that of *permanence*. The system preserves PBL supervision experience and supervision competences as a searchable repository of knowledge validated by the community through crowdsourcing and keeps in a structured format. A future development effort is that of setting up a community wiki to create an even more systematized structure. Fora such as Stackexchange already have a notion of community wiki that allows users with sufficient credentials to add content to this.

At the same time, one must accept that a shift towards acceptance of online extensions of CoP's cannot happen overnight. It is a longer-term challenge to get existing informal communities to use PBL Exchange as an infrastructure that can be used for "thinking together" and as a means of ensuring permanence instead of them perceiving it as an obstacle. The idea that the competences found in an informal community can be made explicit and preserved for posterity is an important selling point.

9. Conclusions and ideas for further work

We have engaged with a DBR project that aims to change and extend the CoP's among supervisors of PBL projects in the degree programmes at Aalborg University. The PBL Exchange platform itself is a potential new infrastructure for communication within and between existing CoP's for PBL project supervisors, but making this become reality is an ongoing challenge.

The theoretical contribution of our project relates to new ways of consolidating CoP's through crowdsourcing and through understanding how they work. In our direct interactions with existing CoP's within departments we have captured diverse perspectives regarding the need for a question-based, readily accessible online CoP. Senior PBL practitioners often see existing CoP's as fully satisfactory ways of providing informal professional exchanges and practice development; whereas younger staff members are visibly more open and express a need for such a forum. One has to thread carefully the terrains of various CoP's and create incentives for members of diverse motivations to participate. The challenge and bounty experiences should be seen in this light. Challenges can nudge more experienced PBL practitioners to participate by discussing core aspects and potentially developmental aspects of PBL. Bounties can empower other members of the emerging community to advance issues of importance to their personally defined learning.

DBR offers many ways to cross the boundaries between educational design experiments and theory development, with the relative drawbacks of partiality with regard to both. This translates in our case to PBL Exchange being mainly a project intervention, designed and advanced by the project team, which corresponds to the DBR critique of lab-like interventions. The way to circumvent this limitation is by frequent interactions with the field and the gathering of significant feedback to integrate in further design iterations, which was very much our strategy. Regarding the theory development, we subscribe to the partial character of findings as generated by an ongoing design process. However, we are able to contribute some preliminary findings with regard to the necessity to focus explicitly on community building: This can support PBL-related exchanges as part of an online forum for CPD. In this regard it is essential to consider the notion of CoP and the ongoing informal learning and development as part of everyday work. CoP- based approaches to learning stress the need to orchestrate 'thinking-together' processes, and here we find an online medium, which is socially facilitative in nature, such as crowdsourcing, that can be a vehicle for these processes. However, careful attention needs to be paid to extending existing CoP's to a larger online CoP. These considerations have in our case led to the design of further technology enhancers to address the orientations of both experienced and newcomers to the practice of PBL.

We are going to incorporate the informal communities more systematically and investigate how this approach should be carried out in order to use PBL Exchange to extend the community. While contact with local communities in the form of information activities directed at the departmental level is still part of our efforts, a longer-term strategy is to create a group of dedicated users that can be explicitly nursed and become a permanent core of the community. Here, it will be important to identify key members of these informal communities and get them interested in participating in this resilient core. The outcome of our further efforts will contribute to a concrete, evidence-based strategy for building new communities around existing, informal ones.

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Digital Storytelling in Teacher Professional Development

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Abstract: This paper explores, through a pilot study, the potentials and pitfalls of using digital storytelling-inspired approaches combined with investigative sketching processes in teacher professional development (TPD) and in-service teacher training, focusing on an individual sense of agency and collegial collaboration. Seen in a broader perspective of societal developments, TPD is increasingly imperative, as teachers have to navigate through extended inclusion of students with special needs, digital literacy, and multicultural classrooms; and as more teachers are entering the profession through alternative pathways, without having the initial teacher education, TPD is increasingly seen as a process of lifelong learning (OECD, 2009 & 2014). The research in this article originates from a small segment of a large longitudinal research project on online teacher professional development (oTPD) for science teachers in Danish elementary schools. Data in this pilot study derive from a two-day workshop, conducted with two science teachers, aiming to 1) facilitate an investigative process for the participants where they, through video productions and personal digital storytelling, could explore, identify challenges and develop their teaching practice, and 2) use the productions as empirical data in the larger research project. Adaptations of digital storytelling developed by www.storycenter.org were applied in the workshop in combination with investigative sketching processes. The analysis in this research documents progress in the teachers' sense of agency and action competence, as well as progress in the teachers' motivation for continuous collegial professional collaboration. Though the experience was of increased sense of agency (also when revisited after one year), the question remains whether the teachers actually had the capability to act in their teaching practice and organisation. The structures of school contexts in general may be such that even though the teachers have identified possible actions and how they would like things to be, few changes are actually obtainable without actionable management support. The pilot study in this article involves a very limited number of teachers; nevertheless, the analysis points out interesting potentials which motivate a follow-up study in these approaches in TPD and in-service teacher training.

Keywords: digital storytelling, teacher training, teacher professional development, reflection, video sketching and narratives

1. Introduction

Teacher professional development is increasingly imperative, as teachers have to navigate increased inclusion of students with special needs, increased focus on digital literacies, and multicultural classrooms; and as more teachers are entering the profession through alternative pathways and not having the initial teacher education, teacher training is increasingly seen as a process of lifelong learning (OECD, 2009 & 2014).

The research in this paper stems from a small segment of a larger research project on online teacher professional development (oTPD) for science teachers in Danish elementary schools. The TPD focus on active participation is related to the teachers' everyday practice and reflection with peers and, through this, enhances the transfer to the practice dimension (Wahlgren, 2009). This larger project was a design-based research project (Amiel & Reeves, 2008) ending in 2017, which included a 3½-year data-gathering process including quantitative and qualitative data. As a part of the qualitative data, a two-day workshop was conducted with two science teachers from an elementary school in Denmark. It is this workshop that constitutes the empirical foundation of this research paper. The workshop involved two methods as possible catalysts for teacher professional development: 1) digital storytelling, based on the model developed by www.storycenter.org (Lambert, 2013), and 2) sketching processes inspired by Systematic Inventive Thinking (SIT) (Barak & Albert, 2017) and video-sketching (Ørngreen et al, 2017).

The research aim of the workshop was to use video productions and personal digital storytelling as A) data collection in relation to the larger research project, and B) a catalyst to professional reflection, agency and teacher professional development.

2. Theoretical framework and practitioners' documented experiences

The process of producing short personal digital videos in collaborative sessions as a means for understanding something new or disseminating something important from that person's life is particularly seen in the *digital storytelling* (DS) method. In DS workshops, the participants are facilitated individually and collaboratively through specific phases in which they develop and share personal and authentic stories. The stories have a narrative structure using multiple modalities within digital media, e.g. text, still and moving images, voice, music, animation etc. (Lambert, 2013).

In a broader perspective, the use of storytelling within organisations as an instrument for organisational change has been acknowledged in various studies (Boje, 2006), indicating potentials of trust-building, transfer of knowledge, generating emotional connections and mending relationships. The sharpening of one's story-listening skills can translate into a more accurate map of collective understanding among the organisational players (Boje, 2006; Luwisch, 2001; Estola et al, 2014; Sole & Wilson, 2002). Pitfalls are also identified, e.g. if the complexity of the storywork and the in-situ context are overlooked, if the presumption of uncovering tacit knowledge through storytelling is overestimated, or if resistance stories are rejected (Boje, 2006). In "narrative therapy" within psychiatry, the potentials are seen in the externalising of personal stories and the possibility of investigation from a 'distance', which can uncover alternative understandings and actions, and repair trust (White, 2006).

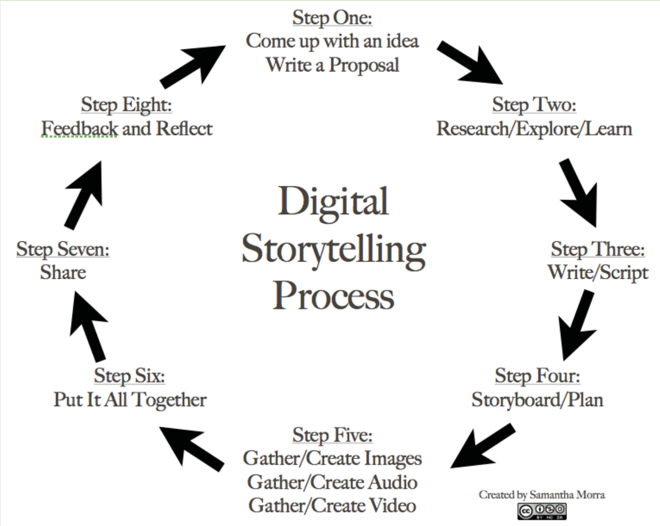
The DS method originated in the US in the 1990s, focusing on the possibilities of the new media in relation to storywork. The method "supports individuals and organisations in using storytelling and participatory media for reflection, education, and social change" (Storycenter, 2018), and has gained international attention, where some researchers and practitioners focus on giving marginalised groups a voice in society, others on developing one's professional identity and supporting relational engagement (Hull & Katz, 2006; Hardy & Summer, 2014; Haug et al, 2012). In addition, various research studies point out potentials for development of collaborative skills, mastery of multimodal digital technology, self-knowledge, self-representation, learning and reflection (Alterio, 2002; Barrett, 2006; Haug et al, 2012; Jamissen et al, 2017).

The DS method consists of different entangled dimensions. The original method, as it is taught to trainers through certification workshops, consists of several steps which, over time, have permuted into a number of versions. Table 1 shows three approaches that emphasise the processual perspectives, but with various connotations and concepts applied. First are shown the seven steps from the online Digital Storytelling Cookbook (originally by Lambert in 2010, and then edited in Lambert, Zalabakova & Steen, 2014, which we use here). The cookbook does not refer to social activities of collaboration and support for the reflection process; for example, it does not mention the story circle, which is normally seen as a strength of the method. Instead the focus seems to be on enabling individuals to create their own stories, though keeping the process perspective by stating that the storytelling process is a journey (Lambert, Zalabakova & Steen, 2014). In the middle is a model by Samantha Morra (2013) as a method to be used with students in class, and the text is primarily written to teachers. Again, this does not include collaborative elements while in the story creation process, but does introduce feedback after sharing the digital story, which is argued as an important element in learning processes, as well as a focus on continuation, as the figure itself is drawn as a circle. The text does not elaborate on this, but it could be understood as either returning to one's story or improving the next story. Finally, steps are shown from an online handbook on transformative storytelling for social change (Transformativestory, 2018). The organisation behind the handbook illustrates three ways of working with digital stories, in a continuum from the personal storytelling in the DS process to collective storytelling via a participatory video process (where the story and the digital video are co-produced). Thus, this approach emphasises the social, as for example the previously-mentioned story circle.

Table 1: Overview of various DS approaches

STEP 1: What do you want to tell? In the very beginning, you need to find out and clarify what your story is about. **STEP 2: Add your emotions.** Once you identify the emotions in your story, you can decide which emotions you would like to include in your story and how you would like to convey them to your audience. **STEP 3: Find the moment of change.** You have found and clarified the insight and emotions of your story. You became clear about meaning of your story. The next step is to tell your story by identifying a single moment so you can illustrate your insight. **STEP 4: Make your story visible.** You already know your story and the emotions you want to show, and you have found the moment of change in your story. Now you need to work on the visual component of the story to bring it to life for your audience. **STEP 5: Add sound.** **STEP 6: Assemble your story!** At this point in the process, you have found and clarified what your story is about and how it sits with you today. You have also established the overall tone you want to convey. You've identified a moment of

change and begun making choices about how to use visuals and sound to bring the story and scenes to life for your audience. Now you are ready to assemble your story by spreading out your notes and images and composing your script and storyboard.
STEP 7: Show your story. Finally, you should think about your audience!
(adapted from Lambert, Zalabakova & Steen, 2014)



(Morra, 2013)

Personal storytelling through digital stories: Digital storytelling is a learning, creating and sharing experience supported by technology, allowing participants to share aspects of their life stories through the creation of their own short digital media productions.
Moving from individual to collective storytelling: Digital stories can be used as a springboard for a participatory video process, and as a way of moving from very personal, individual work, towards a group storytelling project. Central to this shift is a process of reflection and analysis of digital stories by the storytellers themselves.
Collective storytelling through participatory video: Together, participants discuss and agree on a narrative for the film(s) they want to make, and go on to produce these films. It is an empowering process, enabling people to take action for solving their own problems and communicating this to decision-makers, their communities and the wider public.
(adapted from Transformativestory, 2018)

Studies show that personal narratives provide a space to explore, understand and link past experiences with current situations and future conceptions (McKay & Ryan, 1995; McCorquodale & Kinsella, 2015), and to create meaningful bridges between participants' personal and professional lives and arenas (Walters, 2014; Haug et al, 2012). Studies point out that the personal dimension can potentially prompt the participants to 'look at themselves in the mirror' through self-representations and reflect on themselves (Lundby, 2008), and can act as a bridge to community-building and relational engagement based on how the participants are brought into each other's realities through the story sharing in the "story circles" (Haug et al, 2012). It also potentially supports social reflection and development of learning in communities of practice (Fletcher & Cambre, 2009). The multimodal dimension where the participants produce their own digital video by the use of text, images, voice, music, animation etc. holds potential for the participants accessing and investigating experiences and their own conceptions from different angles (Ørngreen et al, 2017). Also, the multimodal dimension supports participants with reading and writing challenges, so that they can engage fully in the production, reflection and learning processes (Gythfeldt & Ohlman, 2012).

Earlier studies of DS interventions in educational organisations indicate that DS potentially supports clarification of professional understandings and negotiation of professional identities (Jamissen et al, 2017), bearing in mind that the goal was not to create consensus and complete alignment, but to support and explicate productive ways to build working combinations of diversity and unity (inspired by Akkerman & Bakker, 2011 in Jamissen et al, 2017).

In conclusion, the experience from the research literature and searching online traces of existing practices is that DS can support social interaction, feelings of empathy, and giving access to the participants' past experiences, among others. The challenge in this project is to gain this and also maintain the framed TPD theme in question – the science teacher profession. One option could be to be strict on the content of the digital stories, but this may lead to the suppression of upcoming issues vital to reflect on to create transformative learning and persistent changes. In this project, we turned to specific sketching processes, as we, on previous occasions, had seen these sketching processes work as a catalyst for presenting a multitude of issues at play, facilitating visual filtering and allowing participants to gain new perspectives on these issues (Ørngreen et al, 2017). In the workshop, we investigated when and in which ways sketching can be included in the DS process. The sketching processes was based on Systematic Inventive Thinking (SIT), originally developed for problem-solving and inventive thinking in relation to product development (Barak & Albert, 2017). In these sketching processes, the participants were asked to experiment with grouping some elements, deleting others, clarifying patterns and bringing certain similar issues closer together.

It is beyond the scope of this paper to include a full review of sketching in creation and design processes, except to point to, for example, the independent works of Gabriella Goldschmidt (2003), Donald Schön (1992) and Bill Buxton (2007), which all highlight the conversational reflective aspects of sketching, whether as a way to have inner dialogue or as shared reference points in collaborative interactions.

Our agency perspective is inspired by Engeström et al and their transformative agency in a cultural activity theoretical perspective, which emphasises the collective processes (Engeström, Sannino & Virkkunen, 2014) and their change laboratories focusing on collaborative design as a strategy to support teachers' agency (Severance et al, 2016). Also, we resonate with the detailing of how agency approaches were used in a social design experimentation in Gutiérrez & Jurow (2016), where the objective was to obtain social equity and learning, and allow for designing the participants own futures.

3. Research design and context

As presented, this research stems from a small segment of a larger research project on online teacher professional development (oTPD) for science teachers in Danish elementary schools. The development of the oTPD was led and done by the Kata Foundation, and the research by Research center for Video @ILD-lab Aalborg University, Denmark during the years 2013–2017. The online resource is Klog på naturfag (KpN) – in English, Smart About Science – and is accessed at www.klogpaanaturfag.dk. The Kata Foundation is a non-profit project fund which works for the purpose of promoting knowledge about learning.

The project was a design-based research project (Amiel & Reeves, 2008) ending in 2017, which included a 3½-year data-gathering process including quantitative and qualitative data. As a part of the qualitative data, a two-day DS-inspired workshop was conducted in December 2016 with two science teachers from an elementary school in Denmark; participation was not mandatory, but voluntary. This paper's research is based on that workshop.

The data collection linked to the workshop included a qualitative mail questionnaire completed by the teachers before the workshop, as well as reflection notes during and after the workshop produced by the facilitator and the co-facilitator, including an evaluation at the end of the workshop in the form of a talk with the participating teachers. Furthermore, an interview was held with the co-facilitator shortly after the workshop, and a mail questionnaire was processed with the teachers a few months after the workshop and repeated one year after the workshop.

The workshop was arranged as a two-day workshop away from the school over three days, with one day back at school in the middle to relate the workshop to everyday activities. Prior to the workshop, reflection on current practice was initiated with a couple of questions and use of the online resource KpN. The workshop began with questions like: *what do I do as a science teacher; why do I do what I do; where am I now;* and *where do I want to go and how do I get there?* This was followed by DS activities, such as manuscript writing, all framed within the science teacher practice. The facilitator and co-facilitator both participated in these exercises and sharing, aiming to support a non-hierarchical setting and trust.

On the second day, SIT-inspired sketching sessions were initiated, aiming for a visual summary and extract of the pivotal points in their story, as well as to modulate these visuals (by multiplying, subtracting, merging and/or changing dependencies) and thereby to explore perspectives and solutions. The participants implemented these perspectives into their manuscripts after a sharing session, and then they individually recorded their voice-over and produced their digital video stories, which they shared in a feedback session.

In the workshop, the teachers initially explored and identified aspects of their individual science-teaching practice. They identified that one of their pivotal challenges was mutual, and they both chose to make these challenges the focal point in the following reflection exercises and story productions. These challenges were centred on difficulties with their science-teacher team. They both felt there existed a lack of knowledge-sharing and lack of collaboration in general on their team.

Our approach to the data collection was partly ethnographical and narrative research and partly participatory action research (Creswell, 2012, e.g. p. 20). The planning and pre-phase were conducted with three researchers. Two researchers facilitated, and the third person served as an external part in the post-phase and in the analysis, asking critical questions to bring the narrative analysis forward and to understand the actions and impressions of the participants' experiences before, during and after the workshop. We focused on identifying signs of reflection and agency. We focused on identifying signs of reflection and agency, as well as signs of change in the participants' understandings and mindsets in relation to the chosen aspect, their experiences of possible actions, their motivation, and their actual actions back at their school. As such, the research rested on a methodological assumption that research of this kind may be well-investigated in small pilot-like sizes, but that these still have to take place in real contextual settings, in an intervention or real-life cases (Creswell, 2012, e.g. p. 20, 69 and 582–4).

4. Empirical findings

On a general level, the teachers stated that the workshop was a positive experience and that it 'moved and shifted something' for them. For example, one of the teachers came to realise that he was not "visible" and not active on the science team, and he experienced a motivation to change this.

They expressed an experience of personal benefit in relation to their practice. For example, they experienced that the explorations from different angles resulted in understandings they did not have beforehand, and both teachers pinpointed that, above all, the most important outcome of the workshop for them was new awareness and insights into what was missing for them personally.

During the workshop, the relation between the two teachers changed. Both teachers described how they were motivated to collaborate with each other in the future. This was a new motivation, given that the two teachers described their relationship as distanced beforehand, and that they did not have any specific interest in each other. The fuel to establish this closer collaboration seemed to come from the identification of a mutual challenge and jointly striving to change aspects at their school; merely spending time discussing these issues provided each with a deeper knowledge of the other. The interview with the co-facilitator showed that she pinpointed this improved relationship between the two teachers as a remarkable change during the workshop. The co-facilitator described the relationship between the two participants as 'distanced' and even strained at the beginning of the workshop, and that this changed during the workshop into a genuine interest and a confident atmosphere. The co-facilitator also noted that as the two teachers were the only two participants at the workshop, they were forced to relate to each other, where they might had avoided each other in larger settings.

The teachers stated in the evaluation that the actual implementation of the changes at the school was difficult, but they found that they were encouraged by having a fellow colleague with the same agenda. They also described how their colleagues reacted with curiosity and interest to their experiences from the workshop. This evoked dialogues at the school, where colleagues expressed similar needs for knowledge-sharing on their teams, and they agreed to prioritise and improve this in the future. The teachers described how they experienced having adopted a new role as 'joint ambassadors' of a sort at their school.

In the data collection two months after the workshop, one teacher responded that the workshop had been referred to several times at their school in the intervening time, and both teachers felt that something had shifted, even though some of these aspects still had not changed at the school. The teachers described how they continued to try to create changes. For example, a meeting was organised focusing on collaboration, which uncovered how the school management could facilitate a better collaboration. This issue had afterwards become something the school management had chosen to prioritise.

In the repeated questionnaire one year after the workshop, one teacher summed up the workshop as being challenging in a constructive sense. It gave time and space for reflection, worked as self-development and investigation into one's own teaching practice, facilitated professional dialogues among colleagues, and provided a positive experience in collaborating with the teacher colleague through the workshop. The challenging part had been recording oneself (voice). The teacher elaborated on the after-effects of the workshop and described how it had initiated ongoing reflection dialogues between the two participating teachers focusing on collaboration at their school.

Though the overall experience has been positively evaluated by the teachers (also over time), there was a large barrier in the first step – that is, to get teachers to take an active part in the initiative. Challenges related to the school's way of organising TPD and to the unknown territory of having to work with DS approaches.

In the interview with the co-facilitator, she reflected on the sketching processes: she experienced them as challenging for the participants, but also beneficial. The challenge was an initial restraint among the participants to grasp, translate and deduce complex, lived issues into a visual image. The beneficial aspects included a somewhat playful approach to personal reflections and support as the participants were asked to put something at stake and bring challenging issues into the reflections. The 'pen and paper' mode seemed to ground and support some of the challenging personal aspects, according to the co-facilitator.

In relation to TPD, the DS process is seen as useful, as it provides structure through phases and activities that aid in the formulation of issues that are important to the participants, which they themselves were not able to explicate to the same degree without the DS process. As DS did not originate in the field of learning, and certainly not as a professional practice TPD tool, but as a way of giving personal voice to participants, it also has some limitations. Also, as shown in the theoretical section, several researchers and practitioners have included more participatory approaches.

5. Discussion, conclusion and future perspectives

In this pilot, we identified signs of change in the participants' understandings in relation to their chosen aspect, a change in the perceived action space, and also in their motivation to implement changes back at their school: within themselves (changed personal behaviour) as well as the collegial relationship and collaboration. We found that the teachers' sense of agency changed, and the fact that the two participants were colleagues at the same school, in the same context with a joint agenda, supported this sense of agency.

Earlier studies focusing on DS in educational institutions showed that some participants have a resistance to 'exhibit' and share personal stories from their private sphere during the workshops (Ribeiro et al, 2014; Haug et al, 2012). Our research is related to TPD and with teachers from the same school, who shared with colleagues on matters that were personal to their teaching. It was therefore interesting to see that they shared willingly about difficult subjects, even though the participants had a strained relationship as they entered the workshop. This setting could have pushed the participants to maintain a distance and resist sharing of personal issues. Nevertheless, the participants expressed an improvement in their relationship and are motivated to collaborate more closely on joint matters.

In our analysis, we also investigated which ways sketching can be included in and support the DS process. The research review showed that, as DS often results in participants finding many and varied themes of interest, sketching was investigated to see if it could be used as a way of retaining the oTPD theme in the workshops and in the personal video stories produced. It appears that DS and the sketching process supported both the first and second objective. The first was that the workshop provided a means for collecting data in relation to the larger research project focusing on TPD. Secondly, DS seemed to support professional reflection and TPD in particular insofar as that the teacher team became aware of issues they had not been explicitly aware of prior to the workshop. Also, sketching supported a more contingent focus on the theme at hand, oTPD and KpN, meaning that a personal but common theme was clear for all present – i.e. even though the sketching in some sense made it clear that there was a common focus, there was also room for individual investigation and personal story.

However, the participants reported challenges in implementing fundamental changes back at their school, both on their teacher team and at the organisational level. Nevertheless, some changes have occurred, and both the teacher team and the school management are involved in constructive changes a year after the workshop. In future research, it would be relevant to investigate possible development of DS and sketching approaches in TPD in terms of scalability, culturally diverse groups, a prolonged process, and using DS and related tools in online environments, e.g. in an oTPD setting. Even though the choice of only two participants was a matter of piloting the method, and the initial idea was to scale the number of participants at the workshop, there may be a particular strength in the size and that the participants was from the same team, turning the DS workshop into an almost team-building and mentoring setting. It will be interesting to see if and how this can be scaled in the number of workshops and participants.

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Connectivism in Elementary School Instruction

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Abstract: Social media, and ICT in general facilitate access to information, encourage its creation and sharing, and not only on the Internet. Connectivism, the latest didactic theory, focuses on the connectivity of sources, establishing relationships, interaction and sharing of knowledge in a constantly forming complex network. However, not all authors have accepted connectivism as the new didactic theory, still thinking of it only as a new approach to the learning process which, at the moment, requires special attention of researchers. That is why an instruction model aimed at cooperative learning was designed. Reflecting the connectivism principles, the instruction model was implemented into education through project instruction of upper primary school students. A partial objective of this activity, apart from verifying the theory in practice, was to encourage the cooperation between students and teachers from partner schools, improve the selected key competencies and integrate new technology into instruction, network technologies and augmented reality technologies in particular. Since student safety is extremely important, especially in primary education, the designed model takes it very seriously. The paper presents the individual stages of the model, both at their theoretical and practical levels. The second part of the paper presents different approaches to implementing the connectivism theory in the elementary school environment, i.e. both in the real-life and virtual environments. This paper is a partial outcome of a complex research project aimed at the implementation of social media into the elementary school environment.

Keywords: connectivism, educational social networks, model, school project, social interaction, social media in education

1. Introduction

The Boom of online technologies into the learning environment, as well as the increasing amount available of information, has led to defining the idea of a new didactic theory - connectivism (known as the theory of digital age). His leaders, Siemens and Downes, rely on the idea that current approaches (behaviorism, cognitivism, and constructivism) do not sufficiently reflect the possibilities of online technology in teaching and learning (Siemens 2004; Brdička 2008). A higher level of knowledge is currently linked to the need to connect to relevant information resources and people who share knowledge and communicate through the network in real time. Internet Options gradually calling for the creation of new models of teaching and learning (Altuna Urdín et al. 2017). Also in the Czech Republic is developed the concept of connectivism, especially in the manifestation of the growing use of social networks in the educational process (Budinova 2017). This paper responds to the call to support the development of this concept: specifically by designing a model with elements of connectivist learning that can be implemented in the school environment at the level of primary education.

2. Connectivism

Connectivism is understood by learning as a process in which the nodes of the complex network are interconnected. For social networks, these nodes (sometimes referred to as entities) may be individuals, groups of people, or for example, organizations whose interconnection is realized through the establishment of relationships (Siemens 2008). Siemens describes Connectivism as: „model of learning for the Digital Age where learning is no longer an internal, individualistic activity (2005, s. 7), which manifests itself in all aspects of human life. He believes that complete knowledge cannot exist in one person's mind. It is therefore required a different approach to creating your own picture of the situation or the monitored area of interest. Downes (2007) develops this idea by saying: "*connectivism is the thesis that knowledge is distributed across a network of connections, and therefore that learning consists of the ability to construct and traverse those networks*". Kultawanich et al. (2015, s. 87) connectivism describe as: "a new online learning pedagogy giving emphasis to an interactive learning in an online context". Černý (2013) presents the basic idea of connectivism as a learning based on the creation of a knowledge network that is based largely on the online environment. The community plays an important role, is an important learning resource and a source of information (Zounek and Sudický 2012). Emphasis is placed primarily on communication and interaction between different members of the network who have different knowledge. More important than current knowledge is the ability to recognize the connection between the different topics and problems, the ability to make decisions, to change their attitudes. Significant is also the connection of the intellectual (set of knowledge and skills) and social capital (a set of contacts with different intensity and quality, the need to build social ties).

In summary, these principles of connectivism are often presented (Siemens, 2005):

- Learning and knowledge rests in diversity of opinions;
- Learning is a process of connecting specialized nodes or information sources;
- Learning may reside in non-human appliances;
- Capacity to know more is more critical than what is currently known;
- Nurturing and maintaining connections is needed to facilitate continual learning;
- Ability to see connections between fields, ideas, and concepts is a core skill.
- Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.
- Decision-making is itself a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision.

The following table provides a basic comparison of didactic theories of behaviorism, cognitivism, constructivism, and connectivism in terms of definitions, principles, methods and other attributes.

Table 1: Basic overview of didactic theories (processed by Brdička 2008; Altuna Urdín et al. 2017; Morrison 2013; Zounek et al. 2016)

	Behaviorism	**Cognitivism**	**Constructivism**	**Connectivism**
Definition	Learning is a process of reacting to external stimuli	Learning is a process of constructing subjective reality based	Learning is a process of acquiring and storing information	Learning is a process of connecting specialized nodes or information sources
Principle	Exploring external behavior	Structured programmable knowledge	Individual learning based on the social principle	Understanding information structures in the network
Method	Drill and Practice Rote learning Multiple choice test Lecture	Rote learning Practice, Testing Lecture Visual tools Multiple choice and essay assessment	Solving problematic tasks Discovery Collaborative group work Scaffolding Self-guided learning based on personal experience Peer grading/review	Comprehensive approach using different sources Self-directed quest for content Sharing of content, sources Spontaneous learning groups Creates knowledge collaboratively Problem-based learning
The role of the teacher	Teacher guides the learning process, is the highest authority, controls the pupil, transfers knowledge	The central role, guides the learning process, prepares to teach, pass knowledge to the pupil, uses technology as a learning tool	Facilitator, helper, guide, coach, creator of authentic experience	Facilitator, assistant, guide, coach
The role of the student	The recipient of knowledge by the teacher, the dominant passive role of the pupil	Student as an active learning process facilitator, acquires the curriculum presented by the teacher, mental activity of the student	Active and Cooperative Creator of Knowledge, The student assumes responsibility for learning, own organization of work	Student builds own learning space through the network
Apps/Tools	Kahoot! JClic Hot Potatoes Thatquiz Socrative	Webquest Blogger YouTube Flip Quiz	Webquest Blogger YouTube Flip Quiz	Moodle Google Docs Edmodo Facebook WiZiQ Key school

2.1 Connectivism vs. traditional educational theory

While Siemens regards Connectivism as the successor to traditional theories (behaviorism, cognitivism, constructivism) of the contemporary world, a number of authors have not yet recognized the idea of accepting connectivism as a new didactic theory and regard it as a new concept - phenomenon in the learning process (Bell 2011, Kultawanich 2015, Clarà et. al 2013, Zounek et al. 2016). Zounek et al. (2016, p. 68) argue: "*Connectivism, in its range, is not yet a complex system, as previous theories, but it can be perceived as the elaboration or addition of existing theories, or as the first significant step towards a future theory of learning the digital age*."

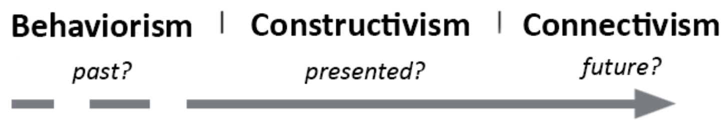

Figure 1: Linear historical evolution of learning theories? (Altuna Urdín 2017)

A similar view is offered by Tracey (2009), which points to the relevance of behaviorism, cognitivism and constructivism theories reflecting the different phases of the learning process.

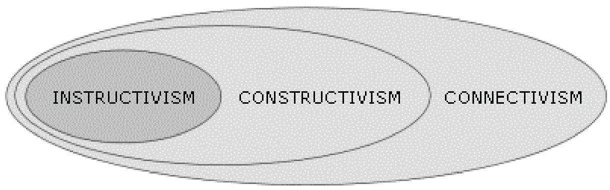

Figure 2: Connectivism by Tracey (2009)

Connectivism still raises many questions, therefore, this issue deserves the constant attention that goes beyond the thematic framework of this paper.

2.2 Connectivism in education

Connectivism is associated mainly with teaching at higher types of schools (e.g. the University Environment); most often in distance learning (Anderson et al. 2011) or lifelong learning. This fact arises from the very nature of connectivist learning. The application of connectivism in education has been verified in the past through MOOCs (Massive open online courses), formerly known as cMOOC or connectivist MOOC (Wang et al. 2014). Such marked courses focus primarily on communication and interaction of students and their mutual learning (Zounek et al., 2016). MOOC, i.e. free online courses available to all participants, are also popular today, as well as technology based on Web 2.0 principles. A popular tool is, for example, Twitter and similar technologies that use keywords, called hashtags, to ensure the information from multiple sources. The success of learning is conditioned by the pupils' skills and by the teachers' skills with technologies to work. Kultawanich et al. (2015) put emphasis on acquiring especially information and personal skills of pupils. The pupil needs to know whether the information is important to him, whether is true, actual, etc. The acquisition of these skills can contribute to an open learning environment that is considered a suitable learning environment to develop information literacy and self-efficacy (Bandura 1977, Taweechart, 2002 in Kultawanich 2015). Connectivism is therefore also important for the self-regulated learning concept (Boekaerts 1997).

Connectivist learning, in addition to MOOC's learning activities, is also associated with Problem-based learning or Project-based learning, i.e. learning focused on a particular problem, project, or research question. Examples of the use of connectivism in school practice include, for example, a model of a flipped classroom with using mobile technology (Cheng-lin & Jian-wei 2016) or model of connectivism learning using the cloud-based virtual classroom to enhance information literacy and information literacy self-efficacy for undergraduate students (Kultawanich, 2015). The described model approaches the following picture (see Fig. 3).

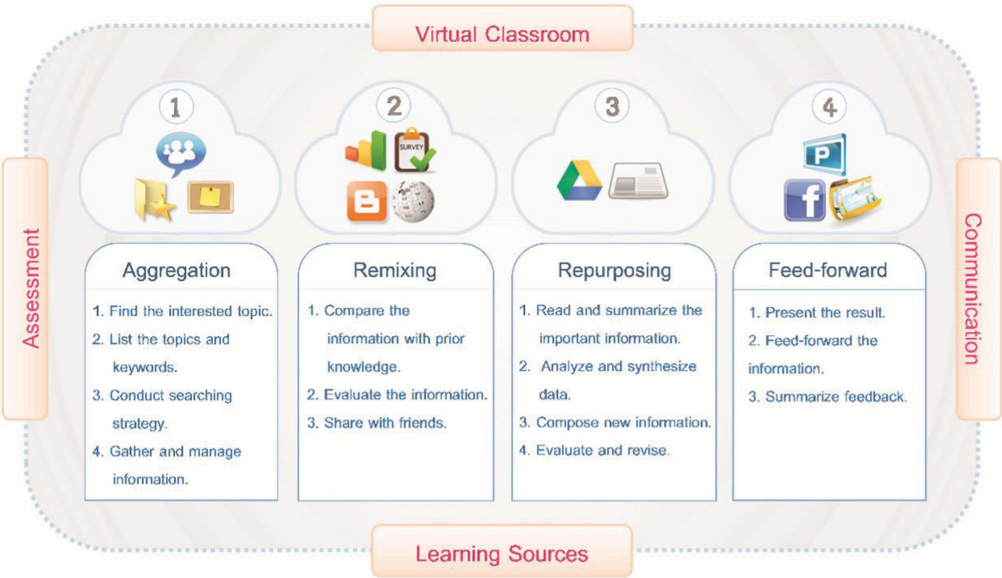

Figure 3: Model – virtual classroom (Kultawanich 2015)

2.3 Connectivism in primary education

Siemens (2005) states that "learning is a process of connecting specialized nodes, knowledge sources or access to existing networks". In the process of collecting information, pupils should proceed systematically. Especially for the safety of pupils in a virtual environment (especially this age category), it is recommended to create a "knowledge base" from which the necessary information can be derived. The pupil's movement in the internet environment should be transparent to the teacher. It is therefore important to clearly identify areas of resources or access to information that are acceptable for pupils.

An appropriate learning environment that supports a variety of activities such as management and sharing of information, collaboration, and communication are considered virtual classes. These platforms combine a range of tools to support the teaching of connectivist learning. Specialized platforms known as educational social networks can extend the paraphrased model beyond the limits of one virtual class. However, the pupil's security in the virtual environment is not compromised. Educational social networks provide a closed environment in which many nodes/ entities (e.g. teachers, pupils/students, schools, project teams, practitioners, specialists, open learning resources, etc.) can come from different areas. The creator of a virtual group, usually a Teacher or Network Administrator, decides who has access to the network.

3. Model development

The proposed model of teaching includes elements of social constructivism and connectivism where learning is perceived as a social process (Wang et al. 2014). Therefore, the emphasis is placed on social interaction and to interact through networks (pupils are encouraged to connect with the source to find the answers they need). The model was designed for project-based learning, i.e. an approach in which students actively explore real-world problems and challenges and acquire a deeper knowledge (Edutopia.org). If successful, it can also be applied in primary school environments. If the model is successfully accepted, it can also be applied in the primary school environment.

3.1 Objectives of the proposed model

The following main objectives were set out in the design of the model:

- Support the implementation of new technologies (especially networking) in the elementary school environment;
- Support for collaborative and cooperative learning;
- Support for building partnerships between schools;
- Support for connectivist learning.

The model centers on the need to establish social interaction - not just face-to-face, but also interactions with new technologies. The Teacher must find ways to implement these interaction connections in the learning process - to build, develop and maintain it, for at least the time necessary to resolve the project. At the same time, the teacher must ensure that pupils have access to an environment that is rich in knowledge. The model assumes the involvement of at least two partner schools that solve a common problem, in order to preserve the principle of so-called positive interdependence. Positive interdependence is understood to mean the connection of one pupil to another, from which everyone benefits, who are involved in solving the task (Kasíkova 2011).

3.2 Educational network environment

Meeting schools are planned in the learning network environment. It is a service that provides teachers and students with the opportunity to meet and conduct online learning. Pupils learn to collaborate, listen, think about others, solve problems in group communication, provide feedback, seek common solutions and other social skills that with proper management can develop their personal folder. A necessary technological condition is to choose a platform that allows the creation of mixed groups or subgroups across several schools. The alternative is TwinSpace, which provides space for the joint meeting of partner schools within the eTwinning project. Validation of the model took place in an environmental education network Edmodo. The advantage of Edmodo is the possibility of creating subgroups, called small groups that are used in group work. Edmodo, like most of the similar platforms, is constantly in the process of development, and its functions are expanded. Edmodo currently provides the ability to link to a Google Account, OneDrive, or Office 365.

3.3 Information resources

The diversity of sources is ensured by a combination of information sources that come from real and virtual the networks interconnected world. In a networked environment education network, students are invited and encouraged to use these specific sources of information – (so-called Nodes of network):

- Family environment;
- Peer environment;
- School environment;
- Virtual environment (open information sources, social media, etc.).

Personal learning network each student differs slightly, although we can assume the incidence of strong ties. However, the family environment and the personal educational environment of pupils (including pupils in a partner school) offer some information potential. The pupil's personal education network can be defined, for example, the following resources /"knowledge base" (see Fig. 4).

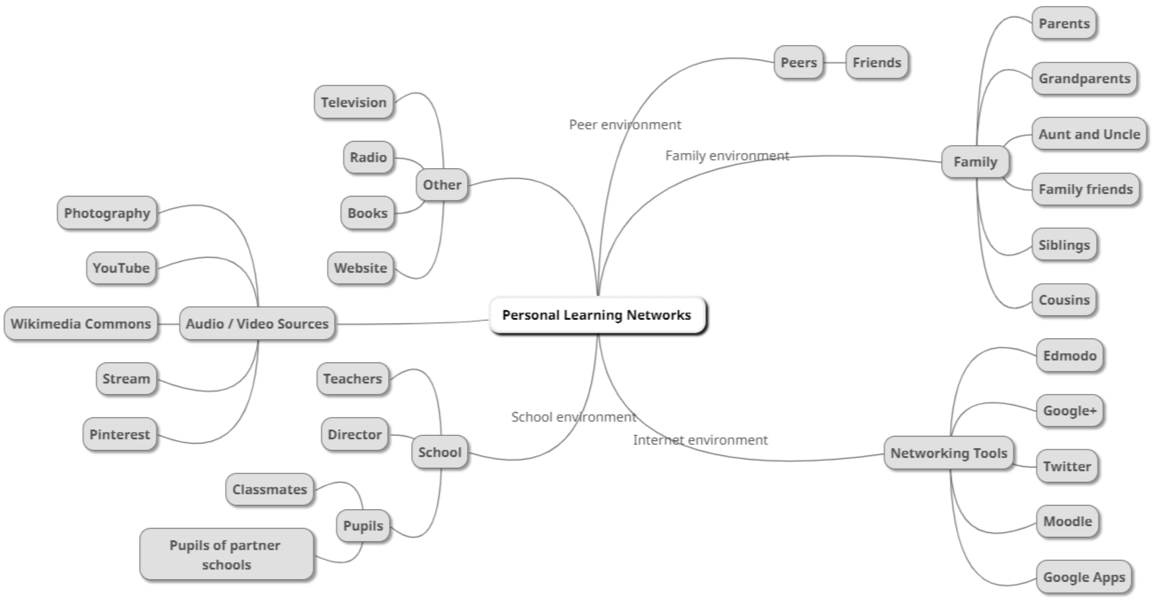

Figure 4: Personal learning networks

3.4 Phases of the model

The process of teaching according to the proposed model can be expressed through four key phases: Community Classroom, Connection, Co-creation and Collective Feedback (see Fig. 5). The Individual phases may be modified for teaching purposes.

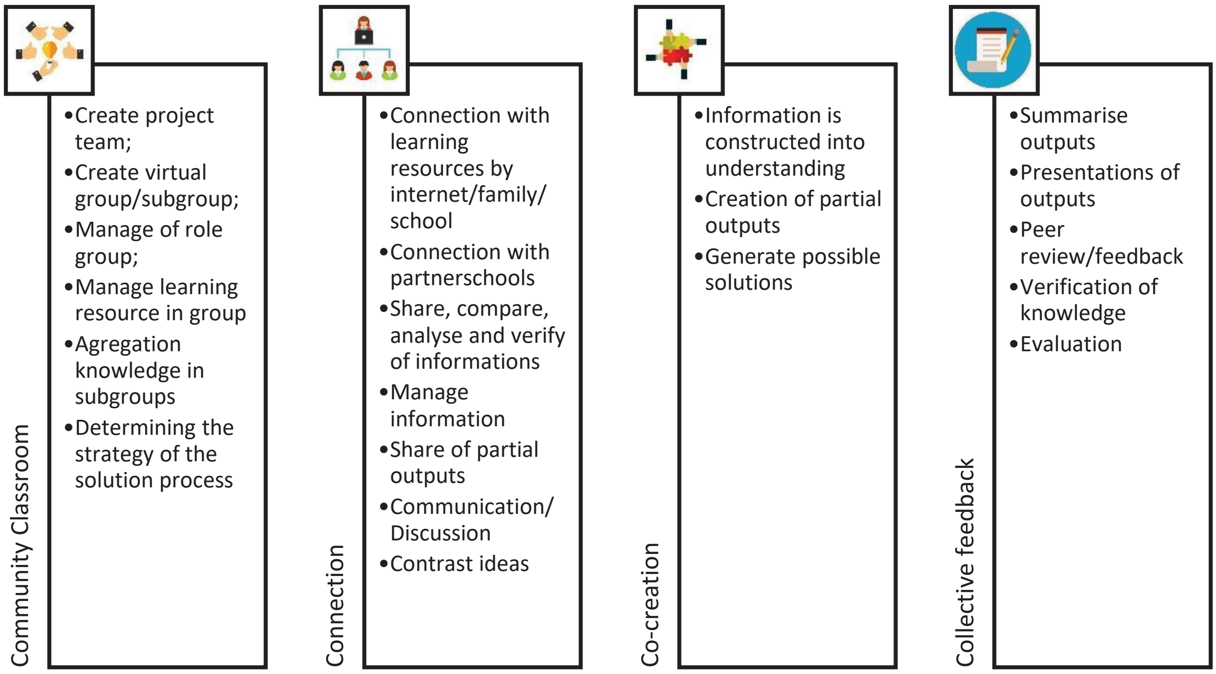

Figure 5: Phases of the model

In the first phase of the model, working groups are formed using the principles of cooperative learning (applying the principle of positive interdependence). Teams are jointly involved in solving the problem. The problem is common to all participating schools. Also, the tangible output of the project is shared by all partner schools. Each working group solves partial topics in parallel to all schools. To solve the problem, pupils need to find information (according to a pre-set framework of approaches to learning resources). They define strategy, map the environment, ask, discuss. This information pupils analyzes in groups, compares and summarizes each other. Information obtained by pupils may take the form of text, testimony, speech, recording or other audiovisual material. The acquisition of audiovisual recordings, students can also use their own mobile devices (model application - "Bring Your Own Devices"). Social interactions penetrate the whole cycle of information work.

Then, the pupils of all partner schools meet in real time in the virtual environment of the learning network. In the learning network environment, pupils are divided into mixed subgroups (groups formed by pupils of all partner schools – see Fig. 6) by subtopics that parallel processed. They transmit their knowledge, compare and mutually verified. Together, pupils strategically resolve the next process, divide the work. They also communicate with other members of other groups (e.g. due to distribution and further processing of subtopic).

In the network environment, pupils use the tools available to support collaborative work. They present their outputs on the common walls of the education network, where it offers the possibility of next sharing in social networking environments.

The teacher (the founder of the virtual class), as well as the cooperating teacher of partner school who has been invited to the virtual group, has the right to supervise the event in all the groups in which his pupils are present. Teachers have the ability to manage virtual teams, regulate their content, provide feedback, encourage, supervise, or if necessary (e.g. inappropriate behavior of pupils) to intervene.

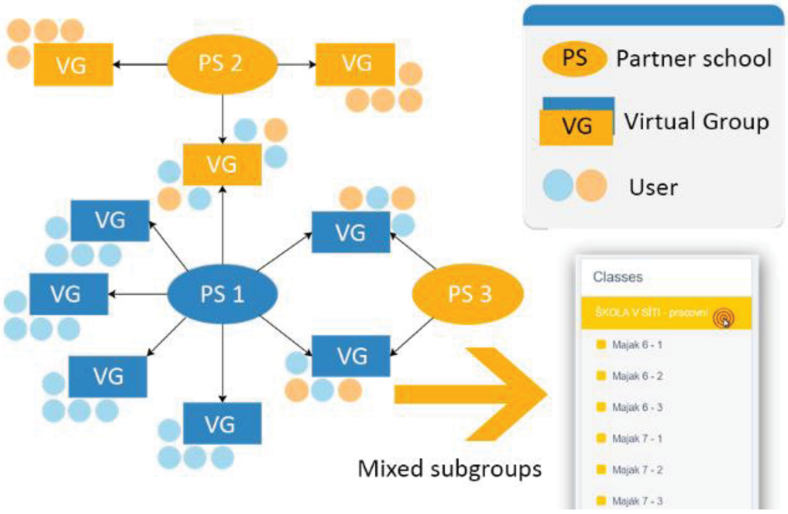

Figure 6: Groups in a network environment

3.5 Practical application in school

Project-based learning has been verified in the school practice of two elementary schools in the Czech Republic as part of an activity to contribute to the implementation of network technologies in schools. The teaching was realized in the first half of the school year 2017/2018. The research sample was made up of pupils of the sixth and seventh classes of two partner schools. The mature output of the project was an interactive "live" newspaper, thematically focused on the local dialect that is gradually disappearing. Other topics were the history of the school and the city where the school is located (history, attractions, present plans). The Interactivity of Newspapers enabled the application of augmented reality – HP Reveal (previously called Aurasma).

The project was based on practical experience. The pupils were divided into groups and took on the roles of reporters who need to get the information, verify, and create a shared output in the form of a short contribution. Pupils could process a post via text, video, or graphically. Teachers defined three thematic areas for both partner schools. The pupils themselves decided on how to approach the topic and how to process it. They could use three sources of information:

- Internet environment;
- Family environment;
- School environment (pupils, teachers, partner school).

Each group worked with a group of pupils from a partner school. Together they formed mixed participatory groups (in Edmodo) that solve a common problem. Information obtained from various sources or from a variety of contacts has been compared, discussed and further developed by the pupils. The Pupils also used their school and mobile devices as tools to capture video clips, images or sound. The pupils placed their knowledge in the learning network environment, where they met together and continuously generated outputs (the individual contributions of each group together formed a common output - an interactive newspaper). At the end of project activity, individual groups from both schools prepared quizzes for their partners and compared each other's acquired knowledge. During the project pupils realized, for example:

- Intergenerational interviews with family members;
- Surveys with teachers;
- Surveys among pupils.

More detailed information is presented by a paper entitled Social media in school practice (Homanova et al., 2018). During the project-based learning process, pupils acquire the skills of cooperation not only through interpersonal communication (face-to-face) but also through available technologies. This situation prepares pupils for a professional environment. Thanks to the technological capabilities of social networks, the model is applicable at the level of all types of schools looking for ways to promote collaboration with partner schools.

4. Conclusion

The potential of network technologies is now mainly associated with connectivism, a young didactic theory that reflects current approaches to education (behaviorism, cognitivism, and constructivism) and extends their validity to today's networks of the interconnected world. Our study focused on connectivity issues in primary school environments. Connectivism builds on the idea that education goes beyond the individual, overcoming an individual approach. The paper also presents a proposal of a model of teaching to promote cooperation with the use of collaborative means of educational networks. The main idea of an integrative teaching model lies in the meaningful interconnection of schools in the virtual environment of the network, in situations that bring schools a common benefit. This interconnections arise, for example, in the partnership of schools and one of the possible means of cooperation can be project activities. The proposed model is based on the idea of connectivity between resources and people, not only through network technologies based on the Web 2.0 principle. Emphasis is placed on the processes of exploration, the search for the meaning of things, phenomena and relationships. In the context of the competitiveness of schools and their qualities, the model could also contribute to the development of cooperation between partner schools and to strengthen the current level of implementation of social media in primary schools (not only) in the Czech Republic. The proposed model was implemented in two primary schools in the Czech Republic through the educational network - Edmodo.

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E-Learning in Al-Farabi Kazakh National University (KazNU): Experience, Problems, Development Prospects

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Abstract: This paper is devoted to study the e-learning practice at Al-Farabi Kazakh National University. KazNU is the leading university of the Republic of Kazakhstan. According to results of the survey of the international rating agency QS (UK) World University Rankings, in 2017 academic year KazNU has ranked 236th among the 800 best universities of the world. It is emphasized that in the QS University Rankings for Eastern Europe and Central Asia (QS University Rankings EECA 2016), KazNU took the 10th place out of 200. According to international organization "GreatValueColleges" KazNU was among the 50 most technologically advanced universities of the world, ranked 31st in the rating. This article reveals the experience of implementing e-learning at KazNU. The specifics of the application of the following technologies are disclosed: access to electronic materials, preparation and use of electronic textbooks, distance learning aids, electronic journals, training web resources, web seminars. The article reveals the experience of preparing of mass open online courses. Online communication between participants in the distance learning process in KazNU is carried out through a modern system of online video conferences Adobe Connect. The article emphasizes the availability of distance learning process at any time and regardless of the location of students and teachers. In the article the following problems are analyzed: the quality problem of electronic courses; legal problems related to the protection of intellectual property; financial problems related to the costs of preparing e-courses and updating them; staffing problems associated with the training of teachers who are able and willing to develop and constantly update such courses. The following scientific results were obtained: 1 Continuing professional development of teachers using e-learning technologies is necessary. The experience of expert teachers should be applied while preparation of e-courses. 2 It is necessary to develop e-learning, to create in Kazakhstan an inter-university Center for the evaluation of the quality of e-courses and training of teachers. 3 The involvement of IT companies is considered necessary for solving the problems of complex informatisation of universities. 4 Being as an e-learning flagship, we believe it necessary to disseminate the experience of KazNU to all universities in Kazakhstan and Central Asia.

Keywords: e-learning, e-courses, mass online courses, international rating, teacher

1. Introduction

List of Abbreviations
MOOC - mass open online courses
DET - distance educational technologies
IDL - Institute of Distance Learning
CMOOC - Center for Mass Open Online Courses
SRI - Scientific Research Institute
DL - Distance Learning

There are 122 universities in the Republic of Kazakhstan. The largest number is concentrated in Almaty (44 universities), Astana (13) and South Kazakhstan region (12). One of the issues is the transparency problem in the management of education. Transparency means lucidity, openness, accessibility, accountability, state authorities' responsibility to civil society. We considered the concept of transparency in public administration in the article «Problems in the Implementation of the Transparency Principle in the Activities of the Public Authority Bodies of Kazakhstan» (Ibrayeva et al. 2016).

The principle of transparency in the field of education is exercised in the system of distance learning. As an example, let us refer to the experience of Al-Farabi KazNU. Al-Farabi Kazakh National University is the leading multidisciplinary higher educational institution in Kazakhstan. The multi-level system of education of KazNU includes: higher basic education (bachelor's degree), higher professional education, master degree and PhD degree. Admission to KazNU is carried out on state educational grants and on a contractual basis. Training of specialists is carried out on more than 180 specialties.

KazNU has sixteen faculties, college, institute of advanced studies, seven research institutes, and eleven scientific centers. There are more than 20,000 students at KazNU, which comprise undergraduates, masters and PhD students. The teaching staff of KazNU consists of more than three thousand people (Udartsev 2010).

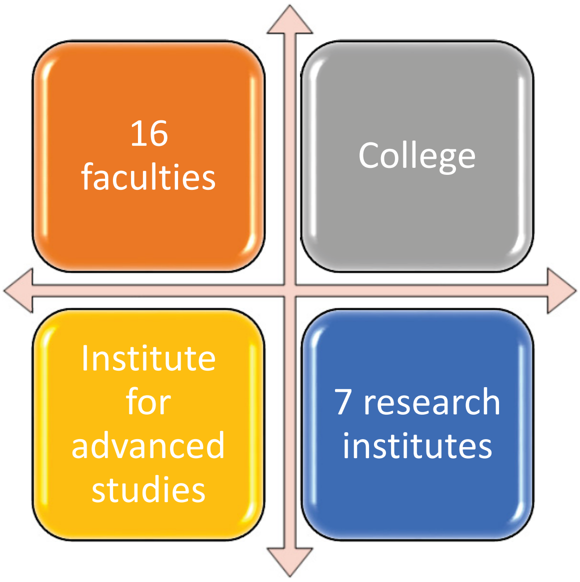

Figure 1: Structure of KazNU

2. From Al-Farabi KazNU development history

KazNU was opened on January 15, 1934 as a part of the Faculty of Biology, Physics and Mathematics, where 54 students were studying 25 lecturers worked (among them 5 professors and 10 associate professors).

The Universities in Moscow, Leningrad, Kazan, and Ukraine helped in the formation of KazNU. During the Great Patriotic War, 287 students and employees (including 135 volunteers) went to the front. The student A.G. Popov was awarded the title of Hero of the Soviet Union.

After gaining independence of the Republic of Kazakhstan in 1991, Kazakh State University was given the name of the great scientist, thinker and encyclopedist, "The Second Teacher" of the East - Abu Nasr al-Farabi. The name of al-Farabi has become firmly established in the history of world science and culture. His works had a great influence not only on the development of Turkic and Kazakh philosophy, but also became a bridge for the rapprochement of cultures of the West and East.

Currently, the university is a large intellectual corporation. The modern scientific and innovation infrastructure is functioning here, consisting of 8 scientific research institutes and a scientific and technological park, 5 institutes and 30 scientific centers of social and humanitarian profile. There is an integration with 10 scientific research institutes "Horde of Science". The university is opening joint international research laboratories with leading foreign universities. The university creates centers of Al-Farabi in foreign organizations of science and education. The European quality mark has been awarded to a number of University programs. The complex structural modernization and system transformations were carried out - a result-oriented management system, process management and rating of achievements were introduced, international cooperation and internationalization were actively developed, infrastructure was being improved (Mutanov G. 2017).

3. Achievements of KazNU

KazNU faculties such as Faculty of Law, Geography and Environmental Sciences, International Relations, Philosophy and Political Science, Higher school economics and business have been accredited and evaluated with high level of quality by the European Accreditation Agency FIBAA. In the prestigious global rating "UI Green Metric Ranking of World Universities - 2017" KazNU took part for the first time and entered to the Top 200 of the "ecological" universities of the world. This demonstrates the high achievements and huge potential of the national university in "green development".

Al-Farabi KazNU entered the top 10 best universities of the developing countries in Europe and Central Asia by QS ranking (EECA - Emerging Europe & Central Asia). According to the results of the study of the international rating agency QS (UK), KazNU entered the top 250 universities in 2017, leading 236th place among the 800 best universities of the world (Agachi 2017). According to the results of an independent assessment made by QS in 2018, KazNU became the first university in Kazakhstan and the only one in the Central Asian region that received the "Four stars" excellence in the international rating "QS Stars Development Road map".

Al-Farabi KazNU topped the rating of the best sites of Kazakhstani universities. University position in the ranking of Webometrics is 1st place in Kazakhstan in 2016 (2001st place in the world). KazNU is today the first and only HEI in the educational system of the Republic of Kazakhstan, which is awarded a special diploma of the authoritative international agency Thomson Reuters "For outstanding achievements in field of science in 2011".Based on the study results of the famous international organization "GreatValueColleges", Al-Farabi KazNU became one of the 50 most technologically advanced universities in the world, ranking 31st place in the rating. It should be noted that in the rating the Kazakhstani University is not only representative of the CIS countries, but also Eastern and Central Europe, along with Singapore and Japan it represents of the entire Asian continent.

On the basis of Al-Farabi KazNU, in accordance with the UNITWIN program proposed by UNESCO, the UNESCO Central Asian Regional Hub for Sustainable Development was established. The UNESCO Chair on Sustainable Development was opened. The university is the leader in the Republic of Kazakhstan on participation in the EU programs - TEMPUS, ERASMUS MUNDUS, which allows fully adapt the basic principles of the Bologna process and bring the academic policy of the university closer to European standards. These are 9 projects of TEMPUS, 7 projects of Erasmus Mundus, in 3 projects KazNU acts as a co-coordinator.

The University, in cooperation with international partners, implements a number of large international scientific and educational projects, such as the "Green Bridge through Generation", which has its own interactive platform www.greenbridgework.kaznu.kz . In January 2014, KazNU was trusted to lead the global United Nations Academic Impact (UN Academic Impact) hub on sustainable development.

Within the framework of the International Consortium UNIFORM Project in conjunction with the University of Tokyo, a unique project is being implemented to create and launch the first national Nanosatellite in the history of Kazakhstan. This development along with other projects was presented at Expo-2017.

KazNU actively cooperates with the state bodies of the Republic of Kazakhstan (Ibrayeva et al. 2017).

4. Experience of implementing e-learning at KazNU

Mass open online courses at KazNU

Mass open online courses (MOOC) – is a modern trend of distance learning (Willis 1993).

Al-Farabi Kazakh National University is the leader among Kazakhstani universities in the implementation of MOOC on the open platform OpenEdx. It is appropriate to mention the advantages of MOOC – the mass character - participation of hundreds and thousands of students in one course; openness - all courses are presented in an open mode; online mode - all can participate, regardless of location; comfort - everyone chooses their own mode and pace of training (Doris & Bolliger 2009).

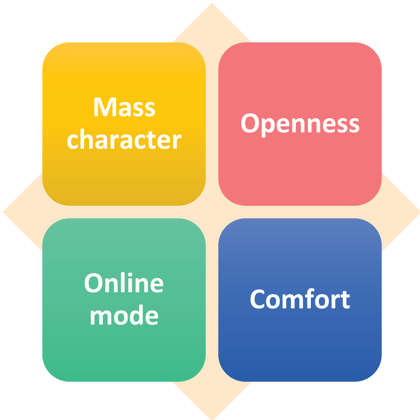

Figure 2: Advantages of MOOC

Since 2014-2015 academic year Center for Distance Education of Al-Farabi KazNU together with the faculty staff members has started the activity on the creation of the MOOC. The advantages of MOOC are mentioned in the Figure 2. Currently, on the Internet address http://open.kaznu.kz the University's own MOOC platform operates based on the Open edX system. On October 1, 2015, the first open courses were launched from leading lecturers of al-Farabi KazNU on the subjects "Theory of Probability" and "Physical Tasks with Associate Professor V. Kashkarov". KazNU established the Institute of Distance Learning (IDL), which included the creation of a center for mass open online courses (CMOOC). Presently, 42 mass open online courses have been developed. 35 MOOC were launched out of them, two courses were launched twice in 2016-2017 academic year, seven courses are being conducted to create a full-fledged MOOC.

Currently, the work is aimed at creating qualitative courses. Today, the lecturers are being trained by familiarizing them with the market of the MOOC and the process of their creation. The most recorded students are noticed in the course "Constitutional Law of the Republic of Kazakhstan". The issue of creating MOOC is of copious interest to many lecturers of domestic education. The possibility of their use in the educational process, the art of shooting video lectures, the use of modern technologies and many other issues were discussed at the advanced training course on the topic "Development of mass open online courses (MOOC)". The refresher course was held twice in June 2016: for the faculty of KazNU, and for employees of other universities of the Republic of Kazakhstan. Totally, the courses were attended by lecturers from five universities: Almaty Technological University, Kazakhstan State Women's Pedagogical University, M.Auezov South Kazakhstan State University, Kazakh University of Economics, Finance and International Trade, Kazakh State Law University. Detailed information about the share of each university is given in the Figure 3.

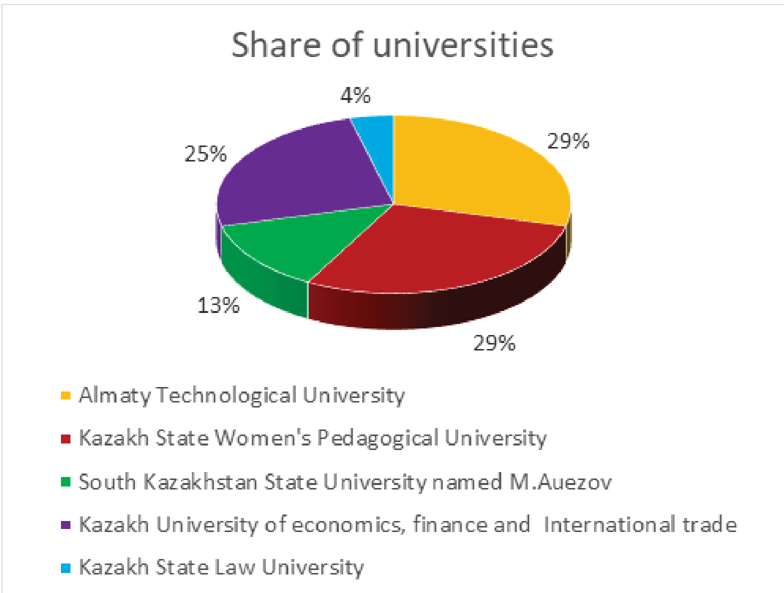

Figure 3: Share of universities

5. International experience of implementing the MOOC

Massive Open Online Courses (MOOCs) are a relatively new learning phenomenon where learners access freely available online educational multimedia materials, and connect with large numbers of other learners via social engagement tools such as discussion forums. Online educational materials, such as videos, glossaries, public repositories, images, and timelines serve as pedagogical tools within a structured course platform, and assessment is conducted via formative quizzes, peer review, essays, and responses to open questions. MOOCs have been hosted on a wide variety of different commercial platforms that allow for open resources and course teaching to be structured in one location (e.g., Coursera, edX, and Futurelearn). These platforms facilitate discussion forums used by learners to comment on course content and share knowledge with one another, and by educators to support social learning, foster community, and promote learner retention (Gallagher & Wallace 2018).

Comparing MOOCs with textbooks makes little sense to me, as textbooks are copyrighted and faculty maintain some semblance of compensation for their intellectual work their academic labor. This is less clear when it comes to the world of the MOOC, but of course for anyone concerned about faculty being adequately rewarded for their intellectual contributions (such as the American Association of University Professors), it supports the position that professors need to maintain high levels of control over MOOCs as intellectual property. In my book, I actually highlight how two democratic ideals sometimes clash within the context of the MOOC movement: the ideals associated with the “knowledge commons” (that knowledge and information should be readily available, including courses and course materials), and the ideal that laborers ought to be justly compensated for their work in this case, a la.cademic laborers and their development and delivery of courses (Rhoads 2018).

Distance education and training provision has expanded dramatically over the past few years. Keegan investigated five main aspects of these definitions and used them to form a comprehensive definition of distance education:

- The separation of teacher and learner throughout the length of the learning process
- The influence of an educational organization in planning and preparing learning materials
- The use of technical media - print, audio, video, or computer - to connect teacher and learner and carry the content of the course
- The provision of two-way communication so that the student may have advantages or even initiate dialogue
- The absence of the learning group throughout the learning and studying process so that people are usually taught as individuals and not in groups, with the possibility of occasional meetings for both didactic and socialization purposes (Keegan 2013).

For Moore, distance education is composed of two parts, each of which can be measured. First is the provision for two-way communication. Some international systems offer greater two-way communication than others. Second is the extent to which a course is responsive to the needs of the individual student. Some programs are too structured, while others are very responsive to the needs and aims of the individual learner (Moore & Kearsley 2012).

We should expand the role and importance of distance education from international perspective. For example, The United States Distance Learning Association is a professional organization of those involved in distance education. Turkish Anadolu University reached over 500,000 distance education students, which made it the largest university on Earth, according to the World Bank in 2000. The Open University of Hong Kong opened in 1989 to serve residents of that huge metropolitan area. Recently, the university has begun to market itself to learners in China and Southeast Asia. Open University of the United Kingdom, a degree-giving distance teaching university offering full degree programs, sophisticated courses, and the innovative use of media (Simonson et al. 2008), (Moore et al. 2011).

6. Distance learning

In the educational process of Al-Farabi KazNU, distance educational technologies (DET) are applied for students of correspondence courses and people with disabilities, as well as for students who have left the country for exchange programs, academic internships and academic mobility (Tussupova et al. 2018).

Training takes place remotely in a learning management system http:http://dl.kaznu.kz/. The duration of one semester is 8 weeks. After the end of the academic term during the examination session (10-12 days) the student must appear at Al-Farabi KazNU. All materials (lecture notes, video lectures, presentations), assignments (tests, written assignments, collective discussions) are provided to the student in electronic form and the possibility of online consultation (chat, audio-video conferences) and offline (correspondence, discussion forum) .

During the academic term, the student, by completing assignments in the distance learning system, can score a maximum of 100 points out of 200 possible, for each discipline. At the end of the academic semester, at the set dates, the student must appear at al-Farabi KazNU for passing the examination session, which can score the remaining 100 points for each discipline.

We will point out the advantages of teaching with the use of distance educational technologies. So, the student does not have to pay for the journey, accommodation, and in the case of foreign universities does not need to spend on a visa and passport. That is why distance learning is less expensive. In US, 51% of educational services are carried out via the Internet. And all students of American universities are required to undergo at least one course using Internet technologies. According to Fletcher's research, e-learning saves from 35 to 40% of the time compared to conventional schooling (Karr et al. 2007).

A student who studies remotely can independently decide when and how much time during the semester he concentrates on studying the material. Students do not need to worry about distance from their classmates remotely. You can always return to the study of more complex issues, watch video lectures several times, read the correspondence with the lecturer, and you can skip already known topics. The main thing is to successfully pass the intermediate and final attestations. With traditional training, it is rather difficult for the lecturer to devote the necessary amount of attention to all the students in the group, to adjust to the pace of each work. The use of remote technologies individualizes the work of the lecturer with each student (Barron et al. 1994), (Drysdale et al. 2013).

We will point out the advantages of teaching with the use of distance educational technologies. Financial issue - financial costs are less than classroom training. Saving time - the student independently disposes of his time. The ability to learn at your own pace - the main thing is to successfully pass the intermediate and final attestations. Individual approach - the instructor works with each student individually. Please see the Figure 4 below.

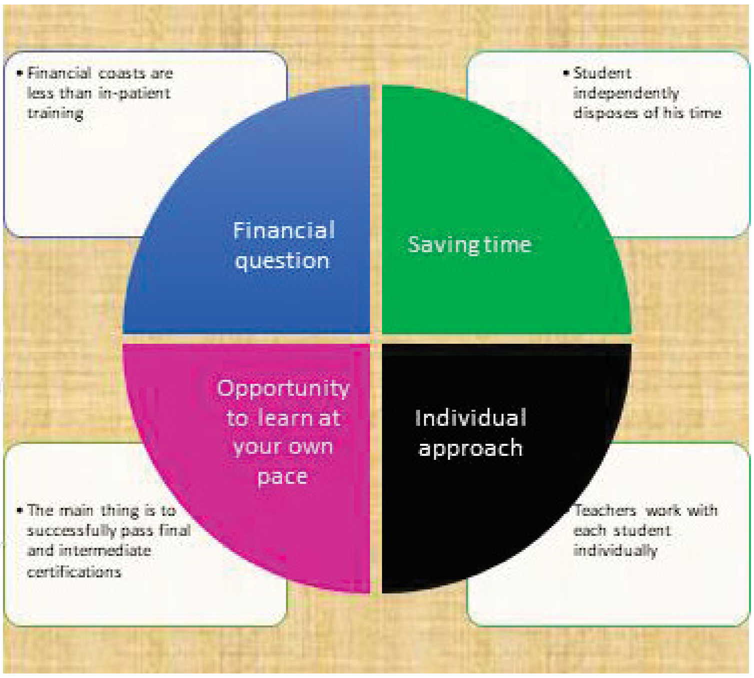

Figure 4: The advantages of learning with the use of distance learning technologies

7. International experience in implementing distance learning

Face-to-face contact teaching is one of the student learning support services often provided by distance teaching institutions (DTIs). This involves formal meetings of teachers and learners for the purpose of teaching-learning interactivity which may include formal teaching, tutorials, seminars, and group discussions, usually for remedial purposes, and practical or laboratory work. On some occasions, students may meet to take part in teleconferencing or teletutorials. During these contact sessions, students are also able to enjoy both group and individual social interactions. Thus, face-to-face contact sessions obviate one of the main criticisms that distance learning gives only instruction and not education. The contact sessions also mitigate the isolation syndrome of distance learning (Wedell 1970).

However, the premium placed on contact sessions varies between institutions. Practices indicate that this depends on three main factors: the size of the institution (student population), the organisational/management structure, and the nature and types of courses being taught by the institution. These factors, to a great extent, determine the role assigned to and the reliance placed on contact sessions. The provision therefore varies from none at all to a strong component (Agboola 1992).

University distance education exists in two principal forms: either a university offers a distance education program in addition to traditional classroom teaching or it is an institution solely devoted to teaching at a distance. Over the twenty years since the open universities were created, there has been much discussion about the differences and similarities, the strengths and weaknesses of the two types of institutions. We must first, however, understand the foundations of the university in the late twentieth century. Its values and traditions will help us determine if distance education is compatible with the university, for the same values and traditions are claimed to form the foundation for open universities (Croft 1992).

8. Problems

In the course of studying the introduction of e-learning at al-Farabi Kazakh National University, the following problems were identified.

First, the current state of the online education industry is new to the education market in Kazakhstan, and accordingly not all universities keep track of this system of education. In this regard, Kazakhstani universities need to be taught how to plan, develop, start and restart their MOOCs. Al-Farabi KazNU through special training programs can promote the advantages of MOOC and teach universities how to create effective online courses and apply them in various forms and approaches of training;

Secondly, the main problem is the problem of electronic courses' quality. The first courses of the MOOC revealed a number of problems related to quality. It is necessary to use more widely infographic, video games, etc.

Thirdly, there are legal problems associated with the protection of intellectual property. In this regard, it is necessary to establish the authorship of the courses on a legal basis. It can be highlighted the personnel problems associated with the training of teachers who are capable and willing to develop and constantly update such courses.

Fourthly, there are also financial problems related to the costs of preparing electronic courses for their updating.

In fifith, the largest number of issues to persistence associated with the psychological and sociological nature of the student. These problems consist of: (1) uncertainty of an educational or professional aim, (2) stress of multiple roles of learner (school, work, home), (3) time management problems, (4) problems related to learning style differences, (5) technical problems, and (6) overachievement or fear of failure. The statistics pointed to the individualness of learning, whether at a distance or in a traditional setting (Phipps 1999).

9. Conclusions and suggestions

1 It is necessary to constantly improve the skills of lecturers using e-learning technologies. For the preparation of e-courses, the experience of expert instructors should be used.

2 It is necessary to develop e-learning, create an inter-university Center for the evaluation of the quality of e-courses in Kazakhstan, the training of lecturers.

3 It is necessary to involve companies operating in the information technology market to solve problems of complex informatization of universities.

4 We believe that KazNU is the flagship of launching e-learning in Kazakhstan. In this regard, it necessary to disseminate the experience of KazNU for all universities in Kazakhstan and Central Asia.

5 In summary, distance education can be as effective as any other category of instruction. Distance Learning occurs and knowledge is retained. Students internationally report that they have learned and that they feel their distance learning experiences are as successful as more traditional education. The keys to successful distance education and learning are in the design, development, and delivery of instruction, and are not related to geography or time. Teaching at a distance is a challenge. The teacher needs to be creative and imaginative in the design and structure of the course. One rule of thumb is that good interactive learning course that work in a traditional classroom may be adaptable to the distance learning environment. But they may require more than just some changes to the visuals or the handouts – they may require inventiveness and innovation in the modern era.

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Perceptions of Pre-Service English Teachers on Using Information Communication Technologies

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Abstract: As the new technologies enter our lives, they affect our thoughts, communication, learning and teaching. Thus, technology has become increasingly crucial for both teachers' personal and professional lives, and learners are increasingly making use of this technology (Daskın, 2017). By the emergence of student-centered teaching, learning goes beyond the classrooms so Information Communication Technologies (ICTs) have been used intensively in education, especially in English Language Teaching by the teachers and students. These ICT tools include media sharing, digital learning materials, instant messaging, online games, social networking, blogging, wikis and collaborative editing tools. ICTs provide new mechanisms for user-generated, participatory, inquiry based and explanatory learning. Young people are not only keen on using ICTs for communicating with their peers but also for their education because they are more computer literate than their parents and teachers. Thus, they prefer to have fast and instantaneous communication and reach information quickly. The aim of this study is to find out pre-service English language teachers' perceptions of using ICTs. The data were collected from 60 pre-service English teachers in one of the state universities in Turkey via a questionnaire that has 6 open-ended questions. The questionnaires were analyzed by finding emerging themes and then categorizing them using Constant Comparison Method. For inter-rater reliability, another rater also categorized the themes. Results of the study revealed pre-service English teachers' perceptions on ICTs. The results showed that they use ICTs in their lessons mostly especially in practicum or macro and micro teaching sessions and they have positive attitudes on ICT use in language education. Results also revealed some problems they encounter while using ICTs in language teacher education and their suggestions on how to improve their use. Based on the results, certain implications were drawn from the study in order to organize future teacher education programs that utilize ICTs.

Keywords: e-learning; teacher education, pre-service teachers, ICTs in language teaching

1. Introduction

Today, the main aim of foreign language teaching is to provide a learner-centered environment where learners use the target language to interact with others while simultaneously expanding their own communicative competence (Lee, 2005). Learners of today are observed to manage and evaluate their own learning, engaging more in self-feedback and hence have higher levels of communication (McLoughlin & Lee, 2010). As Warschauer & Meskill (2000) state by using new technologies in the language classroom, we can better prepare students for the kinds of international cross-cultural interactions which are increasingly required for success in academic, vocational, or personal life.

According to Fee (2009), students are more computer literate than their teachers nowadays, preferring to access information using the Internet. Hence, the aim of education in this digital age is to provide students the opportunity to reach information quickly and accurately and to help them analyze and evaluate information in a right way by using online tools. New generation of learners are described using terms such as 'digital natives', 'millennium kids' and the 'net generation'. Prensky (2011) uses the term 'digital natives' to describe a generation of learners who have grown up in a world of computers, mobile phones and the web; i.e. a generation reliant upon digital media and tools. Prensky and others argued that these digital natives are seen to stand in stark contrast to older generations of 'digital immigrants', who adopted digital media later on in their lives (Conole & Alevizou, 2010).

"Students believe that using interactive technologies helps them to increase learning productivity, encourage a deeper approach to learning, promote the development of communication skills, and improve their understanding of course content" (Kember et.al, 2010). As Mayer (2011) states, the combination of verbal and visual information presented in multimedia environments is not only appealing for learners, but also facilitates the processing of large amounts of information by addressing multi-sensory modes. Students can interact with their peers and with teachers as well as other language learners throughout the world. Thus, their learning becomes more permanent and entertaining, and they become more autonomous, having control over their learning process. In terms of assessment, ICT tools also help teachers evaluate their students instantly. Through the emergence of these technologies, face-to-face education has been supported with online learning and ICT tools, and traditional methods have been transferred to online platforms, since using ICTs in foreign/second language learning affects learning positively enabling students to encounter authentic visual and interactive materials and to listen to native speakers.

2. Literature review

2.1 Information Communication Technologies (ICTs)

ICTs can be defined as technologies that provide access to information through telecommunications and they include the Internet, wireless networks, cell phones, and other communication mediums (Tech Terms 2014) and different types of ICTs include email, virtual learning environment, social networking sites, social mobile applications, user-generated content sites and video-conferencing and voice-over-internet protocols (Oliver & Clayes, 2014). ICTs play a vital role in the future of education throughout the world (Tongkaw, 2013) and are important catalysts and tools for inducing educational reforms that change our students into productive handlers of knowledge (Eynon, 2005). Recently, ICTs are widely used in language education where students who learn a foreign language use ICT tools to communicate with their peers and to learn the language.

2.2 Web 2.0 tools

One of the ICT tools, the term Web 2.0 defines websites that are designed to: (a) rely on the participation of mass groups of users rather than centrally controlled content providers, (b) aggregate and remix content from multiple sources, and (c) more intensely network users and content together (O'Reilly, 2007).

Web 2.0 became a collective term for a mass movement in society: a movement towards new forms of user engagement, supported by Web-based tools, resources, services and environments (Istifci, 2014). Online collaboration and sharing have become the norm (Collis & Moonen, 2008) and with Web 2.0 fostering the development of a more socially connected web, users of this space have become important producers of content, thoughts and ideas, as much as they have been consumers (Anderson, 2007). Wikis, blogs, instant messaging, Internet telephony, social bookmarking, and social networking sites are some of the examples of Web 2.0 technologies. These new technologies make sharing content among users and participants much easier than in the past and change the way documents are created, used, shared, and distributed (Dearstyne, 2007).

2.3 Social Networking Sites (SNSs)

These sites are Web-based services that allow public display of information through a profile page (Hew, 2011; Pempek et al., 2009) that can be public or semi-public and enable members of the sites to connect socially (Boyd & Ellison, 2008). The use of SNSs is increasing among people, especially young generation and SNSs become a popular communication tool. Not only teachers, but also the students use most of these social network sites actively on a daily basis. As most of the individuals heavily depend on the Internet to collect information, do their assignments, keep themselves up-to-date with the agenda, interact with others and for many other communicative reasons, it would be a great opportunity for teachers to attract learners' attention via a tool that they are into and already familiar with (Daskın, 2017.) Social networking sites provide possibilities for people to form common interest groups by collaborating and sharing so they can send videos, photos or content to one another (Aydogan & Akyuz, 2010). The educators make use of different SNSs in order to integrate communicative and collaborative components into their classroom practice (Daskın, 2017).

Social networking sites such as Twitter, Facebook, Badoo, Linkedin and MySpace imitate social networking of people in their real lives outside the Internet and they make their relations turn into a continuous communication via this imitation. Social networking sites can be described as online services, platforms or fields where people have interaction build relations and share their interests and events (Tiryakioglu & Erzurum, 2011).

Being one of the most popular SNSs, Facebook is a social networking site that enables people to interact and exchange information. Users of Facebook create their profiles, have friends and write comments on their friends' profiles or social contents.

Blogs are web sites that people write what they want without having technical knowledge. Blogs are also called as reflexive diaries or learning journals. They can be used in education to follow the development of workers or students. Twitter is a kind of micro-blogging service and the most common types of twitter in education include use as a broadcast medium, opinion sharing about events, sharing of ideas, information and commentary, backchannels at conferences, crowd-sourcing of news and evidence from the ground, and a mechanism for surveying and gathering opinions (Conole & Alevizou, 2010).

Edmodo is another web tool which lets students and teachers collaborate and communicate for educational purposes. In Edmodo, individuals can upload or download files related to a topic, communicate and have discussion together.

Video Sharing Sites such as YouTube, Howcast, Hotmail Videos, TeacherTube, Vimeo, Daily Motion and BBC Learning English Videos also help people share and learn. They can be used to support classroom teaching. Teachers can assign students to watch certain videos for pedagogical purposes. Students can also consult these sites on their own, seeking relevant videos to make learning more personalized and elaborated.

Podcast is a new technology that is used to broadcast sound and videos. It can be controlled, portable, automatic and every time available (Horzum, 2010). The use of RSS feeds in combination with podcasting allows for automatic and synchronous update of new content in a selected player (Orehovacki, Bubas and Konecki, 2009).

Being one of the mobile applications, WhatsApp has been widely used by people in all ages to send messages on mobiles. As Khedekar (2013) states WhatsApp is the leader among social mobile applications.

2.4 Multimedia sharing, online test creation and presentation tools

Multimedia sharing tools are web tools where people can share images, animations, audio or video files. The people who see, watch or listen to the contents can make comments on these posts.

In YouTube there are several videos about language learning. Anyone can start to learn a language bit by bit by watching videos. Teachers can also make use of the videos on YouTube as authentic materials to support the learning activities in or outside the classroom. Utilizing YouTube can improve learners' conversation, listening and speaking skills, raise their cultural awareness about the target language's culture and promote vocabulary development (Watkins & Wilkins, 2011).

Pinterest and Instagram are online photo sharing tools favored by many users. It is possible to share at most one-minute-long videos on Instagram. The users of these web tools can also make comments on the posts. There are language learning accounts on both of the web tools and they mainly post images about grammatical structures and vocabulary items.

The assessment of the language learning should also include interactive elements. Online assessment tools can help teachers at this stage. Tools such as Quizlet, Socrative and Hot Potatoes are among these tools. They have a user-friendly nature with a wide range of question and activity types such as gap filling, matching, putting jumbled words/sentences into correct order, true/false, drag and drop, multiple choice and crossword.

Prezi is an online presentation tool that helps learners prepare slideshows. Users can reach their presentations from any device with Internet access.

SlideShare is another kind of online tool with the premise that it makes the sharing of knowledge easy. SlideShare is equipped with a great many contents from many experts in the specific fields of research.

2.5 Studies on ICT tools and Web 2.0 technologies

Gulbahar's (2008) study aimed at investigating the level of usage of pre-service teachers' and instructors' use of ICT by collecting data via a questionnaire in a private university and the study revealed that teacher education programs fail to provide appropriate instructional technologies in and out of class activities.

Having examined prospective English language teachers' awareness of collaborative Web 2.0 tools, Usluel, Mazman and Arıkan (2009) found that podcasts and blogs were not used a lot by the participants while wikis were most widely preferred web 2.0 among three of them.

Horzum (2010) examined teachers' awareness, frequency and purpose of using Web 2.0 tools in terms of different variables by collecting data from 183 teachers who were in the in-service training in the Ministry of

Education. The result of the study indicated that these teachers were aware of Facebook, MSN and video sharing sites (VSS), but they were not aware of Weblogs or Podcasts. Moreover, they used these tools for fun, communication and accessing information.

Carrying out a study with 216 prospective English language teachers in Distance Education English Language Teaching Program of Anadolu University on their awareness of Web 2.0 tools, Girginer and Istifci (2011) found that prospective teachers used mostly Facebook, MSN and Wikis, sometimes read blogs but they did not use Video Sharing Sites, Podcasts and Twitter. In terms of the use of these tools, they stated that they generally used them for fun, communication and getting information.

Examining 76 EFL teachers' ICT use and their attitudes towards ICT, Şahin-Kızıl (2011) found that the EFL teachers had positive attitude towards the use of ICT in foreign language teaching, and use of computer technologies in this process as more beneficial than traditional teaching methods. However, teachers mentioned about some difficulties such as insufficient training opportunities and inefficient class time.

Cephe and Balçıkanlı's (2012) research tried to find out ELT student teachers' viewpoints about the use of Web 2.0 tools in language learning. The participants received training about web technologies and their usages. The data were collected via a questionnaire and follow up interviews with some of the students three months after the training. The researchers revealed that the student teachers held positive feelings toward the use of web 2.0 tools in language learning and teaching practices in spite of the absence of the technological devices.

Başöz (2016) examined 120 pre-service EFL teachers' attitudes towards language learning through social media by collecting data via a questionnaire. The result of the study showed that pre-service teachers held positive attitudes towards use of social media in foreign language learning, and they reported that social media could help them develop their vocabulary knowledge. The participants expressed that the atmosphere in social media created a relaxing atmosphere for language learning and provided them with a more authentic use of the language.

In the light of the findings above, the aim of this study is to obtain pre-service language teachers' perceptions on using ICTs. The study will shed light on prospective English teachers' perceptions of ICTs in language learning and give insights to language teachers.

This study tries to answer the following research questions:

- What are the ICT tools do the prospective English teachers know and use?
- What are prospective English teachers' perceptions of using ICTs in language education?

3. Methodology

3.1 Participants

Participants of this study are 60 senior pre-service English teachers in one of the state universities in Eskisehir, Turkey.

3.2 Instrument and data collection

A questionnaire that had two parts was given to students to find personal information, their use of ICTs and mobile applications, and emerging themes. In the first part, questions were about personal information about the prospective English teachers, about the use of computer and Internet technologies, how they access the Internet and if they received any training on computer and Internet technologies. In the second part, some open-ended questions were asked in order to detect main emerging themes and students were requested to write their opinions. Emerging themes in their answers were found using Constant Comparison Method that is widely used in qualitative data analysis to make comparisons, form categories and generate a theory. The researcher and another rater categorized emerging themes separately. Then, the two raters had a meeting to decide the final wording of the new categories. Inter-rater reliability was found to be 84% (Pearson correlation coefficient) and since values greater than 0.70 are typically acceptable for consistency estimates of inter-rater reliability, the reliability score was acceptable.

Open-ended questions were structured around the following questions taken from Oliver & Clayes (2014):

- How and where were ICTs used in your ELT education? Please explain in detail.
- How would you like ICTs to be used in ELT education?
- How have you used ICTs in your macro teaching or practicum?
- Where would you like to use ICTs when you become a teacher? Why?
- What are the problems faced in using ICTs in language education?
- What are your suggestions to solve those problems?

4. Findings and discussion

4.1 Personal information

The first part of the questionnaire aimed to detect personal information about the participants and general questions about computer and Internet technologies.

Table 1: Personal information about the participants

Gender	**Number**	**Percentage**
Male	12	20
Female	48	80
Age	**Number**	**Percentage**
21-23	54	90
24-26	6	10
How long have you been using computer and Internet technologies?	**Number**	**Percentage**
6-10 years	15	25
11+	45	75
How do you access the Internet?	**Number**	**Percentage**
on the desktop computer/laptop	28	47
through tablets	8	13
through the cell phone	24	40
Have you ever taken a course or attended a workshop on computer and Internet technologies?	**Number**	**Percentage**
Yes	38	63
No	22	37

4.2 Pre-service teachers' perceptions of ICTs

In the second part, the first research question aimed to detect which ICTs or mobile applications students use.

Table 2: ICTs or mobile applications pre-service English teachers use

ICTs or mobile applications	**Number**
Whatsapp	55
Instagram	55
Youtube	52
Facebook	50
Skype	35
Snapchat	34
Kahoot	25
Kanvas	22

ICTs or mobile applications	Number
Powtoon	25
Google+	20
Podcasts	20
Blogs	16
Answergarden	16
Slideshow	15
Edpuzzle	14
Quizlet	14
Menti	14
Vizio	14
Quizziz	14
Socrative	12
Storybird	9
Goanimate	8
Storyjumper	8
Edublog	7
Wordart	7
Edmodo	6
QR Codes	5

As seen in Table 2, the three top ICTs students use are WhatsApp, Instagram and Youtube.

In order to answer the second research question about their perceptions of ICTs, pre-service teachers were given a questionnaire that has 6 open-ended questions. In analyzing the open-ended responses, a great number of themes appeared. The researcher and another rater tried to categorize emerging themes separately by using Constant Comparative Method. Then they decided on the final wording of the categories.

In answering the first question (How and where were ICTs used in your ELT education? Please explain in detail), students gave a great variety of responses. Some of the frequent responses are as the following:

> *"I did not encounter many tools. They were not used in the lessons. Teachers generally used powerpoint and Canvas. We are given info about these tools but teachers do not use them in their lessons"*
>
> *"Computer science lesson our teacher taught a lot of sites. I used them in my practicum school"*
>
> *"My teachers used power point slides. One of them used prezi. One of them used edublog (we wrote our film reviews. The teacher wrote comments we uploaded videos on Google drive to take feedback. We recorded videos in groups and uploaded them in Youtube"*
>
> *"They were used in every stage, warm-up, lead-in, pre, while, post stages"*
>
> *"ICTs were used to make lessons more attractive, interesting and different. We used them in practicum"*

In answering the second question (How would you like ICTs to be used in ELT education?), some of the students' responses are as follows:

> *"ICTS can be used for testing, we can use online quiz tools. ICTs encourage students to have fun, discover something, create something"*
>
> *"New generation is digital native so lessons should be done according to their needs"*
>
> *"I would like ICTs to be used as examples and ELT students can get used to them and use them in their own classes"*
>
> *"ICT lesson tries to minimize monotony and boredom in the class. We can design our lesson on only using ICTs"*
>
> *"There are so many sites, applications and games to use in the classes. The teachers can use them in their lessons to draw our attention to the lesson"*
>
> *"ICTs should be integrated in each stage of class since they keep the attention of students high. Even students can do their homework via ICT tools"*

"Each student should have a device to reach Internet. However, teachers should control their connection so students can benefit more and teaching process becomes more efficient"

"I would like to use ICT to design a more effective course with more interactive web tools"

In answering the third question (How have you used ICTs in your macro teaching or practicum?), pre-service teachers' most frequent responses are as the following:

"animation programmes for presentation and practice"

"Wordart to practice vocabulary"

"Quizizz and Kahoot after reading a text"

"Smartboard for listening to music, read some blogs"

"Wordcloud for word associations"

"Vizio related to reading text"

"In lead-in and giving homework"

"Practice with online games, PPP, videos, online survey"

"Warm-up with rhymes"

"Pre-reading-vizio (activating students' background knowledge and getting their attention)"

"While reading-kahoot-asking questions"

"Grammar teaching-using Goanimate in preparing videos"

"Canvas, Edmodo, Google classroom to share their Works and I gave feedback"

"Brainstorming (mindmaps)-sharing students' ideas for the topic"

"Digital storytelling tools to develop their writing skills"

In answering the fourth question (Where would you like to use ICTs when you become a teacher? Why?), some of the responses are as the following:

"I want to use them in all steps of my teaching (presentation-practice-production) because ICTs make lessons more permanently effective, attracting and interesting"

"Everywhere-in class and outside class"

"In every stage but especially in warm-up and presentation stage because these tools make students' concentration higher"

"as an extensive portfolio a blog that they can write about their daily life"

"Creating an Instagram account for the lesson and send their 1 minute talk as a post each week"

"If I have the opportunity, I can use them every time because I want my students to have fun and learn at the same time. I want to teach with more modern and technological tools instead of traditional methods"

"In Warm-up watching video makes students interested in the lesson"

"For writing students can write on a blog, can write mails because we use smart phones and computers a lot in every part of our lives"

"In speaking students can send voice messages to each other instead of talking in front of the class"

"Practice stage because students like online games and they join the class more"

"With young learners because they lose their control easily"

In answering the fifth question (What are the problems faced in using ICTs in language education?), some of the responses are as the following:

"Finding the right activity for the right level downloading problems of some worksheets and videos"

"Boredom of students"

"Technical problems such as calibration of the smartboard, power cut- off, Internet cut-off, problems related to some websites"

"Students' and teachers' inexperience to use these programs"

"Students may have trouble understanding what they do"

"Paid accounts"

In answering the sixth question (What are your suggestions to solve those problems?), pre-service teachers' responses were as the following:

"Being careful about connection and using offline programs"

"Mobile phones can be used"

"Make sure each student have Internet Access"

"Using other activities which do not require internet connection"

"Using smart board"

"Not banning internet in the class"

"Giving info about the tool before the class"

"Having plan B to teach"

"Checking if the program works or not before coming to class"

"Downloading the program beforehand"

"Bringing laptop and connecting to Interactive White board"

When the first part of the questionnaire is taken into account, it is seen that pre-service English teachers use computers and Internet technologies intensively since they are considered as digital natives. They mostly use laptops and mobile phones to reach the information easily or to communicate instantly. Most of them attended a course on ICTs.

When the responses of all open-ended questions in the questionnaire are taken into account, it can be said that pre-service English teachers are keen on using ICTs in language education. Most of them preferred to use WhatsApp for social messaging. This finding is in line with Khedekar (2013) who claimed that when it comes to social messaging on mobiles WhatsApp walks away as the winner. The use of WhatsApp is high among the participants since it is instant, easy to use and free. Pre-service teachers use WhatsApp to communicate with their friends and teachers. They form groups and communicate in the foreign language to practice.

Instagram is also used by lots of pre-service teachers to share videos, photos and follow some people or companies related to ELT. Youtube is another Web 2.0 tool that is widely used by the pre-service teachers. Pre-service teachers state that they watch YouTube videos in order to comprehend the lesson better. They also claim that YouTube provides visual, auditory and cognitive contribution. Contrary to findings of Khedekar (2013) who claimed that Facebook is the mostly used social networking site, pre-service teachers in this study did not prefer to use Facebook as they use WhatsApp, Instagram and YouTube. Pre-service teachers also used Skype, Snapchat, Kahoot, Kanvas, Powtoon, Google+, Podcasts, Blogs, Answergarden, Slideshow, Edpuzzle, Quizlet, Menti, Vizio, Quizziz, Socrative, Storybird, Goanimate, Storyjumper, Edublog, Wordart, Edmodo and QR Codes.

The use of these tools shows that pre-service teachers are aware of these applications and tools and they feel positive about using them. As they are the future English teachers, this study proves that they are in line with the technological developments and will use ICTs in teaching students. English language teaching does not only include classroom teaching but also outside learning by educating autonomous learners who take responsibility for their own learning. Pre-service teachers in this study believe that ICTs bring variety to class so students participate in the lesson more actively and eagerly since they are "digital natives" who have grown up in a world of computers, mobile phones and the web; i.e. a generation reliant upon digital media and tools. Thus, teachers of this generation cannot be thought without the knowledge of ICTs. Students of today are also autonomous learners so they do not rely on the teacher outside the class and use ICTs extensively.

Some pre-service teachers complained about the use of ICTs in their departments. They claimed that teachers gave information about these tools but they did not use any tools in the class. Teachers mostly used Powerpoint presentations and it caused boredom among the students. Pre-service teachers also mentioned about ICT lesson they took. They stated that they liked that lesson a lot and learned lots of tools to use in the class in the future. They did not only gain information about the tools but they also used them in the class. For most of them, it was one of the most effective courses.

5. Conclusions and implications

The aim of this study was to obtain the perceptions of 60 senior pre-service English teachers on ICTs. The results of the study indicated that they felt positive about the use of ICTs and used them effectively in their micro and macro teaching. Most of them had taken an ICT course so it helped them to be aware of these tools. They mentioned about which ICT tools they mostly used and which ones they will use when they become teachers. Pre-service teachers also mentioned about some problems they encountered in using ICTs inside and outside the class such as poor Internet connection, power cut-off, technical problems, students' and teachers' inexperience to use these tools. In terms of suggestions, they put forward some ideas such as checking the Internet connection before the class, downloading the program beforehand, bringing laptop to class, being prepared to have some problems and having plan B.

This study revealed that pre-service teachers are aware of these tools so they can use them efficiently when they become teachers. As Wan and Gut (2011) state the 21st century teachers need to be prepared for the 21st century kids, who are themselves competent users of Web 2.0 technologies. This study supports their view since pre-service teachers are found to be active users of these technologies. The findings of this study are also in line with the assumption that if ESL teachers have to use technology effectively with their own students, they must use it for learning when they are already students (Kamhi-Stein, 2000). Therefore, teacher educators play a salient role in student teachers' experience with web technologies by offering more opportunities for greater motivation, negotiation and decision-making (Cephe & Balcıkanlı, 2012). However, some pre-service teachers have some concerns about the use of these technologies in government schools in all parts of the country because of Internet access, bans on the part of Ministry of Education and lack of technological equipment.

This study shows the importance of training future language teachers on using ICTs for their development and teaching. Hence, they will be able to use these technologies effectively when they start their teaching careers instead of learning these technologies when they become teachers. Ozel & Arıkan's study with 122 English instructors showed that they had positive attitudes toward the use of the Internet and Web 2.0 tools in language teaching but they were not using these tools adequately in their teaching. As Comas-Quinn (2011) states, teachers can focus on improving their skills and an understanding of online teaching and learning and, rather than being teachers who reluctantly use technology to comply with institutional requirements, they are supported on their journey to become online teachers for whom the technology opens up new pedagogical opportunities. Thus, training of pre-service teachers on the use of ICT tools seems inevitable. Curriculum planners, Ministry of Education and all the other stakeholders should revise the curriculum of English Language Teaching departments and provide courses that train pre-service teachers on the use of technology and ICTs.

6. Limitations

This study was carried out with 60 pre-service English teachers. More reliable and generalizable results would have been obtained if the study had been carried out with more participants from other faculties. Moreover, gender of the students was not taken into consideration in using ICTs. Future studies may compare students' gender and their perceptions. Perceptions of students from different departments were not compared. Future studies may compare their ICT use and perceptions in terms of their department.

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Use of ICT for Modelling Physical Problems in Pre-Service Mathematics Teacher Training

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Abstract: The ways to getting to know the surrounding world are observation, measuring and experimenting. These empirical methods represent the basis of science education. The subsequent steps are generalization of the gained knowledge and construction of a theoretical model of the studied phenomenon. Observation informs us that an apple falls from the tree to the ground, experimenting and measuring gives us more information on its acceleration during the fall. Subsequently we can create a mathematical model that describes this phenomenon. The phenomenon can be encrypted in the formula $s = \frac{gt^2}{2}$. The created model describes the studied phenomenon only with a limited accuracy. The limiting factors are the accuracy and amount of measured data (accuracy of determination of the invariable of gravity g), the number of aspects influencing the situation (e.g. disregarding drag) and the intricacy of the mathematical apparatus needed for the construction of the model (the model cannot be applied to falls from big heights). However, in order to answer questions of practical nature, an approximate, sufficiently accurate model will do. Computer technology allows creation of numerical models that simulate the particular situation with sufficient accuracy without the need to describe the solution in mathematical terms. If we want to introduce pupils to these solutions, teachers have to be trained to it. It is not enough for a teacher to have the theoretical knowledge needed for creation of the given numerical model. They must also know and be able to use the software that enables the creation of the needed simulation. That is why two new subjects were introduced into pre-service mathematics teacher training at Faculty of Education, Charles University – Physics for mathematics teachers and Mathematical software and numerical methods. In these subjects, students learn to model physical phenomena using computer technology.

Keywords: mathematics education, teacher training, models, problem solving, science education

1. Introduction

The goal of this article is to introduce one of the ways of using computer technology in teacher education to support solution of complex problems where the potential of computer technology is used not only for their solution but simultaneously the gained data and their interpretation are used for development of understanding of physical concepts.

2. Theoretical background

We put emphasis on the use of computer technology as a tool for development of visual literacy in the context of sciences and mathematics. Connection of different areas and emphasis on interdisciplinary overlaps of various disciplines is growing in importance. It is clear that when solving real-life problems use of knowledge from one discipline will not do. One of the modern and very efficient tools connected to use of computers in lessons is Science, Technology, Engineering and Mathematics (STEM). The ability to link knowledge and modify it in a new context is one of the most important competencies to be acquired by future teachers (see Gudmundsdottir, Hatlevik, 2017, Rusek & all, 2017, Bílek, 2016, Hodaňová, 2016, Sorgo & all, 2015 and others).

2.1 Principles of use of ICT in teaching

Jančařík and Novotná (2011) formulated the following principles for selection of suitable activities with a huge potential in teaching:

- Use of computers cannot be autotelic but must be linked to a specific educational content.
- Computing power must be used effectively; results should be presented in a comprehensible way.
- Results from the computer should be further interpreted; space should be provided for follow-up discoveries.

These principles were further elaborated and another principle added (for more information see Jančařík, Novotná, 2018):

Computer technology should only be used in situations when the result of its use is independent of the viewer or of other influences that make the solution unstable.

2.2 Visualisation of data and models

The goal of this paper is to present three problems in which computer is used in accordance with the above listed principles. Computer technology here serves for visualisation of data from calculations. Different types of visualisations are used.

McKim's theory describes three types of images (Pettersson, 1994):

- images we see,
- images we imagine,
- images we draw.

In the context of use of models and ICT in education, the scheme can be applied in three levels (confer, Jančařík, Jančaříková, 2017):

- Models that are static and we only observe them

These models correspond to the first level according to McKim's theory - images we see.

- Models that are dynamic and whose behaviour we deduce

These models correspond to the second level according to McKim's theory - images we imagine. The pupil must go beyond mere observation, they must think, imagine and develop the gained image in their minds.

- Models that we create ourselves

These images correspond to the third level according to McKim's theory - images we draw. The pupil becomes the creator of the model.

Models that we create can be further divided into two groups:

- Models describing a situation we are familiar with
- Models describing a situation unknown to us

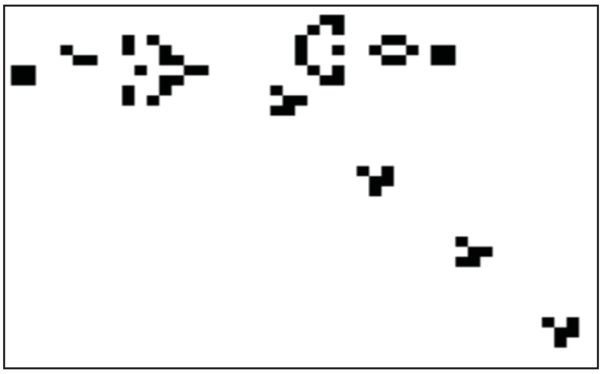


Figure 1: Game of Life

With respect to content development, the most relevant are problems that work on the third level. Here we focus on this category of problems. In these problems, we know the rules according to which the situation behaves and the initial state but before creating the model or before carrying out calculations using ICT we do not know the final state. In other words, we discover the behaviour of the system and the rules on the basis of data that come from ICT. The best known example of such a situation is the game Life (Gardner, 1970, see the figure 1).

Although the presented theoretical principles are well known, it is very difficult to find teaching materials based on these principles and offering sufficient number of problems for students to learn to work with these models/images effectively. The authors want to construct problems that allow application of the above presented theoretical principles in teaching. The goals of this are developing teaching material for their own seminar but also introducing future teachers to the potential of ICT in lessons, thus preparing them for similar use of ICT in their future teaching (confer with Novotná, Jančařík, 2018).

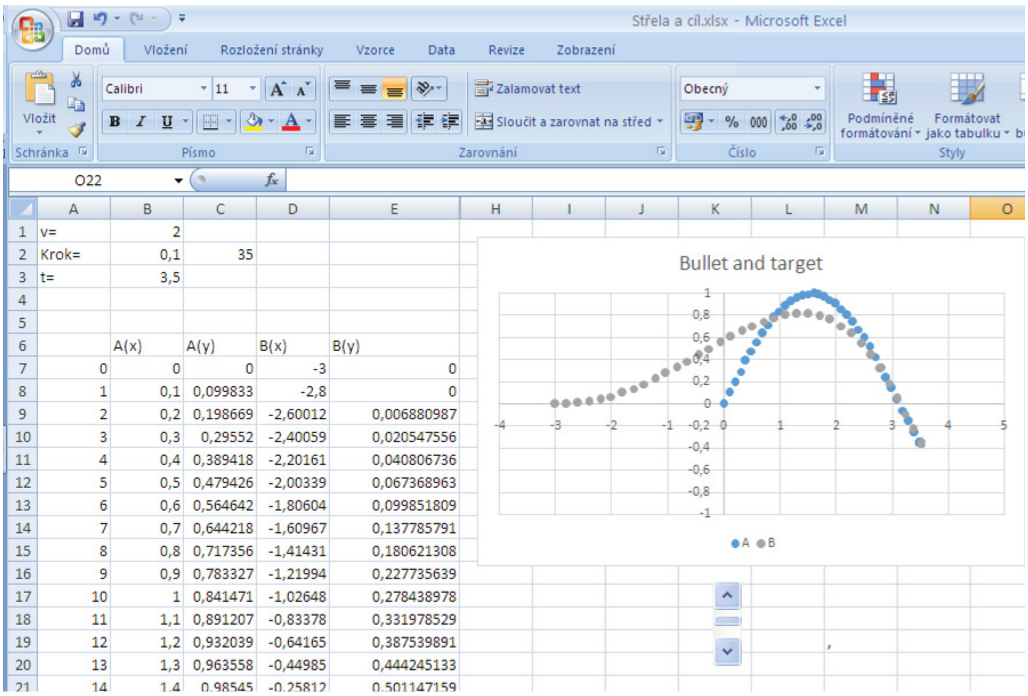
3. Models of physical problems on movement

In the following text we introduce 3 types of models in which students model real behaviour of objects on their own and with the help of a computer model they get to know its behaviour. Gradually three types of problems were created (confer with McKim's theory of three types of images):

- Problem in which it is the solved problem as such that is visualized (Bullet and target problem)
- Problem in which the model describing the solution of the problem is visualized (Trajectory of a car on start problem)
- Problem in which only calculations are carried out and the student on their own visualize the course of the situation in their mind (Free fall problem).

3.1 Bullet and target

Students are set a task to create the trajectory of a bullet which is heading to the target at every moment of its movement to the target moving on a given trajectory. The trajectory of the target is the Pursuit Curve (Weisstein, not dated). It is very difficult to calculate the trajectory of the bullet and thus an approximate numerical solution is used where the trajectory of the bullet changes in exactly given time intervals and is gradually drawn on the monitor of a computer (see the figure 2). The use of this problem has been described repeatedly (see Jančařík, Novotná, 2011), and thus they will not be discussed in detail at the place.



	A	B	C	D	E
1	v=	2			
2	Krok=	0,1	35		
3	t=	3,5			
4					
5					
6		A(x)	A(y)	B(x)	B(y)
7	0	0	0	-3	0
8	1	0,1	0,099833	-2,8	0
9	2	0,2	0,198669	-2,60012	0,006880987
10	3	0,3	0,29552	-2,40059	0,020547556
11	4	0,4	0,389418	-2,20161	0,040806736
12	5	0,5	0,479426	-2,00339	0,067368963
13	6	0,6	0,564642	-1,80604	0,099851809
14	7	0,7	0,644218	-1,60967	0,137785791
15	8	0,8	0,717356	-1,41431	0,180621308
16	9	0,9	0,783327	-1,21994	0,227735639
17	10	1	0,841471	-1,02648	0,278438978
18	11	1,1	0,891207	-0,83378	0,331978529
19	12	1,2	0,932039	-0,64165	0,387539891
20	13	1,3	0,963558	-0,44985	0,444245133
21	14	1,4	0,98545	-0,25812	0,501147159

Figure 2: Bullet and target

3.2 Trajectory of a car on start

The second presented problem deals with calculation of the trajectory a car covers when starting:

Let us suppose a car accelerates from 0 km/h to 100 km/h in 5.6 s, then accelerates to its maximum speed 180 km/h which it achieves in 10.2 seconds. What is the trajectory it covers while accelerating?

When solving this problem, students had to describe the dependency between momentary speed and time using an appropriate function. 3 values were given in the problem formulation (in time 0 s, 5.6 s and 10.2 s) and also the required null derivation function at a specific time 0 s and 10.2 s (the car stand still and the car does not accelerate any longer). There is also an additional requirement that in time 5.6 s is the change of speed continuous (acceleration). A decision was made to use two cubic functions; one will continue from the other. The students set up the required system of equations that they solved using the application Wolfram Alpha (see the figure 3).

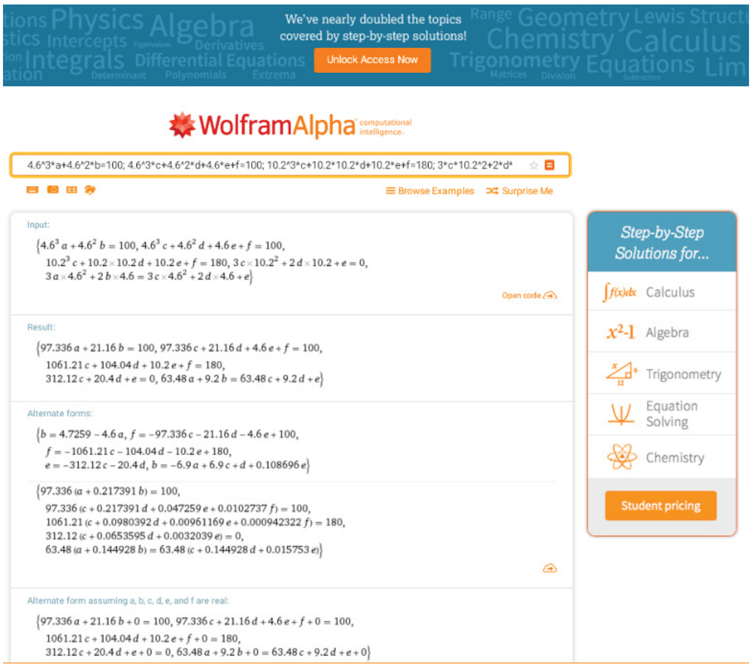


Figure 3: Solution in the application Wolfram Alpha

The solution has one free parameter. That is why the graph of functions was constructed in the environment of dynamic geometry (see figure) and the impact of this parameter on the situation was studied. This allowed the students to observe and find the interval in which the graph corresponds the condition from the problem formulation that the car keeps accelerating. They stated that the optimal parameter is the one for which change in acceleration is continuous.

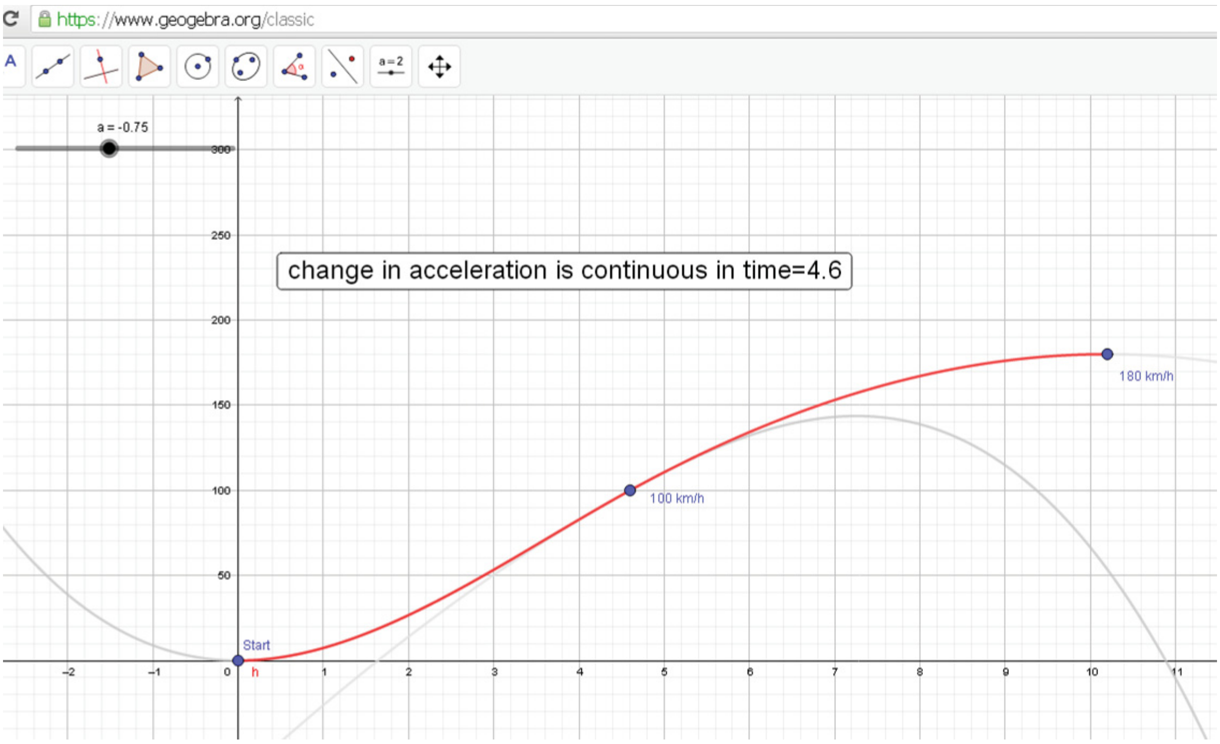


Figure 4: Solution of trajectory of a car on start problem

3.3 Free fall

The last problem the students were solving was calculation of the time of free fall of a stone from high altitude (twelve kilometres). The solving process started by a discussion of the students on the parameters that can affect the fall. The factors they found substantial were the change of density of air and gravitation acceleration in dependence on altitude. After this discussion the students went on to search for all needed information and set up an application in which they were simulating the fall in small steps. Having constructed the model, the students went on to experiment with adjusting parameters in dependence on what object was dropped.

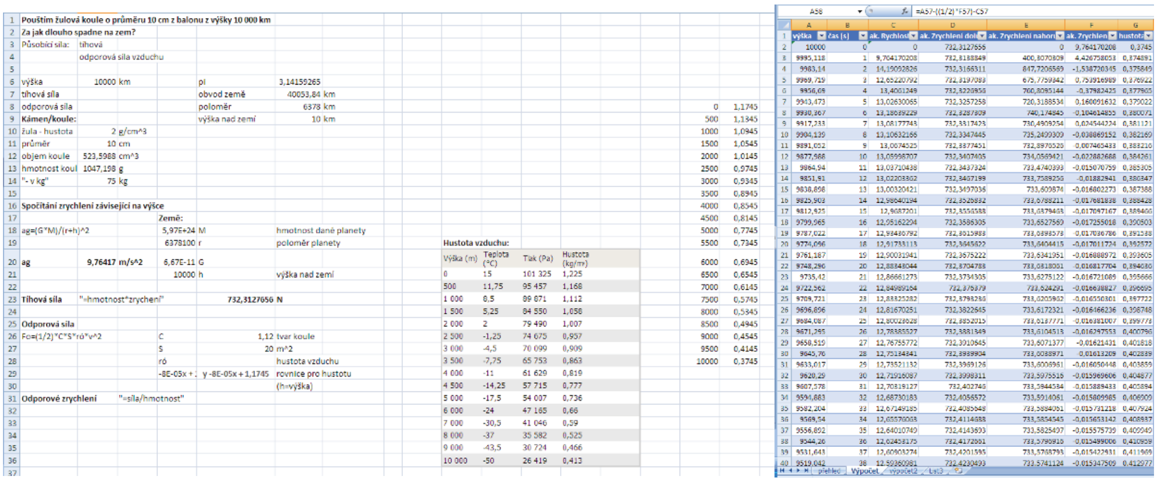


Figure 5: Solution of free fall problem

In this model the students used only a numerical solution created in MS Excel. In one sheet they put in all parameters and formulae, in the second sheet the calculations were carried out. In the calculations primarily two values were studied: how long it would take for the object to fall down and at which altitude it would have the highest speed.

4. Experimental verification

The here reported experiment in which these problems were introduced and used in a seminar was conducted with a small group of preservice mathematics teachers. It was conducted within the frame of the course Mathematical software and numerical methods in the summer semester of the academic year 2017/18. The course was both for students of regular and combined form of studies and was attended by 10 students. The problems were solved collectively within individual sessions. Each problem was solved in one three-hour session. In each session the students simultaneously got to know the potential of the application they would use, methods of numerical mathematics and relevant parts of physics. Having finished the course, the students evaluated the problems as such as well as their benefit. This evaluation was conducted using a questionnaire survey. The course was completed successfully by 8 students, the questionnaire filled in by 6 of them (return rate 75%).

4.1 Understanding the problem

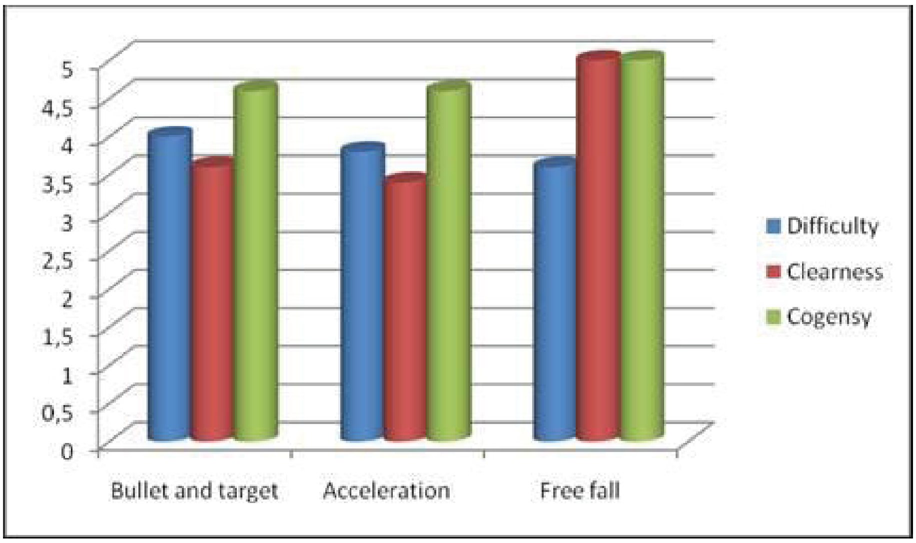


Figure 6: Understanding the problem

In the first three questions the students evaluated how difficult they found the problem and how illustrative and convincing the solution was for them. The problems were evaluated on the scale 1-5, where 6 represented most difficult (or most convincing and most illustrative). The graph (see Fig.) shows the average values of each of the answers. The problem perceived as the easiest was the last one. Despite the absence of graphical outputs from models it was also regarded as the most illustrative and convincing. One student evaluated the task as follows: *At the beginning, this problem was very difficult, especially for recording of all physical factors that exert influence v on the stone while falling freely. The numerical solution was elegant and illustrative (especially of we did two into two separate worksheets).*

4.2 Development of knowledge

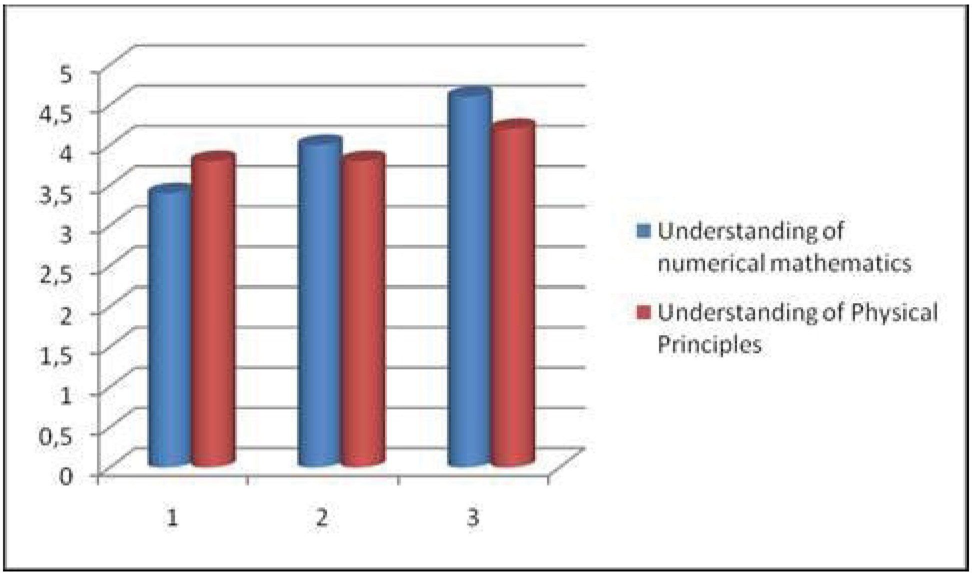


Figure 7: Development of knowledge

Further questions focused on how the problems contributed to students' grasping of methods of numerical mathematics and to understanding of physical principles (see figure 7). Students' answers confirm the previous finding. The last of the given problems was marked by the students as the most beneficial in both areas.

5. Conclusion

The results of experimental verification show that it is worthwhile to use complex problems from physics in preservice mathematics teacher education. Students perceive the given problems as beneficial and claim they contribute to development of their knowledge. They appreciate especially the fact that they get familiar with practical application of their knowledge. The experiment also seems to suggest that graphical output is not always needed for understanding a problem formulation. What seems to be much more important is that students understand the model and that they have the opportunity to experiment with it.

Further research should focus primarily on the role of experimenting with a model in grasping the impact of various parameters and on posing further problems that would enable development of students' knowledge.

One of the goals of the authors is to prepare future teachers for the use of ICT in classrooms. That is why it would be worthwhile to study how the here presented types of problems influence the participating students in their future teaching careers. This research will have to be conducted when they finish their university studies, i.e. in the horizon of five years.

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Assessing Students´ use of Personal Learning Environment

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Abstract: The current trend in education is to connect formal, non-formal and informal learning. It is based on the idea that the student's key competencies should be developed continually. Moreover, it is also influenced by technological development, particularly the massive use of mobile and cloud technology which can be used in all three ways of acquiring knowledge and skills. A Personal Learning Environment appears to be an effective way to connect formal, non-formal and informal learning, using the available technology. Students should be able to create their own Personal Learning Environment at a very early age. 12 is a crucial age, however. At this age, the majority of students own a cellular phone, use a computer and the Internet. As far as education is concerned, at this age students need to process much more information than before. This sudden change is caused by an increased number of vocational courses. Since a Personal Learning Environment is a complex tool, it can include virtually anything. That is why it can differ from student to student. The question is how to assess students' use of an environment that should help them be prepared for their professional lives? That is why the author decided to design a tool for assessing students' use of a Personal Learning Environment. The paper presents the designed scoring rubrics aimed not only at assessing students' use of a Personal Learning Environment, but also at their ability to organize content in this environment. Over a period of six months, the designed scoring rubrics were pilot tested on a sample of elementary school students of different ages. During this time, the designed tool was used to assess students' use of a PLE. The results, which are being presented in this paper, illustrate the development of students' use of a Personal Learning Environment.

Keywords: personal learning environment, key learning to learn competency, E-R-R-A model, mobile technologies and devices, projective test, web application

1. Introduction

There are a number of ways to fulfill the potential of the available information and communication technologies in various forms of learning aimed at different target groups. The success/failure of a newly introduced way of using digital technology in a particular education area aimed at a particular target group is mostly determined through a pedagogical experiment aimed at determining the difference between the input and current level of knowledge. However, such research is not always enough. In some cases it is necessary to continuously monitor a student's progress.

Aside from such a narrowly focused use of digital technology aimed at acquiring particular knowledge, there is another approach (which is becoming more and more popular) which uses computers and other devices in a more comprehensive manner – to develop key competencies or to conduct simultaneous instruction in more educational areas. Students' digital portfolios or Personal Learning Environment can serve as an example. Both approaches are intended to be used in more than one subject and educational areas, as well as in formal, non-formal and informal education (Fiedler and Pata, 2009). Its wide range of uses makes a digital portfolio and Personal Learning Environment one of the best ways of using digital technology for learning (Ministry of Education of the Czech Republic, 2014). The author believes that students should start working with a digital portfolio and Personal Learning Environment as early as elementary school, i.e. at a time when they come into contact with digital technology and most of them already own a cellular phone or a tablet.

Our research was aimed at the students' use of a PLE. We designed an instruction model which divided instruction into a number of stages. In each stage a PLE was used to help the students master the skills necessary to work with a PLE. It is important for both the teacher and the student that the student learns to use a PLE correctly so that they can use it at other levels of education. It is vital that the student's use of a PLE is diagnosed correctly and accurately. Such diagnostics would allow the teacher to provide the student with feedback regarding their performance, i.e. what they should do to improve.

That is why the described research was aimed at the students' progress regarding mastering the PLE-related skills and habits rather than the amount of knowledge acquired in particular subjects with PLE-based instruction. The first partial goal was to design an appropriate diagnostic tool which would be able to continuously record and evaluate the student's use of a PLE, thus allowing the teacher to follow their progress. The second partial goal was to establish criteria which the teacher would observe.

The goal of the presented research was to answer the following questions:

- What is the appropriate tool for measuring the degree of mastery of the PLE-based skills and habits of elementary school students?
- Can it be measured continually?
- How long will it take the student to master the skills?
- Will there be a significant difference between boys and girls in mastering the skills?

2. Theoretical background

2.1 Personal Learning Environment

A PLE can be defined from both technical and pedagogical perspectives. From a technical perspective, a PLE is defined as a set of tools and services suitable for everyday personal learning and cooperation (Zielasko, 2012). From a pedagogical perspective, Attwell (2007) defines a PLE as an approach to using new technologies in education which support a learning that is controlled by an individual. Attwell bases his definition on the basic idea that a PLE can be realized without technology as a systematically arranged set of notes, books, notebooks, journals, pictures and other content. Chatti (2010) combines the PLE's two perspectives (theoretical and practical). He defines a PLE as a set of lightweight services and tools that belong to and are controlled by individual learners. At the same time, it offers personal spaces for effective knowledge sharing and collaborative knowledge creation.

The following is the basic set of tools used by the teachers and students in instruction:

- **Calendar** for planning learning activities in the first stage of a thematic unit.
- **Glossary of Terms** for writing down important terms and explaining their meaning.
- **Notepad** for writing down simple texts.
- **Storage** for saving different types of files.
- **Sharing** to realize the reflective part of instruction and bulk distribution of study material to students.
- **Concept Map Editor** to realize the final stage of instruction.

2.2 Scoring rubrics

The Research Institute of Education (2008) defines scoring rubrics as an evaluation tool that supports formative assessment, i.e. continuous, non-formal assessment aimed at providing feedback to students. Mertler (2001a) defines scoring rubrics as an evaluation guide which consists of predetermined performance criteria. Based on the aforementioned definitions, scoring rubrics can be understood as predetermined description of the student's monitored results and performance in order to provide them with feedback on the level of monitored criteria. Scoring rubrics are usually used to evaluate performance or products created based on an assigned task.

There are two types of scoring rubrics – holistic and analytic rubrics. The teacher uses holistic rubrics to evaluate the entire process or a product regardless of its parts (Nitko, 2001). This type of rubrics is used for tasks with more than one correct answer/solution.

Analytic rubrics evaluate individual parts of a task/performance, with the final assessment being the sum of all parts (Moskal, 2001). Both the teacher and the student are provided with feedback on every monitored criterion. This feedback can help both the teacher and the student further improve their skills. Given the diversity of the monitored competency and PLE-based skills, analytic rubrics were more appropriate for the purposes of this paper.

Since the research objectives were too specific, predesigned rubrics could not be used. For the research purposes, rubrics with the following criteria needed to be designed:

2.2.1 Proposed scoring rubrics

Designing scoring rubrics was an important part of our research. Our rubrics were based on Mertler's methodology (2001b), according to which the process of designing rubrics takes place in several steps:

1. Determining learning objectives

In the first stage, learning objectives, which the students should meet at the end of the monitored period, were determined. A general objective: *"Students will master skills and habits related to the creation and use of a PLE"*. It was necessary to further specify activities which the students would be able to perform at the end of the monitored period:

- The student is familiar with their PLE.
- The student actively uses various applications and tools to search for and process information.
- If necessary, the student is willing to share their notes and files.
- The student plans and organizes their learning.

2. Identifying specific monitored criteria

Based on the defined objectives, the following criteria were created, the level of which was monitored and evaluated:

- The student's general use of a PLE.
- Concept map.
- Searching for and processing information.
- Organizing one's notes and files.
- Sharing.
- Organizing one's activities.

3. Describing an above-average, average and below-average performance for every monitored criterion.

For every monitored criterion, it is necessary to define what is and what is not acceptable with regard to the predetermined objectives:

4. Describing the highest and lowest levels based on the Point 3 results.

The levels defined in Point 3 can be used to determine the highest (exemplary) and the lowest (unsatisfactory) evaluation level, respectively.

5. Describing the in-between performance levels.

In order to make the student skill acquisition process as accurate as possible, the following 4 performance levels were created: Exemplary, Acquired, Development and Unsatisfactory. In order to make the results statistically evaluable, every monitored criterion was assigned point score which corresponded to particular performance levels. The total score is the sum of points for every monitored criterion.

3. Research methodology

In order to be able to measure the progress in skill acquisition continuously, the scoring rubrics tool needs to be used repeatedly. In the case of repeated measuring, assessment frequency needs to be set correctly to prevent data redundancy, students from becoming discouraged by excessive evaluation and teachers being discouraged by high time requirements. The instruction design, as described in Figure 1, was used for determining assessment frequency.

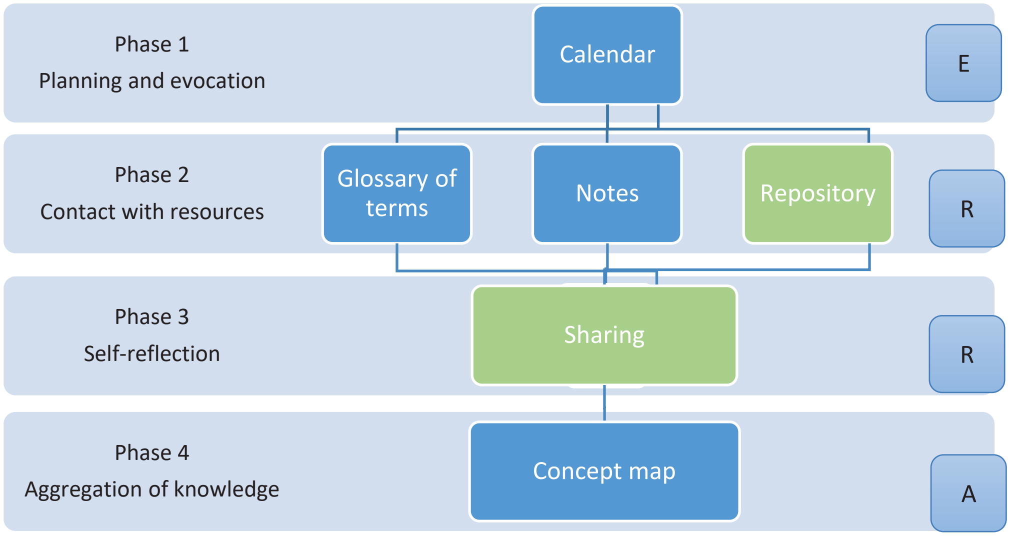

Figure 1: PLE-based instruction stages

The E-R-R-A model (Javorcik, 2017) was used to divide PLE-based instruction of each thematic unit into four stages. Each stage of instruction is aimed at a different PLE area. In each instruction stage (including home preparation) students use a PLE differently, i.e. use different tools in order to work with a PLE systematically. It can be assumed that this intensive use of a PLE will help students make great progress in a short period of time. The student assessment frequency was determined based on the instruction model and the author's assumptions – the students were evaluated after each completed thematic unit, using the following scheme:

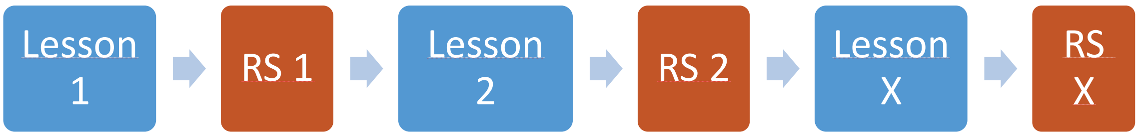

Figure 2: Student assessment frequency based of proposed scoring rubrics

All participating teachers of the following subjects were familiar with the assessment scheme: history, art education, English, computer science, civic education, Russian and Mathematics. A PLE environment was used in all those subjects. 72 students of two grades from Czech Republic participated in the research – 42 7th grade students (Groups 7A and 7B) and 30 8th grade students (Group 8A). The PLE-based instruction and the related student assessment using the presented scoring rubrics lasted 6 months.

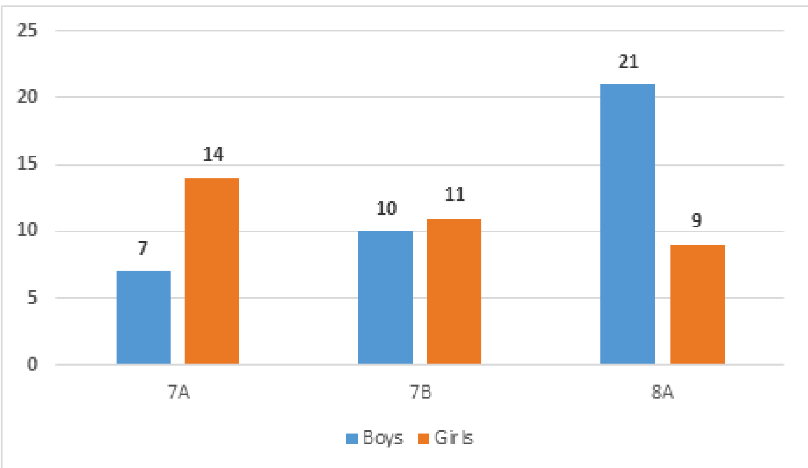

Figure 3: Sample layout (7A, 7B, 8A indicates the classroom of a particular grade)

4. Results

Histograms drawn into a system of coordinates can be used to clearly illustrate the assessment results. Since the number of thematic units in the participating groups was different, each group was included separately (graphically depicted in Figure 3 as 7A, 7B and 8A, respectively). The assessments (graphically depicted in Figure 3 as RS) are sorted in ascending order from the beginning of the research (the number 1 corresponds to the first assessment).

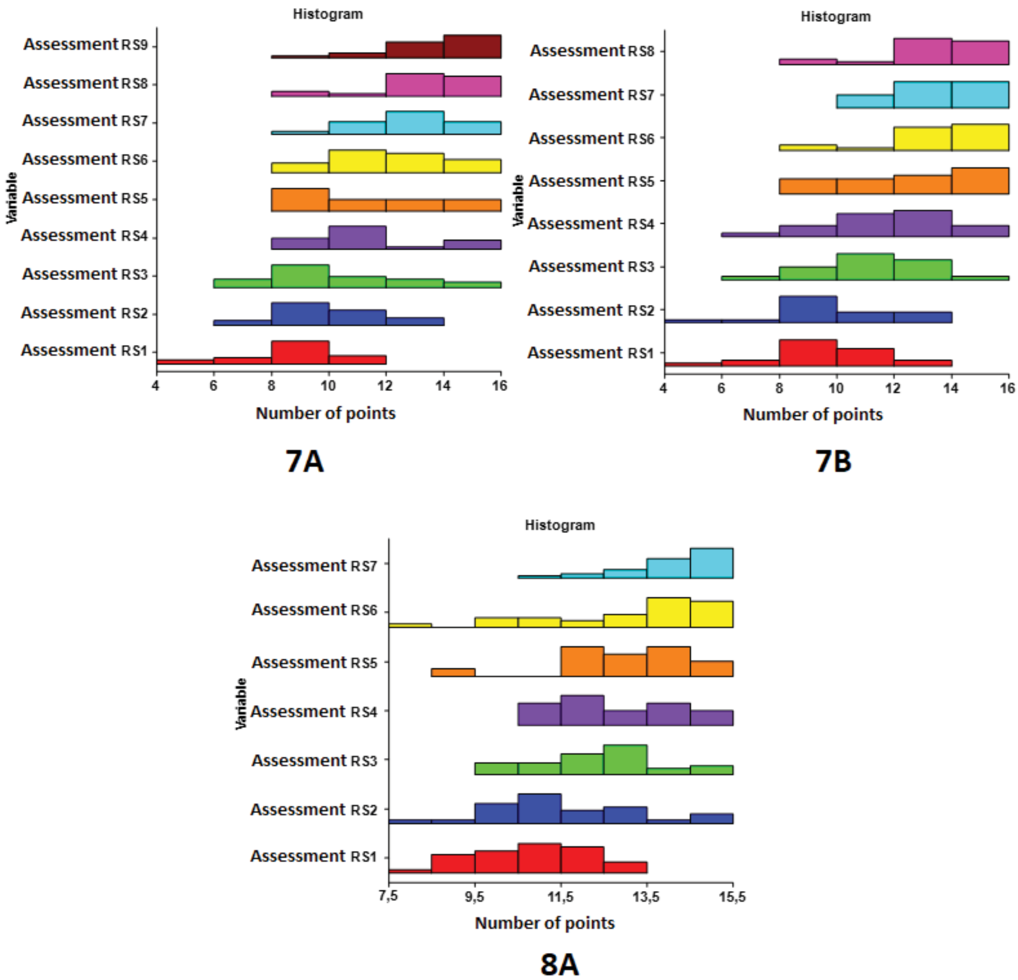

Figure 4: Graphic depiction of results of participating groups in ascending order

Gradual acquisition of the monitored skills, which is illustrated by the increasing number of points achieved by all students, can be seen in the Figure 3 graphs. The long-term and systematic use of a PLE-based application helped the students develop skills related to the creation of their own PLE. The histograms also show that the students in all three groups had similar results in the final thematic unit. This fact is graphically illustrated by the following box plot:

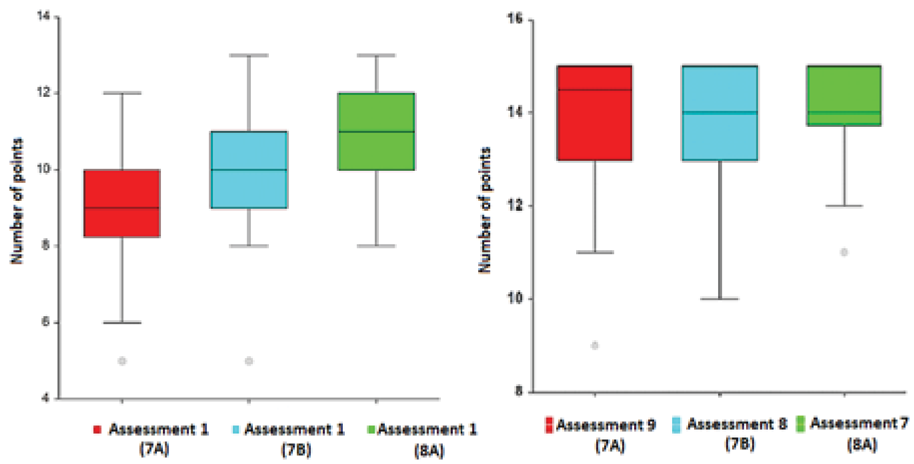

Figure 5: Graphic comparison of scoring rubrics results at beginning and end of research, by groups

This statement was statistically verified by non-parametric tests[1] (Wilcoxon sign-ranked test), which were conducted to compare the difference between the first and the last assessment. For this purpose, null and alternative hypotheses were formulated for each group.

Null hypothesis (H_0)

There is no difference in the students' skills at the beginning and the end of the experiment.

Alternative hypothesis (H_A)

There is a statistically significant difference in the students' skills at the beginning and the end of the experiment.

The results of the statistical testing are presented in the following charts:

Chart 1: Statistical comparison of first and last scoring rubrics assessment – 7A

Wilcoxon Signed-Rank Test
Trida 7A
Paired Difference: Hodnoceni RS1 - Hodnoceni RS9

	Exact Probability*		Approximation Without Continuity Correction			Approximation With Continuity Correction		
Alternative Hypothesis	**Prob Level**	**Reject H0 (α = 0,050)**	**Z-Value**	**Prob Level**	**Reject H0 (α = 0,050)**	**Z-Value**	**Prob Level**	**Reject H0 (α = 0,050)**
Median ≠ 0			3,9136	0,000091	Yes	3,8948	0,000098	Yes
Median < 0			-3,9136	0,000045	Yes	-3,8948	0,000049	Yes
Median > 0			-3,9136	0,999955	No	-3,9323	0,999958	No

Since the resulting p-value for Group 7A is less than the stipulated level α, the null hypothesis for Group 7A can be rejected in favor of the alternative hypothesis. Chart 1 shows (the last to one line) that in the last scoring rubrics assessment the number of points (which corresponds to the level of the monitored skills) is significantly higher than in the first assessment. 3

Chart 2: Statistical comparison of first and last scoring rubrics assessment – 7B

Wilcoxon Signed-Rank Test
Trida 7B
Paired Difference: Hodnoceni RS1 - Hodnoceni RS8

	Exact Probability*		Approximation Without Continuity Correction			Approximation With Continuity Correction		
Alternative Hypothesis	**Prob Level**	**Reject H0 (α = 0,050)**	**Z-Value**	**Prob Level**	**Reject H0 (α = 0,050)**	**Z-Value**	**Prob Level**	**Reject H0 (α = 0,050)**
Median ≠ 0			3,8240	0,000131	Yes	3,8052	0,000142	Yes
Median < 0			-3,8240	0,000066	Yes	-3,8052	0,000071	Yes
Median > 0			-3,8240	0,999934	No	-3,8427	0,999939	No

Since the resulting p-value for Group 7B is less than the stipulated level α, the null hypothesis for Group 7B can be rejected in favor of the alternative hypothesis. Chart 2 shows (the last to one line) that in the last scoring rubrics assessment the number of points (which corresponds to the level of the monitored skills) is significantly higher than in the first assessment.

Chart 3: Statistical comparison of first and last scoring rubrics assessment – 8A

Wilcoxon Signed-Rank Test
Trida 8A
Paired Difference: Hodnoceni RS1 - Hodnoceni RS7

	Exact Probability*		Approximation Without Continuity Correction			Approximation With Continuity Correction		
Alternative Hypothesis	**Prob Level**	**Reject H0 (α = 0,050)**	**Z-Value**	**Prob Level**	**Reject H0 (α = 0,050)**	**Z-Value**	**Prob Level**	**Reject H0 (α = 0,050)**
Median ≠ 0			4,7518	0,000002	Yes	4,7415	0,000002	Yes
Median < 0			-4,7518	0,000001	Yes	-4,7415	0,000001	Yes
Median > 0			-4,7518	0,999999	No	-4,7622	0,999999	No

[1] Using a Shapiro-Wilk test, it was determined that the data do not meet the conditions for regular division.

Since the resulting p-value for Group 8A is less than the stipulated level α, the null hypothesis for Group 8A can be rejected in favor of the alternative hypothesis. Chart 3 shows (the last to one line) that in the last scoring rubrics assessment the number of points (which corresponds to the level of the monitored skills) is significantly higher than in the first assessment.

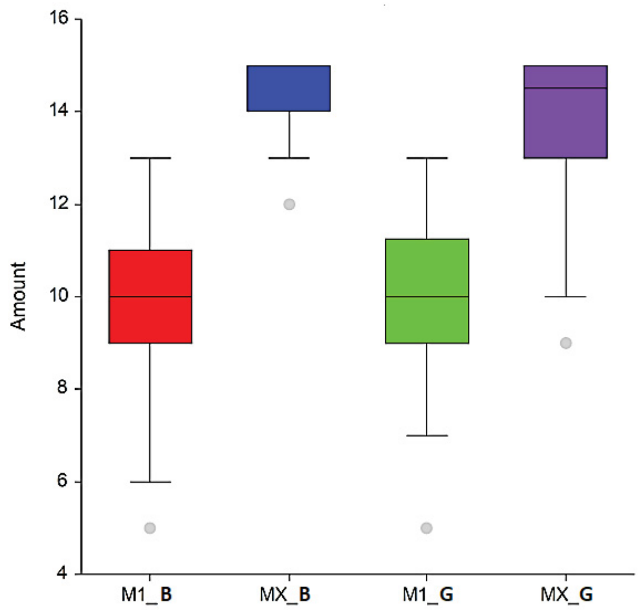

Figure 6: Graphic comparison of boys' (B) and girls' (G) results at beginning and end of research

The research sample was divided into boys and girls. When their results were compared, there were no statistically significant differences either at the beginning or at the end of the research. Figure 5 supports this statement.

5. Discussion

The comparison of the groups' assessment results shows that the students' skills related to the creation and use of a PLE gradually improve. The Figure 3 graphs show that the proposed scoring rubrics are able to capture the current level of the monitored criteria. Moreover, an appropriate assessment frequency can very well measure progress in mastering those skills. Teachers can use the information on the process of mastering the skills as feedback and adjust their instruction accordingly (Hawkins, 2007). However, this information is also for the student, as formative assessment (Stiggins, 2016). It takes a regular student five months to reach the target skill level. The time required to master the skills depends on the intensity of use of a PLE. If PLE-based instruction was used in a greater number of subjects, the student's progress would be more rapid. Statistical tests showed that by systematically using a PLE according to the E-R-R-A model, students acquire the skills required in the 21st century. At the beginning, there were differences between the older (8A) and younger students (7A and 7B). However, at the end the differences were not statistically significant, i.e. the skill level of the younger and older students was identical after having spent the same time in a PLE-based instruction. Therefore, the age difference is not a significant factor when it comes to the use of a PLE. Moreover, the skill level of boys and girls is also interesting – there were no statistically significant differences between them either at the beginning or at the end of the research. This finding contradicts the notion that boys are better with technology than girls. Last but not least, the progress in both groups was similar.

6. Conclusion

The presented research was aimed at finding and verifying an appropriate tool for determining the level of skills related to the use of Personal Learning Environment tools. Scoring rubrics were selected from the available tools. For the purposes of the research, scoring rubrics were designed and verified in the instruction of subjects where students used a Personal Learning Environment. The results prove that the proposed evaluation tool is suitable for repeated measuring of the skill level of the target group members. Aside from producing a verified method for measuring PLE-related skills, the research also proved that the use of a PLE helps students develop the key learning to learn competency (Javorcik, 2017). Different approaches of boys and girls were found when working with PLE. The introduction of PLE and other digital technologies is conditioned by the development of digital literacy among pupils (students) and their teachers. According to the survey of the Czech School Inspectorate, teachers teach digital technology in education with a powerpoint presentation. On the other hand, pupils and students lack skills related to efficient and safe work with digital technologies. In the future, the author would like to focus his research on the development of the skills required in the 21st century and how to measure them.

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Innovative Approaches to Addressing the Difficulties Encountered by Greek Students in Learning Russian Verbs of Motion

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Abstract: With the passing of time and with the contribution of modern technology, in the process of learning Russian language as a foreign language someone can notice a relative precedence of practice against science. There are difficulties that have no proven methodological solution. From this point of view, such kind of problems occurs in the process of learning Russian language and, in particular, the Russian verbs of motion by Greek students. Complexities arise in connection with the absence in the Greek language the category of verbs of motion as such, as well as because of the difficult understanding of the lexical and semantic properties of these verbs. This work presents the principles used in the process of developing a location-based application that complements and enriches qualitatively an existing distance learning platform. Here's an example of using this application in the process of learning Russian verbs of motion by Greek audience. The course curriculum covers the initial and intermediate advanced stages, with the support of ethno-psychological and ethno-linguistic techniques. The conclusions highlight the preconditions for location-based application success and those points that need to be studied in the near future, e.g. the forum of the web-based lesson.

Keywords: learning Russian as a foreign language, teaching principles, location-based mobile application, student-cantered approach, Greek audience motivation to learn

1. Introduction

Historically, the learning of the Russian language was primarily addressed to older people, who consciously aimed at acquiring the basics of the language in a short period of time. They acquired knowledge about the structure and the way of implementing the language in different situations and styles, using sentence models and oral patterns. They understood the particularities of the Russian language and its differences from their mother language purely in a practical manner, memorizing grammar rules, words and expressions. It is worth mentioning that they devoted a large part of their educational time, up to 85%, in speaking, even without any translation.

Towards the end of 20th century, methods of intensive teaching were widely applied. The differences that these teaching methods brought had to do with the attention that they attributed to the duration and forms of communication, the social and psychosocial climate, the presence of significant motivation by the students, the elimination of subjective, psychological barriers, etc. Today, we have enough evidence which confirms the positive impact of the application of those intensive forms of teaching. The student, in a relatively short period of time, acquires skills and habits to use the language in different situations and on issues of his/her interest. Of course, all this effort requires very good organization, namely, a set of predefined roles for each one of the members of the educational community, carefully selected topics for investigation, case studies for analysis, etc.

In the context of intensive teaching methods, elements from other methods are also being utilized. The reason for this is that in the speech of students who are taught intensively a foreign language, oral and grammar mistakes are often observed and, as a result, the teacher is trying to overcome these difficulties by integrating in the courses relevant exercises and grammar clarifications (Krjuchkova et al 2017). The communicative method exerts great influence on the teaching of the Russian language which has, as units of specific control, elements that either confirm, or request, or ask questions, etc. Unfortunately, in the case of teaching a foreign language, this method does not always bring positive results. Especially in the case of the Russian language, this is mainly because the latter has complex compositions of prefixes, many cases, original verbs, etc.

From studying different teaching methods as well as the everyday application of various approaches, we reached to the following teaching principles.

2. Principles and questions

In this paragraph, the term principle is defined as the set of assumptions that lie in the formulation of the educational process and the rules that the teacher must follow for the development, use and personalization of the educational material. The knowledge of as well as the compliance with these principles provide teachers with a multifaceted assistance, on the one hand to attain education of high pedagogical quality and on the other to identify and analyze students' problems and to promptly note their requirements from the educational technology.

Conscious way of learning: This principle requires from the student not to passively accept the theory and particularities of the language. Not just to memorize, but to work hard, trying to understand the rules of speaking, grammar, etc. If it is necessary to repeat something, he/she should do it, so as to consolidate and widen their knowledge, trying to express their points of views in a conscious way.

At the beginning, based on some speech patterns, and then, by expressing their opinions on the discussed subject without using patterns, but in a conscious way. From this point of view, process of learning e.g. Russian verbs of motion requires the use of models. When the student understands the model of a verb, e.g. of the verb <читать-read>, then, learning several other verbs (<желать-wish, работать-work, etc.>) that follow the same model will be done more effectively and within a shorter period of time.

The following questions arise: How educational technology could assist the student to fully realize the patterns and models that cover the phenomena, the theory and the particularities of the Russian language. Namely, how the educational technology will develop exercises that will be based on real events and environments and at the same time will assist the student to fully understand the educational material under the prism of his/her own interests?

Communication: This principle refers to the ability of expressing an opinion, namely when separate expressions are interconnected and a dialogue is taking place between members of the educational community. As practice, communication constitutes at the same time (i) a basic objective of learning the Russian language, (ii) an indication of the degree of student participation in the educational process, and (iii) one of the measures depicting student's performance.

In principle, communication requires the intensive acquisition of knowledge on speaking the Russian language. For this purpose, the student should have the opportunity to listen and speak as much as possible. It is the continuous speaking that will integrate the student in the educational process, in the desired social environment and will, at the same time, contribute to the development of relevant habits and abilities.

The following question arises: How the educational technology could provide virtual environments that automatically or semi-automatically generate scenarios of dialogues adapted to student's interests and needs to communicate?

Predetermined topic/situation: As it is known, the primary objective of foreign language teachers is to teach students to express themselves on predefined topics and/or situations of everyday life. Among them on situations, in the form of a game, that provide students with the opportunity to take initiatives/decisions. However, the point is not to create *a priori* a game or a set of topics and situations for examination. What is necessary is to be in a position to make dynamic interventions in the organization of the educational process as a whole. This implies careful time selection, i.e. when the student should analyze the situation at what stage or depth a certain topic should be discussed.

The discussion here is about increased complexity as language units of different level are mixed in sentences with a continuously increasing number of components. In the case of Greek students, for instance, they find it difficult to learn when they should use the verb <идти> and when the verb <ходить>, which both are translated into the Greek language with only a single verb: <πάω, I go>.

The following question arises: What is the best way through which educational technology can assist students to understand the utility of the "right" choices in their daily life, using e.g. prerequisite, additional or comparative explanation (Romero C. and Ventura S., 2006)?

Functionally oriented: In order for students to learn the language in practice, so as to express their thoughts in Russian, they should take into consideration the functional organization of the linguistic units. The functional principle assumes that all the facts of the language should be analyzed under the prism of their utility for students to express their thoughts, opinions, etc. This is the reason that these syntactic constructions, this lexical-grammar material are being selected on the basis of which the communication activity of the student is being accomplished.

The following question arises: How the educational technology contributes to the personalized selection of voice material and how this material is expressed with minimum verbal elements and grammatical rules?

System-based: This principle presupposes an internally organized set of units and elements, interlinked and having the same goal, so they are at different levels, dimensions and distance. These elements characterize the language and determine in a unique manner the structure of both oral and written way of expression.

The combination of internal relations of the language with the particularities of the linguistic units in speaking and writing constitute a functional system. The system-based principle has as its primary objectives (i) the generalization of linguistic units, (ii) the enforcement of order and discipline among them and (iii) the definition of causalities in their operation at the various levels of language acquisition. By learning the language, the student is required to understand the linguistic structures, the semantics of structural units, the content of their relations and the rules governing their use. In parallel, the student should recognize the influence of Greek language as a system, to understand and memorize those units of the Russian language that either do not exist or do not fully correspond to those of the mother tongue as a system.

The researches that we have conducted lead us to the conclusion that the habits and abilities of students which are rooted in the Greek language, often negatively affect the student's understanding of the Russian language as a system.

The following question arises: How educational technology could assist students to select the appropriate way of knowing the Russian language as a system and to avoid the negative influence of the mother tongue?

From simple to complex / Enriching the content complexity: During the teaching of a foreign language, the educational material is gradually provided starting always with some basic, initial knowledge. When this knowledge is being absorbed, the educational material is supplemented with new knowledge, which "transfers" the students from their existing, known and controlled situation (status) to a new one, initially unknown and, ultimately, more complex one. That way of knowledge provision allows the students from the beginning of the educational process, starting with the most elementary educational material, to acquire some basic skills and speech habits, which they can afterwards develop and apply. So, the educational material is being complemented, expanded and becomes more and more difficult.

The following question arises: How educational technology could assist the teacher (i) to make sure that the students clearly understand the provided educational material and (ii) to select the proper, both in terms of quantity and quality, new knowledge (material) to be provided to students?

Parallel processing: The functional approach to teaching requires the simultaneous presentation of syntax and morphology with verbal and grammar of the Russian language. For this purpose, several prototypes, enriched with verbal units, are being offered to the student. According to these standards, through iteration and variations, the student must create new, similar sentences, using the elements of the language that he/she already knows. Hence, the verbal model plays a double role: it constitutes the basis for learning both syntactic and verbal structures.

The following question arises: How educational technology could assist the teacher in the dynamic selection of models, i.e. of models with the appropriate level of complexity?

Using the mother language: The aforementioned principles does not only exclude, but also requires the use of the Greek language by students. More specifically, the use of the mother tongue helps the transfer of useful knowledge, skills, and habits. It can and should help the student to overcome the difficulties arising due to complete or partial lack of correspondence between the two languages.

The following question arises: How educational technology could assist the members of the educational community to completely take advantage of the positive influences of the mother tongue and, at the same time, intelligently avoid the negative ones?

Current status: It is necessary to take into account the social and economic conditions of work, the scientific background and the stage that the student is in learning the Russian language. For example, if the student is in an environment that everybody speaks Russian, this will help him/her significantly. But it is a well-known fact that over time the student's environment will change. It is according to these changes that the educational material, exercises, the themes for dialogue and the situations to consider should be selected.

The following question arises: How educational technology could perceive, assess and inform the teacher and the students about the changes in their environment – new faces, new collaborations, new interests, and new perspectives?

Personalization (student-centered learning): Taking into account the personality, morals and the mentality of the Greek student is a fundamental principle in teaching the Russian language. As it is already known, the speech and writing of a person –as a mean of self-expression- are unique, as unique are the tempo and speed of learning. The principle of personalization sets the Greek student at the center of Russian language learning and leads (i) to the comprehensive understanding of the educational material, (ii) to the increase of the quality of the educational process, (iii) to the decrease in the duration of the education etc.

The following question arises: How educational technology could assist the teacher to understand what are the student's particular characteristics (profile) according to their culture, interests, mentality and, consequently, which are their skills, particularities, their strengths, etc.?

Cultural background: In the context of the educational process, the student comes into contact with the culture, history, traditions and customs of the Russian nation. This knowledge allows them to properly understand both the history and the current situation in Russia, the attitudes and the problems of an ordinary citizen. In this way, the educational background of the Greek students is being gradually upgraded.

The following questions arise: In what point of the learning process of the Russian language the educational technology could offer general purpose educational material? What the content of this material could be, so as to attract the interest of the Greek students? Could this material be simultaneously offered, in a time that will not slow down the predetermined educational flow?

To answer satisfactorily some of the aforementioned questions, we developed an application, called m-RusGr, that complements and enriches qualitatively an already existing platform for distance learning (moodle). Together, the two of them form one learning system with location-based characteristics (Fig. 1).

3. Location-based learning

In the framework of this work, the location-based learning is defined as the complete or partial execution of the educational process with the use of:

- specially designed educational material that takes into account the capabilities of smart mobile devices and, consequently, the existence (desired) or absence (undesired) of connection with the central moodle platform (host/server/cloud), i.e. with the members of the educational community and,
- personalization techniques, predicting, motivating etc. which have been qualitatively enriched with information about the location of the student, the colleagues, means of transportation and site attractions available in the area, the usual routine routes (tracking) and the means of transportation that the student uses, the weekly working hours, entertainment and leisure (time schedule), about other members of educational community who have the same interests, the same or similar goals, skills, interests, etc.

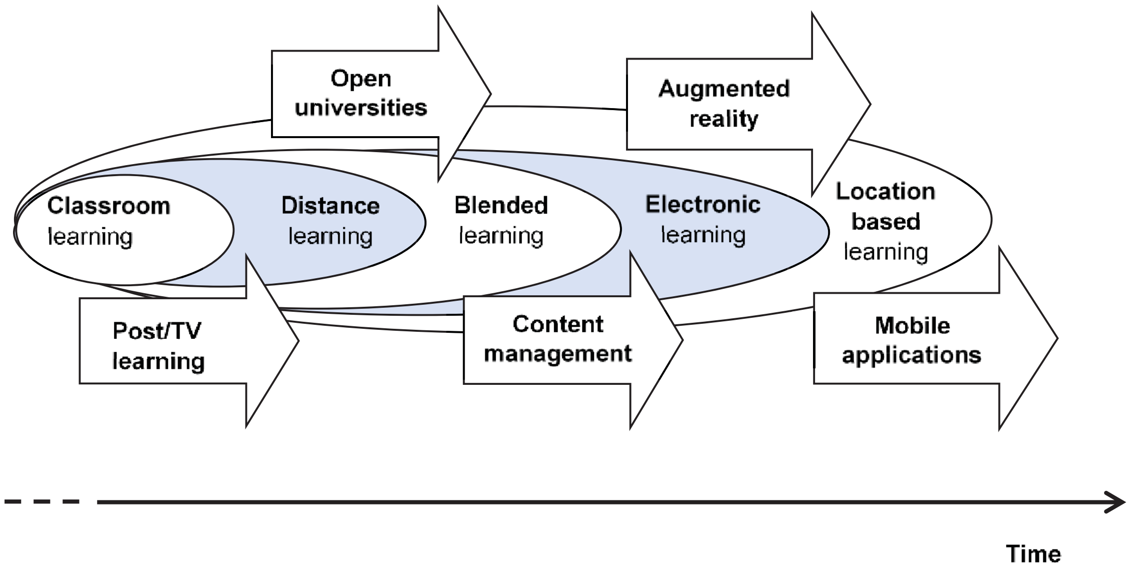

Figure 1: Learning evolution: each new artifact enriches and integrates the old one

4. Mobile application

We developed the m-RusGr application that runs on smart mobile devices. With the student's permission the application follows his/her tracks and categorizes them (Kalita et. Al. 2017, 2015). At the same time, this application marks the site attractions available in the student’s route. Based on this and other information regarding the Greek student’s profile, the application adapts and/or generates exercises covering the Russian verbs of motion. (see Figure 2).

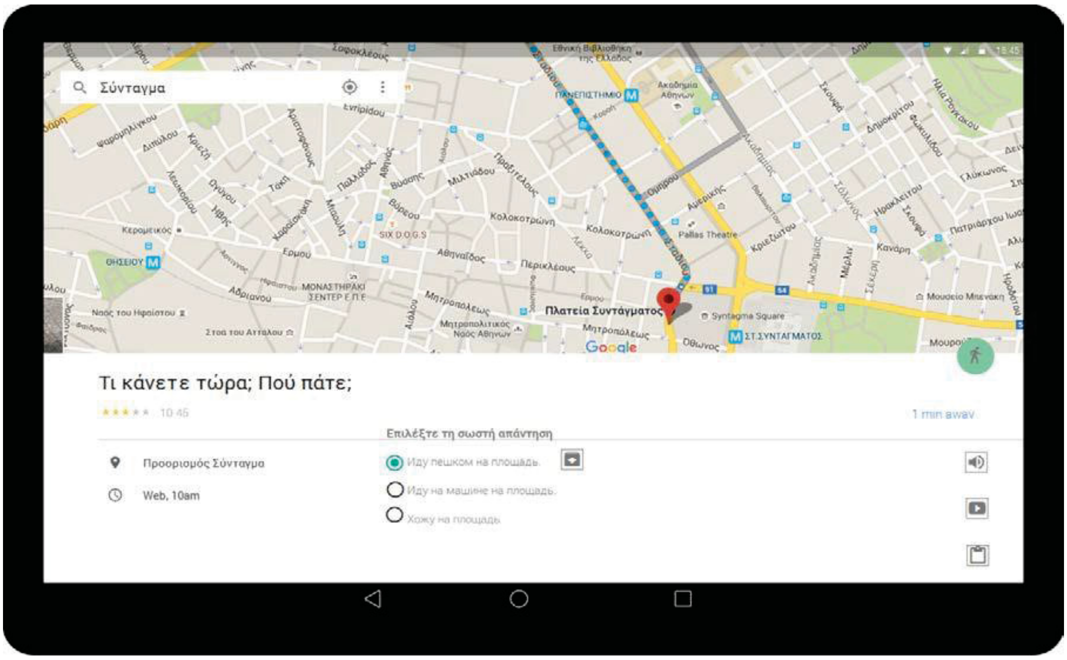

Figure 2: An example from the m-RusGr application

Imagine, for instance, that the student is at the center of Athens and wishes to go to box office of the National Theater to buy tickets, and then, go back home.

Throughout the route, queries (exercises) are being shown, that take into account the fact that at first, she/he is walking, then gets on the bus, gets off the bus and crosses a square, enters the theater, buys tickets, and finally returns home with a taxi. In each of these steps, exercises are being automatically generated, while helpful videos, animations and sound recordings are also provided.

Currently, this application has been distributed in a closed group of students, who act as test-users. Based on their observations, useful conclusions will be drawn regarding the interaction environment with the application and the model on which the teaching method has been based (Kalita et. al. 2016, 2014).

5. Conclusions

The changes taking place nowadays in the field of education and the opportunities that modern technology has to offer in the field of Russian language learning are deep, long, and sometimes noticeable and other times invisible, so they should not be ignored by the members of the education community. Moreover, complete and qualitatively advanced location-based learning systems must be developed.

Of course, in addition to the above, the answers to the following questions remain open: When and under which conditions the Greek students will be even more interested in learning of the Russian language? In the context of web-based learning of the Russian language, who would be the students that will show tolerance to -possibly-different points of view from the rest of their colleagues? Is there a possibility over time that this type of courses will acquire an undesirable political, religious, and/or ideological dimension? After the end of the course can the teacher compare and study the contributions made by the students? Are there some patterns of interaction, in order to increase the Greek student's awareness (Romero C. and Ventura S (2006? What are the most important factors that affect the performance of Greek students?

To answer these questions, apart from the obvious and necessary attempt of the teacher, students should also help from their side. Only in this manner, the quality of foreign language learning courses will be improved. At the same time, a sense of solidarity among the members of the educational community should prevail. They should constructively comment on the "learning" activities on social networks, actively participate in the lesson's forum and beyond.

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Analysis of Students' Navigational Behaviour in a Moodle Course

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Abstract: Learning Management Systems (LMS) are widely used by educational institutions all over the world to fulfil educational objectives and to achieve better learning results. LMS offer various sets of tools to support teachers in creating, administering and managing online courses. Although in the literature there are many references to the significance of learning styles and their impact on the learning process, a major drawback of LMS is that they do not consider a student's learning style and deliver the same set of educational resources to all students. Recently, there has been growing interest in enhancing adaptivity in LMS. This article investigates students' navigational behaviour in an online Moodle course to reveal whether students with different learning styles act differently in such a course. An evaluation study of a Moodle course was conducted in the context of an introductory programming course in order to investigate students' behaviour with respect to the Felder-Silverman learning style model. Students were asked to answer ILS questionnaire right after their first login to the course in order to obtain information regarding their learning style preferences. Seven different types of learning objects were used, namely outlines, content objects, videos, solved exercises, quizzes, open-ended questions, and conclusions. For each one of the aforementioned types the total time that a student studies it and the number of visits to it were calculated and analysed. The study was conducted over the first six weeks of the course. On completion of the respective course sections, students had to answer seven five-point Likert type questions evaluating the effectiveness of each type of learning objects. The aim of our analysis was to investigate whether students with different learning styles use different strategies to learn and navigate through the course. In addition, we investigated student's grades on the mid-term exam to reveal whether students' learning styles affect their performance. Summarizing the findings of the study, we come to the conclusion that differences exist in the students' navigational behaviour depending on their learning styles but we cannot draw safe conclusions regarding their performance on the exam.

Keywords: learning styles, learning management systems, navigational behaviour, e-learning

1. Introduction

Although the use of Learning Management Systems (LMS) has grown exponentially during the last decade, their effectiveness is sometimes questioned. A causal factor is that these systems typically do not consider the individual learning styles and deliver the same set of educational resources to all. Learning style refers to attitudes and behaviours which determine the way an individual learns something new (Honey and Mumford, 1992). When learning styles are ignored, students become inattentive in class, do poorly on tests and get discouraged about the courses and themselves. Consequently, provision of same instructional conditions to all students can be pedagogically ineffective (Akbulut and Cardak, 2012).

On the other hand, some criticism has been raised against learning styles over the last years. Although it is widely accepted that students learn in different ways, some researchers believe that there is no real scientific basis for the proposition that a learner actually has a certain optimal learning style and learning is improved if teaching is matched to learning styles (Kirschner, 2017). However, most researchers still believe that the theory of learning styles continues to offer something useful and the criticism that has been raised is invalid (Newton, 2015). Dekker et al (2012) found that 95% of teachers in UK, The Netherlands, Turkey, Greece and China held the belief that students learn better when they receive information in their preferred learning style.

The purpose of our paper is to present an analysis of students' behaviour in a Moodle course in terms of their learning style. More specific, we investigated whether students with different learning styles prefer to spend more time on particular types of learning objects or visit them more often. The findings of our analysis may contribute to the field of adaptive learning in two ways. First, objects that are preferred by students of a specific learning style, should be presented to them either more often or first in a course's sequence. Second, the findings can be used as valuable information for developing an automatic approach for the detection of students' learning styles based on the actual behaviour of students during an online course. In addition, we investigated ILS's precision and whether students' learning styles affect their grades on the mid-term exam. Summarizing, this study objective was primarily guided by the following questions.

RQ1: Does students' learning styles affect their navigational behaviour on an introductory programming course in Moodle?
RQ2: Does students' learning styles affect their grades on the mid-term exam?
RQ3: Can ILS questionnaire be used on its own for the detection of students' learning styles?

The remainder of the paper is organized as follows. The next section gives a short description of Felder Silverman Learning Style Model (FSLSM). This is followed by a section where related work is presented. In section 4 an overview of the investigated patterns of behaviour is given. After a section, where the evaluation study is presented, in the final section are the conclusions.

2. Felder Silverman leaning style model

Students differ from one another in many ways. For some students a course seems to be easy, whereas others face problems with learning in the particular course. A causal factor is that students have different ways to acquire and process information and these differences are known as learning styles (Felder and Silverman, 1988). Learners with a strong preference for a specific learning style might have difficulties in learning if their learning style is not supported by the teaching environment (Felder and Silverman, 1988). On the other hand, providing them with educational material that suits their learning styles makes learning easier.

Although a wide variety of theories and learning style models have been put forward, the Felder-Silverman Learning Style Model (FSLSM) (Felder and Silverman, 1988) has managed to be singled out. Carver, Howard and Lane (1999) argued that FSLSM stood out because it describes learning styles in much more detail, perhaps due to the fact that it combined different main learning style models (Dorca et al, 2013). Most other learning style models classify learners in few groups, whereas FSLSM distinguishes between preferences on four dimensions each with two scales: active/reflective, sensing/intuitive, verbal/visual and sequential/global, according to the way students process, perceive, receive and understand information. Students' learning styles are considered as tendencies, since even those learners with a strong preference for a particular learning style can at times act differently (Graf, 2007).

Each learning style model uses a different instrument in order to detect students' learning style preferences. The Index of Learning Styles (ILS) was developed in order to identify learning style preferences in FSLSM (Felder and Soloman, 1997). ILS is a 44-item questionnaire with 11 forced-choice questions about each of the four dimensions. Every learner has a personal preference for each dimension, which is expressed with a value of between -11 and 11 (including only odd values). The aforementioned range comes from the 11 questions that are posed for each dimension. When answering a question, for instance, with an active preference, +1 is added to the value of the active/reflective dimension whereas an answer for a reflective preference decreases the value by 1.

3. Related work

Several systems have been developed to provide content that fits students' individual learning styles (Graf, 2007). These systems reflect users' characteristics in a user model and apply that model to adapt instructional aspects of the system accordingly (Brusilovsky, 2001). Different frameworks have been used for the development of adaptive systems with learning styles being the most useful (Thalmann, 2014) because they can be used to adapt the content presentation to the learner (Bernard et al, 2017). Many of these systems apply automatic approaches to detect students' learning styles (Feldman et al, 2015).

The first step towards developing such systems is to determine relevant patterns of behaviour for each learning style. Popescu, Badica and Trigano (2008) analyzed students' interaction with an educational hypermedia system in order to investigate how can a student model be created and updated with respect to learning styles. Although the results were promising, they could not draw any definitive conclusions. A causal factor is that the sample of the study was relatively small since only 22 undergraduate students were involved. Moreover the validity can be challenged since the experiment lasted only for 4 hours. Graf and Kinshuk (2008) conducted a similar analysis with promising results. However, three threats to the validity of their study exist. The first is that only 43 students participated in the study. The second threat is related to the fact that the visual/verbal dimension of FSLSM was totally ignored in their study. The third threat is related to the fact that the behavioural patterns were not correlated to a student's learning style but to only one response in a specific question of ILS ignoring the fact that a learning style is calculated by responses in 11 questions.

4. Investigated patterns of behaviour

In order to analyse students' behaviour in a Moodle programming course with respect to all FSLSM dimensions, the type of the incorporated learning objects should match diversity of learning styles. Taking under consideration students' preferences in terms of FSLSM (Felder and Silverman, 1988; Graf and Kinshuk, 2008) as well as the fact that our findings should be applicable for LMS in general rather than only for Moodle, it was decided to use seven different types of learning objects which are implemented in most LMS: outlines, content objects, videos, solved exercises, quizzes, open-ended questions, and conclusions. Outlines present an overview of the educational objectives of the current section. Content objects present the theory of the section. Videos explain basic concepts of theory and provide hints for problem solving. Solved exercises consist of the description of an exercise and its solution. Quizzes include multiple close-ended questions where each one of them demands prediction of program output or filling gaps in a program. Open-ended questions include a small piece of code and learners are required to predict their output and reason for this prediction. Finally, conclusions summarize the main points of the current section's theory. Content objects, outlines, conclusions and videos are all created as resources and, therefore they cannot be distinguished by Moodle. To overcome this drawback, we implemented an extension to Moodle authoring tools which enables the teacher to annotate them with appropriate metadata during their creation, so as to state the specific type of each resource.

The behavioural patterns that we decided should be investigated are related to each of the aforementioned types of learning objects. Two patterns for each of the seven types of learning objects were used comprising the total time that a student studies a specific type of learning object and the number of visits to it. Moreover, two patterns related to the review of the quizzes were also used. For all these patterns, we decided to use relative values because they express students' actions in terms of the total amount of their effort and, therefore, they are more meaningful than absolute ones. Relative values were calculated by dividing the absolute values of time and number of visits by the total time spent on the course and the total number of visits. Finally, we decided to use two more patterns related to the score of students in quizzes and open-ended questions. The total set of the eighteen behavioural patterns that were decided to be used is presented in Table 1.

Table 1: Investigated patterns of behaviour

Pattern	Description
outline_duration	relative time spent on outlines
outline_visits	relative number of visits on outlines
content_duration	relative time spent on content objects
content_visits	relative number of visits on content objects
video_duration	relative time spent on videos
video_visits	relative number of visits on videos
conclusion_duration	relative time spent on conclusions
conclusion_visits	relative number of visits on conclusions
solved_duration	relative time spent on solved exercises
solved_visits	relative number of visits on solved exercises
quiz_duration	relative time spent on quizzes
quiz_visits	relative number of visits on quizzes
quiz_review_duration	relative time spent on reviewing quizzes' results and feedback
quiz_review_visits	relative number of visits on reviewing quizzes' results and feedback
quiz_average_score	average score on quizzes
open_duration	relative time spent on open-ended questions
open_visits	relative number of visits on open-ended questions
open_average_score	average score on open-ended questions

5. Evaluation study

In order to investigate the research questions of the present work, an evaluation study was conducted during the winter semester of the 2015/16 academic year in the context of the Procedural Programming introductory course, taught in our department. Course's total length is 13 weeks consisting of a 2-hour weekly lecture and a 2-hour weekly laboratory where students practice and solve a problem. In addition, they have to attend a

Moodle course that was created for the study. On completion of the first six weeks of the course, students are required to take a mid-term exam. The study was conducted up to the mid-term exam. During this time, five sections about the fundamental concepts of procedural programming were presented to students, namely an introduction (I/O statements, data types, assignment statement), if statements, loops, functions and arrays. Each section of Moodle's course consisted of an outline, content objects, videos, solved examples, one quiz, one open-ended question, and a conclusion.

To answer our research questions an evaluation questionnaire, students' grades on the mid-term exam and student's behaviour data were analysed. Students had to answer the questionnaire on completion of Moodle's course but prior to the mid-term exam. The questionnaire consisted of five-point Likert type questions, ranging from 1 'strongly disagree' to 5 'strongly agree'. Overall, 139 students participated in the study. Students were asked to answer ILS right after their first login to the Moodle course in order to obtain their learning styles. Students' distribution in each learning style as derived from the ILS questionnaire is presented in Table 2.

Table 2: Students' distribution in each learning style derived by the ILS questionnaire

Active	Reflective	Sensing	Intuitive	Visual	Verbal	Sequential	Global
71	68	77	62	77	62	69	70

To answer RQ1, we calculated mean and standard deviation values for the investigated behaviour patterns that are presented in Table 1. In order to check for statistically significant differences, a two-tailed t-test was applied for patterns where data were normally distributed and a two-tailed Mann-Whitney U test (u-test) for patterns where data were not normally distributed. The Kolmogorov-Smirnov test was used to check whether data were normally distributed or not. The findings regarding each FSLSM's dimension are presented in Tables 3, 4, 5 and 6.

Table 3: Navigational behaviour of active/reflective students

Pattern	Active		Reflective		t-test or u-test
	M	SD	M	SD	
outline_duration	0.00008	0.00004	0.00014	0.00015	U=1370 *p=0.02
outline_visits	0.03436	0.01921	0.04858	0.03186	t=-2.513 *p=0.014
content_duration	0.40462	0.14166	0.46672	0.11757	t=-2.235 *p=0.028
content_visits	0.21317	0.07877	0.19723	0.06884	t=1.019 p=0.311
video_duration	0.08262	0.05510	0.08315	0.04134	t=-0.052 p=0.959
video_visits	0.05664	0.02002	0.06010	0.02449	t=-0.724 p=0.471
conclusion_duration	0.01601	0.01293	0.02065	0.01696	t=-1.436 p=0.155
conclusion_visits	0.01543	0.00990	0.02047	0.01398	t=-1.940 p=0.056
solved_duration	0.08508	0.05923	0.09175	0.07345	t=-0.468 p=0.641
solved_visits	0.03038	0.01937	0.03417	0.02250	t=-0.849 p=0.398
quiz_duration	0.23012	0.11519	0.27333	0.13982	t=-1.580 p=0.118
quiz_visits	0.57682	0.11020	0.56132	0.11621	t=0.644 p=0.521
quiz_review_duration	0.05477	0.05400	0.06734	0.07421	U=1054 p=0.582
quiz_review_visits	0.14964	0.07804	0.14904	0.08524	t=0.035 p=0.972
quiz_average_score	73.76	10.352	75.51	9.764	U=1061.5 p=0.540

Pattern	Active		Reflective		t-test or u-test
	M	SD	M	SD	
open_duration	0.10440	0.06014	0.10526	0.06535	t=-0.064 p=0.949
open_visits	0.07319	0.02565	0.07812	0.02365	t=-0.942 p=0.349
assignment_average_score	90.93	10.197	86.68	12.150	U=762 p=0.062

As can be seen in Table 3, statistically significant differences exist between active and reflective students regarding the relative time spent on outlines (U=1370, p=0.02) and the relative number of visits on them (t=-2.513, p=0.014). The specific findings are in accordance with FSLSM theory as reflective learners prefer to contemplate on the educational material and, therefore, it is expected that they would spend more time on the outline and the conclusion. Although differences also exist regarding the conclusions, they were not found to be statistically significant. According to FSLSM, reflective learners are inclined to think intensively about the subject matter. Consequently, content objects, solved exercises and videos are recommended for them. Thus, a high number of visits on such features, as well as spending a large amount of time on these features overall are expected from reflective learners. Such differences can be seen in Table 3. However, only the difference regarding the time spent on content objects was found to be statistically significant (t=-2.235, p=0.028).

Table 4: Navigational behaviour of sensing/intuitive students

Pattern	Sensing		Intuitive		t-test or u-test
	M	SD	M	SD	
outline_duration	0.00011	0.00013	0.00011	0.00008	U=1000 p=0.384
outline_visits	0.03959	0.02626	0.04612	0.02952	t=-1.070 p=0.288
content_duration	0.43528	0.13326	0.43139	0.13697	t=0.130 p=0.897
content_visits	0.20634	0.08025	0.20178	0.06068	t=0.276 p=0.783
video_duration	0.09034	0.05322	0.06898	0.03286	t=2.033 *p=0.045
video_visits	0.06105	0.01983	0.05364	0.02630	t=1.495 p=0.138
conclusion_duration	0.02028	0.01707	0.01505	0.01066	t=1.549 p=0.125
conclusion_visits	0.01934	0.01351	0.01575	0.00987	t=1.305 p=0.195
solved_duration	0.08790	0.07472	0.08991	0.04989	t=-0.135 p=0.893
solved_visits	0.03224	0.02029	0.03264	0.02274	t=-0.085 p=0.933
quiz_duration	0.24684	0.11735	0.26434	0.15205	t=-0.603 p=0.548
quiz_visits	0.56454	0.11427	0.57630	0.11216	t=-0.465 p=0.643
quiz_review_duration	0.06542	0.07384	0.05390	0.04582	U=904 p=0.966
quiz_review_visits	0.15536	0.09186	0.13803	0.05684	t=1.096 p=0.276
quiz_average_score	75.38	9.190	73.39	11.479	U=840.5 p=0.614
open_duration	0.10029	0.05442	0.11340	0.07582	t=-0.940 p=0.350
open_visits	0.07688	0.02548	0.07376	0.02310	t=0.568 p=0.571
assignment_average_score	87.38	12.878	91.13	7.562	U=991.5 p=0.422

Sensing learners tend to like solving problems by well-established methods. In contrast, intuitive learners like to learn in more innovative ways, and they have a strong dislike of repetition. They like challenges and tend to be more creative. Consequently, sensing learners are expected to show a preference for quizzes since those that were used in our course were not as challenging as writing a program from scratch. As can be seen in Table 4, such difference exists but was not found to be statistically significant. The only difference that was statistically significant refers to the time spent on videos. More specific, sensing learners showed a preference for the particular type of learning objects. This preference can be justified by the fact that sensing learners are expected to show a predilection for perceiving information using their physical sensations. In addition, watching a video cannot be considered as an innovative and creative challenge that can draw an intuitive learner's attention.

Table 5: Navigational behaviour of visual/verbal students

Pattern	Visual		Verbal		t-test or u-test
	M	SD	M	SD	
outline_duration	0.00011	0.00012	0.00011	0.00005	U=439 p=0.282
outline_visits	0.04099	0.02721	0.04971	0.03003	t=-0.903 p=0.369
content_duration	0.43282	0.13157	0.44379	0.16077	t=-0.232 p=0.817
content_visits	0.20369	0.07352	0.21417	0.07912	t=-0.402 p=0.688
video_duration	0.08463	0.04951	0.06748	0.02959	t=1.016 p=0.313
video_visits	0.05801	0.02049	0.06252	0.03698	t=-0.570 p=0.570
conclusion_duration	0.01801	0.01583	0.02245	0.00864	t=-0.824 p=0.412
conclusion_visits	0.01715	0.01177	0.02645	0.01553	t=-2.173 *p=0.032
solved_duration	0.08610	0.06790	0.11085	0.05447	t=-1.054 p=0.295
solved_visits	0.03096	0.01937	0.04503	0.03108	t=-1.931 p=0.057
quiz_duration	0.25652	0.12883	0.22108	0.14289	t=0.774 p=0.441
quiz_visits	0.57596	0.10523	0.50356	0.16096	t=1.847 p=0.068
quiz_review_duration	0.06251	0.06320	0.05161	0.08656	U=253 p=0.145
quiz_review_visits	0.14922	0.07593	0.15022	0.12668	t=-0.035 p=0.972
quiz_average_score	74.93	9.969	72.56	10.899	U=306 p=0.462
open_duration	0.10354	0.06273	0.11652	0.06380	t=-0.587 p=0.559
open_visits	0.07323	0.02091	0.09856	0.04107	t=-3.065 *p=0.003
assignment_average_score	88.81	11.512	87.56	11.013	U=323.5 p=0.617

As can be seen in Table 5, two statistical differences exist (p<0.05). The first refers to the number of visits on conclusions (t=-2.173, p=0.032) where verbal learner showed a preference for the particular type of learning objects. The second difference refers to the number of visits on open-ended questions (t=-3.065, p=0.003). Both differences were expected since verbal learners prefer the word form, both written and oral, as a way of best understanding information. In contrast, visual learners learn best by looking at the educational material. Thus, in terms of the selected features, it can be expected that this learner type will spend an overall great amount of time on videos. Although such difference can be seen in Table 5, it was not statistically significant.

Table 6: Navigational behaviour of sequential/global students

Pattern	Sequential		Global		t-test or u-test
	M	SD	M	SD	
outline_duration	0.00010	0.00009	0.00012	0.00015	U=1091 p=0.312
outline_visits	0.04082	0.02943	0.04327	0.02485	t=-0.415 p=0.679
content_duration	0.42347	0.13015	0.44796	0.13905	t=-0.853 p=0.396
content_visits	0.20070	0.07804	0.21019	0.06809	t=-0.599 p=0.551
video_duration	0.08600	0.05424	0.07873	0.03850	t=0.704 p=0.483
video_visits	0.06018	0.02387	0.06018	0.02387	t=0.832 p=0.408
conclusion_duration	0.01919	0.01642	0.01748	0.01377	t=0.518 p=0.606
conclusion_visits	0.01894	0.01307	0.01695	0.01157	t=0.744 p=0.459
solved_duration	0.07190	0.04770	0.10105	0.07619	t=-2.073 *p=0.041
solved_visits	0.02737	0.01460	0.03611	0.02426	t=-2.110 *p=0.038
quiz_duration	0.25098	0.11636	0.25557	0.14771	t=-0.164 p=0.870
quiz_visits	0.56769	0.11477	0.56991	0.11220	t=-0.091 p=0.928
quiz_review_duration	0.07281	0.07609	0.04611	0.04394	U=830 p=0.249
quiz_review_visits	0.15945	0.08959	0.13573	0.06785	t=1.366 p=0.175
quiz_average_score	75.27	9.565	73.89	10.694	U=888 p=0.501
open_duration	0.10089	0.05462	0.11018	0.07235	t=-0.691 p=0.492
open_visits	0.07555	0.02452	0.07612	0.02501	t=-0.106 p=0.915
assignment_average_score	88.08	11.428	89.50	11.484	U=1027.5 p=0.625

Sequential learners prefer to take a logical step-by-step approach that increases in complexity. It is assumed that they would have a much stronger preference for solved exercises as they constitute a linear approach to eventually acquiring a full understanding of the task at hand. The aforementioned hypothesis is verified by the findings presented in Table 6. Sequential learners spent more time on solved exercises than global learners and also visited them more often. Both differences were statistically significant. On the other hand, global learners tend to digest material, not realizing any connection initially, and rather suddenly grasp its meaning. As it is significant for this learner type to get to grips with the overall picture, features that can help them to achieve this are the outline and the conclusions. However, our findings didn't verify this hypothesis.

Taking under consideration the findings that are presented in Tables 3, 4, 5 and 6 regarding the investigation of RQ1, we can answer that students' learning styles affects their preferences for specific types of learning objects but we could not validate all the findings of previous works (Graf and Kinshuk, 2008).

Students' grades on the mid-term exam were analyzed to answer RQ2. The findings regarding whether students' learning styles affect their grades are presented in Table 7.

Table 7: Student grades on the mid-term exam

	Active	Reflective	Sensing	Intuitive	Visual	Verbal	Sequential	Global
Grade	20.59	20.54	19.78	21.71	20.82	19.09	19.86	21.44
t-test	t=0.034 p=0.973		t=-1.356 p=0.180		t=0.787 p=0.445		t=-1.109 p=0.271	

The results in Table 7 indicate that students with different learning styles may perform better on the mid-term exam than others. We cannot draw the conclusion that students' learning styles definitely affect their grades though since the conducted t-test did not reveal any statistically significant difference.

In order to answer RQ3, students were asked to answer to four questions, each of which describes a different dimension of the FSLSM. Each question thoroughly describes the behaviour and preferences of each of the two learning styles of the specific dimension. Subsequently, students were asked to choose which of the two respective styles best suits them. For example, as regards the first dimension, they are asked whether they believe they are active or reflective learners. Students' responses were compared to the results obtained from the ILS questionnaire. The findings of the comparison are presented in Table 8.

Table 8: Comparison between ILS detection and students' responses regarding their learning styles

Active / Reflective	Sensing / Intuitive	Visual / Verbal	Sequential / Global
60%	60%	66%	51%

Despite the fact that ILS is proven to be a reliable and valid instrument (Felder and Spurlin, 2005), the results in Table 8 indicate that ILS cannot be used on its own for the detection of students' learning styles. This conclusion does not dispute the questionnaire's validity but it indicates that the detection of learning styles solely via the ILS questionnaire is either error-prone due to students' inaccurate responses or students are unaware of their learning preferences. Consequently, the ILS questionnaire cannot be used on its own and automatic approaches for the detection of students' learning styles are also needed.

6. Conclusions

Although learning styles have been subjected to some criticism over the last years, researchers still believe that the theory of learning styles continues to offer something useful. Many systems have been proposed to adapt the educational material but the integration of learning styles and adaptive learning system still requires further researches and experiments (Truong, 2016).

In our contribution to research, we investigated the behaviour of students in an online programming course in Moodle with respect to the students' learning styles. By analyzing several patterns of students' behaviour, we found significant results for some of them, indicating that students with different learning style preferences also behave differently in the online course. However we found that students' different behaviour did not affect their grades on the mid-term exam. More specific, regarding the active/reflective dimension, we found three statistically significant differences which refer to the time spent on outlines and content objects as well as to the number of visits on outlines. The only significant difference between the behaviour of sensing and intuitive learners refers to the time spent on videos. Regarding the visual/verbal dimension, two significant differences were found which refers to the number of visits on conclusions and open-ended questions. Finally, two significant differences exist between sequential and global students. These differences refer to the time spent on solved exercises and the number of visits on them. It should be pointed out that all the aforementioned differences are in accordance with the theory of FSLSM.

Previous works (Graf and Kinshuk, 2008; Popescu, Badica and Trigano, 2008) revealed more statistically significant differences but that does not dispute the validity of these works as existing differences may be due to the type, the quality and the way that the educational resources were used. Although our research looks similar to previous works, it has some major differences. First, the sample of our study was larger. Second, we investigated the behaviour of visual and verbal learners that were exclude from previous works. Third, students' behaviour was investigated with respect to their learning styles regarding the particular FSLSM dimension instead of considering their response to only one question of the ILS which may lead to misconceptions.

The threats to the validity of the empirical study are related to the imbalance in student distribution for each learning style and students' inaccurate responses to ILS questionnaire. The results in Table 2 suggest that the first threat has been mitigated to an extent. In order to mitigate the second threat, we are developing an automatic approach for the detection of students' learning styles. The aforementioned approach has a greater potential to be error-free as real data will be used in order to detect students' learning styles. By implementing the automatic approach, students' learning styles will be dynamically updated to detect possible changes.

The findings of our research have several implications for improving adaptivity. First, they provided information for extending the adaptive functionality in Moodle. In addition, they can contribute towards automatic detection of students' learning styles in order to surmount the disadvantages of solely using ILS. These preliminary findings lay the groundwork for further research in the field of adaptive learning. Our future work will focus on the exploitation of the aforementioned findings in order to provide adaptivity in Moodle as well as the implementation of an automatic approach for the detection of students' learning styles.

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Supporting Virtual Learning for Digital Literacy: First Experiences With a Mobile app and Gamification Elements

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Abstract: Due to digitalization, media literacy and collaboration skills are still or have become even more important for students, especially for future digital workers. The following paper reports about virtual learning in the field of information processing with the learning objective of increasing students' digital literacy. The conceptual design of the respective course is based on different learning approaches like self-regulated learning, small group learning as well as face-to-face teaching and is realized within the scope of a faculty wide blended learning programme called MUSSS. Online and on campus-tutors support and supervise students especially while practicing their skills. To support self-regulated learning phases a mobile app has been designed which is able to connect to the LMS. In order to motivate students and to give them feedback about the solved tasks, gamification elements are implemented in an app. Furthermore a study, based on a student survey (n=86), was carried out in order to evaluate the respective course. Results show that, although on a general basis students regarded the course positively (for example concerning its up-to-dateness and the spreadsheet analysis), most of them considered its workload and level of difficulty inappropriate.

Keywords: mobile learning, higher education, digital literacy, blended learning, gamification

1. Introduction

Throughout the last decades, basic education on information and communications technology has been in a constant flux. On the one hand, this change has been driven by the constant development of new technologies, on the other hand business environment and the social surroundings have been steadily changing, which has led to altered demands as regards IT basics. Naturally, this has had an impact on learning settings at all levels of education.

At our institute, students have received basic education on information and communication technology for a long time. The course "Information Processing" is in the focus including fundamentals on hardware and software, search tools and strategies, data analysis using spreadsheets, databases, SQL, collaboration on the web, the reflection of information and communication technology with regard to legal frameworks, security issues and its impact on the individual or society as a whole.

The example of the course "Information Processing for Business and Social Sciences" at the University of Linz, Austria, shows how the content of teaching can simultaneously be a learning method itself. The learning objective of this course is to improve computing skills for bachelor students of Economics and Social Sciences. The skills construct is defined in terms of the users' knowledge and ability to utilize computer hardware, software and procedures to design, develop and maintain specific applications for working with information.

In order to meet the students' demands to receive theoretical as well as practical instruction, the course "Information Processing for Social and Economic Sciences" consists of partly online, partly on campus classes on the one hand and of accompanying tutorials on the other hand. Besides, an app, which is connected to our learning management system Moodle, is offered to the students. This app is - amongst other features - designed to motivate students through gamification elements.

The learning scenario is based on a blended learning approach consisting of a combination of elements from a multi-media distance learning program and on-campus classes. This approach mixes synchronous and asynchronous instruction and also applies IT activities with computers, mobile devices, video conferencing and other emerging electronic media. Exams are offered – detached from the particular courses – each month and are taken on the computer in the form of a multiple-choice test as well as a practical exam.

The present paper describes the realisation of an "Information Processing" course, explains the app, which is used within the scope of this course, as well as its features, and additionally refers to the outcomes and results of an accompanying survey conducted in order to evaluate this course. The required data were collected by means of a written questionnaire. Students who had already participated in the course "Information Processing" were asked for their opinion on content and topics, organizational structure, activities, tutors etc. The purpose of this survey was to find out, how this particular learning setting is perceived and evaluated by the students. The outcome shows an atmospheric picture of the course organization and learning outcomes.

The results of this study served as one of our starting points for the app development – with the aim of supporting teachers in terms of course administration on the one hand and in order to assist students with their course organization and throughout their self-learning phases on the other. Finally, future prospective plans concerning the app are demonstrated.

2. MUSSS: MUltimedia Study Service SOWI

At our University, since 2009 a blended-learning concept called MUSSS (**MU**ltimedia **S**tudy **S**ervice **S**OWI) has been running at the Faculty of Social Sciences, Economic & Business (SOWI). Students, who take MUSSS courses, are usually undergraduate students, studying either Social Economics, Business and Economics, Business Informatics or Business Education. Additionally, a couple of courses within the scope of some of the graduate programs are offered as MUSSS courses, too, for example in Digital Business Management or in Business Informatics.

The vision of MUSSS was to introduce a parallel program to traditional on campus courses, which should attract - on the one hand - students who work besides studying and - on the other hand - students with care responsibilities for children or - for example - elderly persons. Furthermore, students who live far away from University could also benefit from MUSSS. Most courses are held in the form of online courses offering online content (videos, audio commented slides, learning programmes, micro learning tools…) wikis, chats, forums and other communicational (video conferencing tools...), technical or social learning activities. In addition to that, pedagogical strategies like peer review or (business) case studies are implemented. Another import component of the blending learning program is the tutorial support from fellow students, who support the learning process of students.

Basically, courses are offered either as mere online courses or as mixed courses consisting of on site (i.e. taking place on campus in classroom settings) as well as online phases. There are two different types of MUSSS courses: Regular MUSSS courses and MUSSS O.C. courses. Regular courses are fee-based, which is due to an increased and very intense support provided especially via online media and through tutors as well as a smaller number of participants during the on site phases which makes for a better student-to-teacher ratio. (JKU, 2018)

MUSSS O.C. stands for Multimedia Study Service SOWI Oline Content - implying there is no attendance needed except for the exams and online material is offered for free. Students participating in these courses prepare for their exams independently by themselves studying with the help of the online material (videos, audio commented slides, papers) provided by the MUSSS teachers, and the app.

The course "Information Processing" presented in this paper is offered both as a traditional on-campus course and as a special MUSSS version, which is described in detail below. A MUSSS O.C. type of this course, however, cannot be provided since students have to discuss, reflect upon and present content in class, which contradicts the character of a MUSSS O.C course.

3. Digital literacy in higher education

Digital and especially media literacy for virtual learning and collaboration are becoming ever more important learning objectives in business education. Advanced collaboration skills and media literacy are vital in order to be accepted in a globalized business setting where virtual communication between enterprises is part of the day-by-day business.

Throughout recent years, the digital literacy didactics discussion has been dominated mainly by moderate constructivist approaches, in which the conceptualization of knowledge plays a central role. Knowledge is thereby not regarded as the immediate result of a knowledge transfer within a learning process but constructed by the learners themselves. Constructivism puts the learner into the center of theory construction and supersedes the idea of a possible external controllability of learning. Special focus is thereby placed on the collaboration of learners within learning communities (Papchristos et al, 2010). The conceptualization of knowledge is essential for constructive learning methods. Within constructivism the situation of learning plays an important role. Gräsel et al. (1997) emphasize active learning, which is situation and context dependent as well as self-regulated:

Learning as an active construction of knowledge: Learning is an interactive process of reorganizing knowledge, performed by the learner. However, what it means to the learner depends on his or her previous knowledge, attitudes and previous experiences.

Situation and context dependent knowledge construction: The context in which learning occurs is central for the learning itself. Thus, the learning situation should ideally resemble a real application context. Authenticity is given, when learning tasks contain central characteristics of a real application context.

Self-regulated learning process: The idea is that the learners themselves shall regulate and control most of their learning processes. The learners regulate the way and the pace of learning as well as when and where they learn. The learning environment should be organized in a way that it best supports the self-regulated learning process.

Joint knowledge construction: Learning is not an isolated process but happens within a social and cultural context. Therefore learners with different knowledge and backgrounds should collaborate. From a constructivist point of view learning also means “joint learning” which is why collaborative learning is considered as highly useful from this perspective.

Due to its moderate constructivism the conceptual design of the information literacy program mixes different learning approaches (Katzlinger et al, 2010) and is implemented in the course “Information Processing” as follows:

Self-regulated learning assigns the major responsibility for learning to the student. Within the framework provided by the goals and objectives of the subject, students should be able to determine their own learning goals, decide on how to achieve their goals best and how to select from the different learning resources and also be able to measure their own progress. Different learning materials such as lecture notes or a Wiki with text-to-speech elements are provided for the students. Students must complete homework assignments after each lesson, especially in order to improve their practical work with the software tools.

Small group learning in heterogeneous groups is a valuable learning resource. The transfer of knowledge is enhanced by confronting students with problems that encourage them to not only learn content, but also to develop strategies that enable them to recognize the ‘analogy' or the ‘underlying principle' which can then be transferred to new problems and contexts. The group meets face-to-face or as a ‘virtual group’ supported with collaboration tools like web conferencing, audio conferences or chats. The students prepare a presentation and a Wiki on a current topic relating to ICT.

Face-to-face teaching for a reflection of the learning content. Faculty facilitate learning by asking questions, by stimulating critical thinking, by challenging the students' opinions and perspectives, by providing feedback to the presentations and homework and by evaluating student performance. During the process of acquiring new knowledge, students are encouraged to think and to discover rather than to simply memorize facts. In doing so, they are supported and supervised by (online) tutors. These are students in higher years, who have act as teaching assistants. Their role is an intermediary one between teachers and students and may vary according to whether their tasks correspond more closely to the role of a teacher or the role of a student.

4. Learning scenario

4.1 Learning setting for information processing

The target group of the course “Information Processing” are bachelor students of the major economics and business sciences. Each semester seven courses for 30 participants each are offered, plus two additional courses in the summer holidays, that are designed as blended learning courses.

The core element of the teaching concept is learning in "real situations". This means that on the one hand learning situations are created that integrate the students’ everyday learning into the learning setting. On the other hand, students learn how to use ICT tools to solve business management tasks. The technological basics of ICT are not the primary the content of the course, it is taught to explain how the different tools like spreadsheets or queries in a database work. A critical reflection on ICT, as for example on security issues or its impact on society is also part of the course. ICT is course content and part of the teaching method itself. The penetration of comprehensive areas of life with ICT, especially with mobile devices, can be used in the learning process by integrating everyday tasks and situations. The teaching concept includes different phases that alternate and refer to each other; phases of passive knowledge acquisition on the part of the students alternate with phases of active knowledge construction.

The course “Information Processing” consists of three parts:

- Firstly, there are lectures in which teachers explain theoretical and practical content. In a second learning step experiences from the tutorial and the self-regulated learning phases are reflected upon and discussed.
- Secondly, tutors offer tutorials in which students are able to practice spreadsheet, SQL, HTML, etc. The students work in small groups (of up to ten members) in a PC lab.
- Thirdly, there are assignments for self-regulated learning. If possible, these tasks refer to everyday student life or business management tasks. One of the tasks is, for example, to format a seminar paper (from another course) and to apply certain functions of the word processor.

The assessment of student performance takes place in two parts. The theoretical part is assessed by means of a multiple-choice test, the practical part by an examination directly taken on a PC in our electronic examination room (Katzlinger et al., 2017). For teaching, different media are used. The learning contents of the course, for example, are provided to the students in the form of a wiki, the lecture notes are a print version of the wiki. Additionally, students use Web 2.0 tools to solve their tasks, such as a wiki to document their group work and, in doing so, they acquire a basic knowledge of HTML. Likewise, the subject area of information research is closely linked to tasks from everyday student life, as for instance to retrieve information for other courses.

The self-regulated learning phase increasingly shows the tendency of BYOD (bring your own device), meaning learners use their personal mobile devices such as laptops or tablets to solve their tasks (Heinen et al., 2013, Song et al., 2017). Basically, this development corresponds to the approach of learning in “real situations”, as already realized in the first version of our teaching concept. Learners prefer to work on their own devices right through to working with their own software. Using open source software for different operating system platforms makes it easier for the learners to prepare with their own devices. Another approach is to use software that is available in the cloud or that can be accessed via browsers such as wikis or blogs.

Course participants can be categorized according to their different previous knowledge on ICT. As expected, this gap doesn’t close over the course of time. This heterogeneity of the target group is accounted for in the teaching concept in that the teaching content has been divided into a basic and a deepening part, with the basic elements being partly taught already in secondary school. The conveyance of basic knowledge is part of the self-regulated learning phase. Students can test their acquired knowledge with the aid of structured tasks.

4.2 App and app future

In order to support students and teachers with their studies or teaching respectively, a mobile app has been developed. It focuses, among other things, on helping students to organize their tasks during the semester, on reducing drop out and on achieving better learning outcomes in the course. The app is designed to connect with our learning management system Moodle, which shall allow for getting information e.g. from the calendar or about already assessed exercises. As regards teachers, the app supports them in their administrative tasks like e.g. attendance checks, since students are able to confirm a QR-code with the app.

In order to support students during their self-learning phases, the mobile app is used through which the learners are able to get feedback about the tasks accomplished within the framework of the course. In order to find out, whether or how students can be additionally motivated, gamification elements are implemented which could enable students to compete against each other and to compare themselves to one another.

"myJKU" provides students with an overview of all kinds of study relevant information including the menu of the students' refectory and University news as well as of their grades and information regarding the curriculum for example through the study guide.

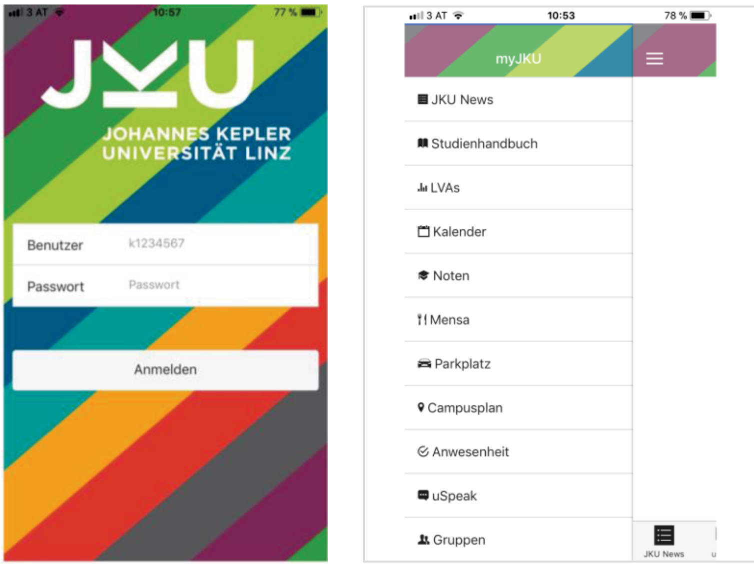

Figure 1: Starting page and overview

In order to confirm their attendance in the respective courses, students are enabled to simply scan a QR code and, in so doing, verify that they are present in the classroom. To accelerate the study progress, students are able to activate an "e-assistant" which reminds them of upcoming deadlines, informs them about grades, awards, emails from teachers, enrolment information etc.

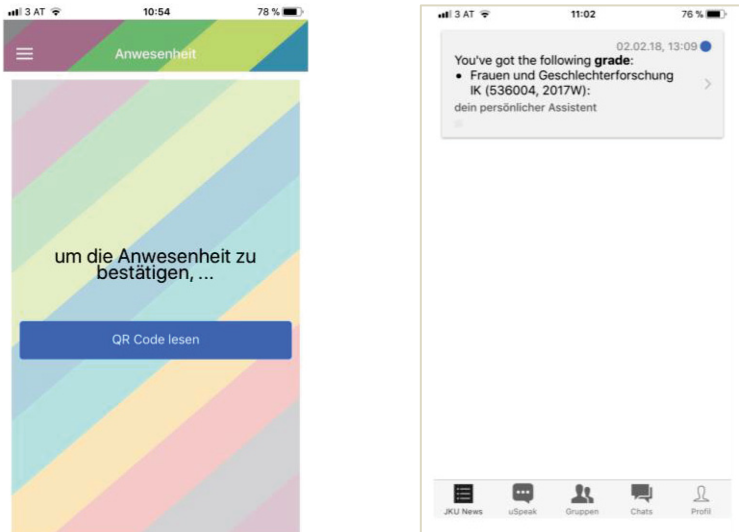

Figure 2: Attendance confirmation and grade information

A park-riding feature even tells the students, which of the parking spaces are free or already taken:

In addition to that, the app allows for chats, which can be initiated by teachers as well as students, group chats and the conduction of surveys. As regards the compulsory group work that has to be performed in some of the courses (for example in the course Information Processing), the app enables students to organize themselves through groups or find learning groups.

Studies show that students learn more effectively if positive emotions are evoked (Arnold, 2009). These emotions influence amongst others also motivation and learning behaviour and therefore the learning efficiency (Pekrun, 2018). Gamification elements have "… the potential to foster motivation in different contexts" (Sailer et al, 2013, 36). Our gamification elements, which are partly already implemented and accordingly soon to be released, are currently being tested as to whether they are able to motivate students through spurring their ambition, to challenge them and to accelerate competition with fellow students. Moreover, social exchange is warranted through group tasks.

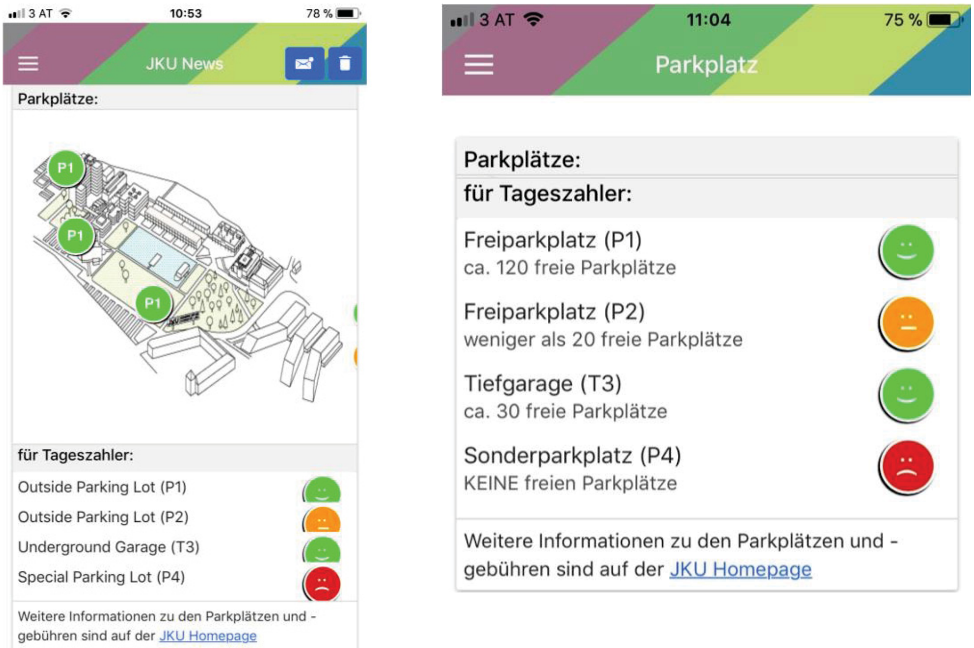

Figure 3: Park-riding features

Most of these features are based on the learning platform Moodle that is used at the JKU. In order to collect and provide data for the app, a special version of Moodle was created, which supports the features of the app. Students have to upload their solved tasks, homework, group work and so forth on the platform or carry out learning programs, quizzes etc. online either on the computer or via mobile devices. Subsequently these data are analysed and the results presented to the students.

Gamification elements are brought in through messages regarding for example homework or group work. Through the app, students are provided with information, telling them, for instance, that "30% of the students, who are attending your class "Information Processing", have already turned in their homework B5." This shall lead to time pressure as well as encourage competition among students. With relation to exams, particularly to those which are taken online in our examination room (Katzlinger et al., 2017), students can easily be compared to one another. These results are presented to the students either by means of messages or via figures. They receive messages saying, for example, "You were the best student" or "10 fellow students did better than you did…" Thus, competition as well as an acquisition of status is offered since there is a form of ranking available between students. This feature is available for the solving of Moodle quizzes, too.

Furthermore, Moodle allows for awarding a sort of trophy called award. Students are able to earn such awards through the completion of special tasks or through excellent achievements. Instead of sticking with the current practice, however, of providing award winning students with a plain message, they could be awarded with little rosette ribbons, winner badges or cups in the future, that could appear next to their profile picture; naturally provided that students give their permission to do so. Hence the learners are able to see their achievements and feel proud of themselves, which in turn may stimulate them to continue to push themselves. The features listed above are not limited to single courses or to individual tasks in the respective courses, but can also be used for indicating the student's individual position during his or her overall study progress.

Due to the budget situation of Austrian universities, there is – unlike in former times – nowadays an orientation capacity and the indication of funding is based on students, who are actively taking part in exams (bmwfw, 2015; Parlament der Republik Österreich, 2018); Since there is now an increasing tendency towards putting an emphasis on those students, all effects that motivate students to take part in exams are accelerated Therefore it could be useful for students to get informed about the position the occupy as compared to other students, who - for instance - started their degree at the same time, and we would like to find out whether this motivates them to try even harder. This ranking could be carried out with regard to ECTS, attended courses or not yet completed courses.

4.3 Gamification

Digital educational games and gamification elements can be used to induce cognitive changes on the part of learners. Anderson and Krathwohl modified Bloom´s taxonomy of learning and teaching into a table consisting of a knowledge dimension (factual, conceptual, procedural, metacognitive knowledge) and a cognitive process dimension, with analysing, evaluating and creating representing a high level of cognitive processes (Anderson, Krathwohl Bloom, 2001). In the revised model, higher levels of knowledge creation require more challenging and motivating teaching environments. The presence of knowledge and skills at a metacognitive level and the creation of critical thinking skills are desired effects of teaching with educational games (Mulenga, Wardaszko, 2014). Games can help to improve cognitive functions as for example visual motor skills and executive functions (Kooiman, 2015).

Game-thinking is beginning to enter a wide range of non-game contexts. “Gamification is not about games people play at work place, but about using game mechanics, for achieving organization effectiveness” (Singh, 2012). The term gamification describes the use of gaming elements and game mechanics in a non-game context. Gamification does not turn the entire business into a game just as innovations do not turn it into a research and a development laboratory.

The feeling of completely deepening or emerging into an activity is called “flow” (Nakamura, Csikszentmihalyi, 2014). In this way, an ideal area is placed between challenge (anxiety and stress) and demand (boredom and routine). Key features of gamified processes, which have a significant positive influence on employee engagement, are:

- Faster feedback loops
- Clear targets and rules
- Addictive background stories
- Challenging solvable tasks

Most games use different gamification elements and game mechanics like badges or leader boards. Blohm and Leimeister list the following different game design elements (Blohm, Leimeister, 2013).

Table 1: Game design elements (Blohm, Leimeister)

Game-design elements		**Motives**
Game mechanics	**Game dynamics**	
Documentation of behavior	Exploration	Intellectual curiosity
Scoring systems, badges, trophies	Collection	Achievement
Rankings	Competition	Social recognition
Ranks, levels, reputation points	Acquisition of status	
Group tasks	Collaboration	Social exchange
Time pressure, tasks, quests	Challenge	Cognitive stimulation
Avatars, virtual worlds, virtual trade	Development/organization	Self-determination

The mobile app described above uses different gamification elements to support and motivate students. The mechanics used include scoring systems with badges and trophies as well as tasks, levels and rankings to promote competition. The group tasks encourage social exchange and collaboration among the students.

5. Evaluation

In this paper we report about a study on this blended learning programme, which is based on a student survey (n=86) and on first experiences with the mobile app and the question of how it helps to improve learning outcomes. The written questionnaire consisting of open and closed questions (with preformulated answers) was predominantly conducted in order to optimize the course “Information Processing”. The questions aimed at gaining information about the required workload, the level of difficulty, the procedure of exams, the content of teaching etc. In total, 26 male and 60 female students (n=86), aged between 20 and 41 with an average subject age of 23.8 took part in the survey. 59 students were studying business & economics, 23 business education and two were enrolled in both studies. For the survey, they had to answer both open and closed-ended questions concerning – amongst other topics – the content of the course and the exams.

Most of the students (around 65%) were working besides studying, however, only 5% of them were employed fulltime. What is interesting is that their occupations ranged from study or teaching assistant to handball trainer, from museum guide, company accountant, controlling/marketing/IT or medical employees to head of accounting and controlling.

Although 55 out of 86 students rated the course's up-to-dateness as very good or good on a five-point Likert scale, the workload and the difficulty of the course were assessed more critically. Only 46% or 26% respectively of the participants rated these two criteria as very adequate or adequate. Also the speed of learning was seen as problematic, since nearly half of the students (44%) rated it as only medium, 19% even stated that the speed of learning was poor or even very poor.

With regard to the content of the course, around half of the students found that the topics "information retrieval" (mean 2,49) and "internet" (mean 2,33) were covered very well and well, while, on the contrary, "data archiving" (mean 3,31), "documenting (in the web)" (mean 2,83) and "Wiki" (highest mean of 3,44) were not appreciated by 30% of the students.

Asked how many hours per week the students had to work for the course, one student named the minimum of 0,5 hours while another one named the maximum of 20 hours. The average working time was 5,11 hours. 47 students (55%) did not use the learning videos, which were made in order to explain for instance spreadsheet formulas. Three-quarters of the students were of the opinion that additional material and the handouts from the tutorials were very useful or useful. One participant expressed the wish for even more handouts from the tutorials. One mentioned that the tutorials should be recorded. 62% stated that the Wiki and the scriptum were very useful or useful. Students told us, that the Wiki should be organized in a different way and that more material for Calc and SQL would be useful.

On a five-point Likert scale (1 to 5 in correspondence to the school grading system) students could furthermore evaluate the homework they had to do. Only 10 students gave it a "1", 30 of them gave it a "2", 25 gave it a "3", 18 students gave it a "4" and 3 of them a "5", i.e. a poor. Most of them stated that the amount of the homework was too much, too time-consuming or too difficult and that they wished for correct answers to the questions. 11% of them either gave it a "1" or a "4", 31% a "good", 22% a "3" and 23% a "5".

Thus, the survey results show that students did not seem to be clear about the grading system. According to the students the grading system for their homework was unfair or "didn't make sense". Generally, students liked the presentations and the practical exercises as well as the interactive elements of the course and the broad range of topics covering even legal aspects and socio-political aspects of IT. In large part the participants stated that the tutorials should be maintained.

6. Findings and future research

Furthermore, this article reports about first experiences with and reveals in which ways a mobile app could be used in order to support and motivate students. The app is usually used by 50% up to 95% of course participants, in the blended learning courses the percentage is even higher.

The app helps students to structure their tasks especially in the self-regulated learning phase. The given homework assignments are structured according to their level of difficulty and have clear deadlines. So, the app is a helpful tool for students to organize their work. The gamification elements inform students about how they are doing in comparison to their fellow students and could thus provide indications of how students could be further motivated.

Competition between the students can be fostered in that the best 10% of the students get a bonus for the final exam.

Not only students benefit from the app, teachers do so as well. They get feedback about their students' activities and are able to see how many of their students are actually using the app. On the app or via email they are provided with an overview of the grading of the homework assignments, such as "task E2 (order book)" of 28 students was graded with an average of 9.57 points, 3 (10%) of the students received an A (13.3-12.88 points) – see table 2. The tutors do the first grading of the homework.

Table 2: Overview grading "task E2 (order book)"

Category	from	to	number	%
A	13.3	12.88	3	10%
B	12.04	10.92	7	25%
C	10.5	9.24	9	30%
D	8.68	6.44	7	25%
E	5.88	2.24	2	10%

Students have to solve 20 tasks which deal with practical skills of the tools like information retrieving, documentation in the wiki, word processing, spreadsheet and SQL. In order to deal with the heterogeneity of the target group, students with a sound knowledge can jump over to tasks on a higher level, in our case, however, only a small number (5%) of students makes use of this opportunity.

Due to the fact, that the mobile app has been in use for only one or two terms, respectively, data is still being collected and the evaluation is still in progress, so there are not enough results yet, but first experiences show that a high percentage of the students use the app.

Our next step will be to evaluate the data that has already been collected and as the case may be to further adapt the app. Thereby the main objective will be to find out whether and in which ways students can be motivated through game-based elements. Moreover, for the future more gamification elements are planned and soon to be implemented. Perhaps in the future even augmented reality elements could be implemented or micro learning games be applied on a broad basis. Future research will focus on the use of the app and the question of whether and how it could impact its users' motivation in order to keep drop-out numbers low and motivation high.

In the future still more levels and quests could be implemented so that students could get the opportunity to get to many different levels – depending on their knowledge or competence – or to practice via extra units in the form of quests. Currently a micro learning program in accounting is being implemented, which students are able to play on mobile devices or in Moodle. A next step is also to integrate more micro learning elements into the app. Micro learning is a didactical concept to make learning easier, as it supports learners to learn on a regular basis and step by step. Micro learning uses frequent changes of activities and employs micro content as a foundation for knowledge building (Bruck et al, 2012). The app will integrate single-choice question to prepare for the theoretical exam.

The acquisition of digital literacy in higher education benefits from an integration of different media like mobile apps and games into the respective learning scenario. Students use these devices in their everyday lives; they represent a learning opportunity for discussion and reflection – and students have fun with them.

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A Pilot Evaluation of a Virtual Reality Educational Game for History Learning

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Abstract: Several studies have suggested that the use of ICT may motivate students in history learning and help them develop historical thinking. Virtual and augmented reality, mixed reality and tangible environments and other similar technologies can provide authentic, interactive, and explorative experiences to the students, moving away from the traditional book-based education into new immersive game-based learning experiences. In this study, we present a virtual reality (VR) game for history learning, and the results of a pilot study with students. In the game, the students are moving around virtual Acropolis where six trials are waiting for them. Each trial is related with a Greek myth and students have to complete a number of different activities for each trial in order to proceed to the next one. The aim of the game is to complement third graders' history learning in schools. The game is free of charge, and the only infrastructure that is necessary is a typical smartphone and a Google Cardboard. A pilot study with twenty-eight (28) primary school students took place in the context of an exhibition focused on gamed-based learning. Data were collected through questionnaires and focus group discussions. Students' responses revealed their positive attitude towards the VR game since they considered it as simple, innovative, valuable, inspiring, challenging, practical, predictable and appropriate for learning about history. That's why they also supported that similar environments would have been of great value in schools. Students supported that they were fully focused on the tasks at hand and they felt present in the virtual environment.

Keywords: historical thinking, history learning, game-based learning, virtual reality

1. Introduction

For many centuries people have been trying to understand what it means to be a part of history and how and why particular people become historically important figures (Korallo, 2010). History satisfies man's instinct of curiosity about past developments in all aspects of life (Adesote and Fatoki, 2013) while history education provides students with knowledge about the past, how it has determined the present and the way we live. Although history education should promote students' critical thinking (Yilmaz, 2008), latest evidence suggest that traditional history teaching leads to sterile memorization of historical knowledge while students acquire a poor understanding of historical events and processes. Therefore, it is necessary to find new strategies that could help students get a better, broader and more comprehensive understanding of history (Howson, 2007). The recent prompts for teaching history focus not only on the knowledge that the students will acquire but also on the skills that they will develop and which will allow them to understand, analyze and interpret the facts. Students are encouraged not just to remember facts, but to familiarize themselves with the way historians work: they are asked to construct their own, personal, meaning about what the sources "are telling" them.

To this end, several studies suggest to employ technology for improving history teaching (Masterman and Rogers, 2002). Information and communication technologies (ICT) can be used to increase students' motivation, interest and enjoyable feelings during the learning process (Boadu et al., 2014) and transform history learning to an explorative and critical thinking approach (Blanco-Fernández et al., 2014). Many ubiquitous technologies such as augmented and virtual reality as well as tangible or mixed reality installations are continuously being examined in the history learning context (Triantafyllidou et al. 2017). These approaches offer interactive and explorative experiences to the students, moving away from the traditional book-based education into a new immersive game-based experience. Such approaches engage students much more than traditional learning and add to the learning experience higher entertainment levels. Korallo et al. (2012) suggest that virtual environments may be especially useful for history learning since they can provide interactivity and motivation. Korallo (2010) underlines that interactive virtual environments can allow students to actively control the educational environment, can give them the feeling that are present at a particular period of time in history, can provide easy access to some realistic historical materials and consequently can support more the understanding of diversity in history. Historical video games, virtual museums, augmented reality guidance into archeological sites are some well-known applications exploiting these technologies.

In this study, we present a virtual reality (VR) game for history learning, and the results of a pilot study with students. In this game, students take the role of an ancient Greek hero and visit different places, solve puzzles and answer interactive quizzes.

2. Virtual reality in education

Virtual reality (VR) is an interactive computer-generated experience taking place within a simulated environment. It uses computing power to create and simulate virtual environments from which the user has the illusion of being surrounded and to which he can move freely, interacting with the objects they include, as he would do in the real world.

Researchers and education stakeholders recognized virtual reality as a powerful tool for the learning process. VR can transform learners from passive information receivers to an active knowledge explorers. The introduction of virtual reality technology in primary, secondary and higher education began in the early 1990's with projects such as Science Space, Safety World, Global Change, Virtual Gorilla Exhibit, Atom World, and Cell Biology (Youngblut, 1998). However, limitations such as the installation cost (Merchant et al., 2014; Riva, 2003), headset weight and fit, simulator sickness (Costello, 1993) and poor instructional design of the virtual learning environments (Chen, Toh & Ismail, 2005), restricted the widespread dissemination of VR in education.

Despite the initial limitations, the rapid increase of the processing power, the reduction of VR technology infrastructure cost, the design of immersive 3D virtual environments and the high-speed internet connection increased again the prospects of VR technology in educational settings (Merchant et al., 2014). Free and easy to use authoring systems such as Blender and Unity 3d, for the development of 3D objects and 3D interactive environments, allow researchers and instructional designers to exploit VR technology in various domains and educational settings.

The particular features and affordances offered by virtual reality seem to contribute to positive learning outcomes (Mikropoulos & Natsis, 2011). Virtual reality allows to rebuild past worlds, monuments and ancient cities and enable the comparison of different historical periods and their physical transformation. VR technology has also been used to promote critical historical thinking and cultural heritage. Architecture and archaeology also explore this technology to enhance the understanding of cultural heritage (Maietti et al., 2017). Virtual museums take advantage of virtual reality in order to display, preserve, reconstruct and store collections in a digital form (Liarokapis et al., 2017). The ability of the users to take, manipulate, redistribute and redescribe digital objects of the past is considered as the primary educational value of virtual museums (Bayne et al., 2009).

There are a lot VR applications for history education. For example, the 3DMURALE project (Cosmas et al., 2001) developed 3D multimedia tools to record, reconstruct, encode and visualize archaeological sites such as the ancient city of Sagalassos in Turkey. The Foundation of the Hellenic World (FHW) has produced a number of VR applications for representing the Olympic Games in ancient Greece (Gaitatzes et al., 2004; Blanco-Fernández et al., 2014). A characteristic example is 'Walk through Ancient Olympia', where the user apart from visiting the historical site, learns about the ancient games themselves by interacting with non-player characters (NPC), such as athletes in the ancient game of pentathlon (Liarokapis et al. 2017). Koutsabasis and Vosinakis (2018) developed a VR kinesthetic application of sculpturing Cycladic figurines, which places the user at the role of an ancient craftsman who creates a figurine with bare hand movements. Eggarxou and Psycharis' (2007) used 3D environments to allow students to explore the Erechtheum in ancient Athens. There are also some VR games for Google Cardboard such as Acropolis VR (Mozaik Education, 2018) and Acropolis experience (Unimersiv, 2018).

3. Trials of the Acropolis

Most of the previously mentioned VR applications focus more on the realistic approximation of the archeological sites and they are less focused on the instructional interactions that promote historical thinking skills. In this study, we present a virtual reality game based on the world of Greek mythology aimed to function as a supportive tool for history lessons of 3rd grade students in Greek schools. The game is called "Trials of the

Acropolis", it has been developed with using free programs and technologies (Chintiades et al., 2017) and is available for free from Google app store (in Greek and English editions) (Chintiadis, 2018).

The game aims to familiarize students with five myths. The rationale of the game was to let the users participate actively in the learning process and learn through the acquisition of experience rather than through passive exploration of the virtual space. For this reason, emphasis was given on the game design.

The design of "Trials of the Acropolis" was based on the "Design, Play and Experience" (DPE) framework of Winn (2009). This framework proposes a methodology for designing serious games through three aspects: the *Design*, *Play* and *Experience*. Each of them has four common layers, namely, the Learning, Storytelling, Gameplay and User experience layer (Winn, 2009).

At the *Learning* layer the designer has to prepare the educational content and pedagogy elements in order to aid the game's learning purpose. The first step of this process is to consider the target audience and the learning outcomes of the end-user experience. Just as the teachers prepare their instructional interventions or guide the students during a course, the designer needs to define the learning outcomes using proven techniques.

The *Storytelling* layer provides a story with a different perspective for the designer and the player. The designer, with the help of the narrative, the setting and the character design tools, lays the core foundation of the main scenario having in mind to provide purpose and engagement. The player, however, experiences a different story because during gameplay the elements of the designer's story are combined with the interactions that the player performs, thus forming a different story experience.

The *Gameplay* layer is important because it represents the players' interactivity and what he is allowed to do within the game world. The mechanics, dynamics and affects are the main integral parts of this layer. Generally, the mechanics define the operations within the game. The dynamics with the contribution of the player's choices provide the resulting behavior. The affects are the overall experiences and emotions. The user *Experience* layer is generally what the player sees, experiences and hears during the game. For this reason, the designer must develop a truly engaging experience and story, with an easy to use interface so as to make the player focuses more on the gameplay and learning aspects rather than the interface complexities.

Based on the DPE framework we exploited a specific sequence of interactions for every user trial in the Acropolis: user engagement, narrative-based learning, hermeneutics, assessment as shown in Table 1.

Table 1: Aspects and steps of the game trials

Design	Play	Experience
Be acquainted with the archeological site	Student starts walking and staring at the virtual world	Engagement
Familiarize and understand myths through digital storytelling	In a specific and related point of the virtual world, a character narrates the myth to the students while presenting related images	Narrative-based Learning
Offer puzzles of related images that will help students better understand the myth	The student solves the virtual puzzle and discovers the meaning of the image	Game-based learning – Hermeneutics
Offer interactive quiz for consolidating the myth qualities	Student answers the interactive quiz in order to fulfill the trial and get feedback	Game-based learning – Self Assessment

Initially, the user is placed in a specific area of the Acropolis so as to explore the place, feel part of it and engage with the virtual world. More specifically, the player is placed at the entrance of Propylaea, visiting the Acropolis for the first time and without knowing anything about the challenges which he will confront. Afterward, he meets a character, an ancient warrior, that has to fulfill an ancient myth, which according to the scenario, no one in the history of Ancient Greece has ever managed to. The character narrates the myth with the use of an image slider synchronized with the narration (fig.1) and informs the user about the trial objectives. At the next step, the student has to solve a virtual puzzle (fig.2) that reveals an image related to the specific myth. Students are also asked to provide their interpretation of the image. Finally, at the end of every trial, the user has to answer an interactive quiz so as to assess and improve his understanding of the myth. The quiz is consisted of five multiple choice questions. Behind the user, there are five pictures that give information about the quiz questions. Therefore, the user can turn his head and study these images so as to consolidate his knowledge and answer the questions (Fig.3). After each response, appropriate constructive feedback is given. If the user answers correctly at least four out of five questions, he can continue on the next trial. Otherwise, he has to repeat this step.

The player come across six trials, "The trials of the Acropolis" as they called. The first five correspond to specific myths that are subjects of the 3rd grade history book while the last trial tries to revise all the previous myths. The myths that are addressed in the game are short versions of *Gods and Titans*, *Hercules*, *Theseus*, *Jason and the Argonauts*, *Odyssey*.

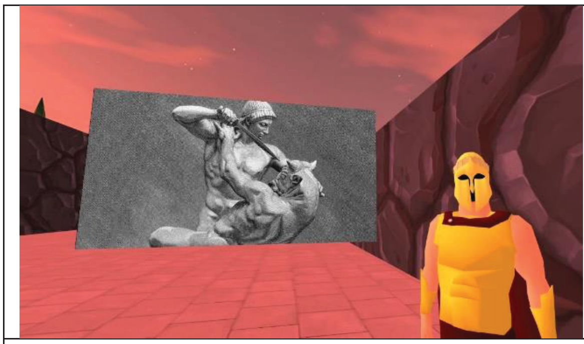

Figure 1: The avatar narrating a story

Figure 2: Solving the puzzle

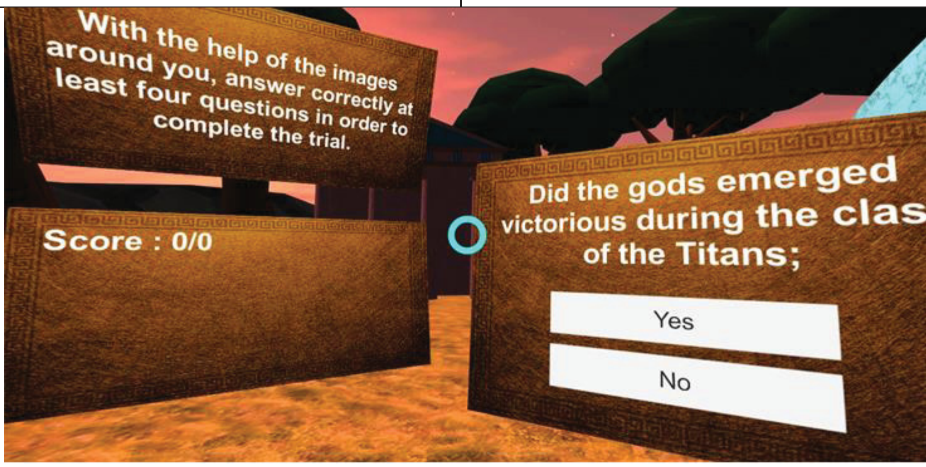

Figure 3: Answering the quiz

4. Methodology

4.1 Purpose and research questions

The purpose of this study is to examine and describe the students' attitudes and experience towards the VR game describe previously.

The research questions were the following:

- Do the students assess the VR mobile game as interesting and engaging?
- Do the students consider the VR world as authentic and expressive?
- Do the students consider the VR mobile game as effective and usefull?

4.2 Participants and procedure

Trials of the Acropolis was explored by 28 primary school students, in the context of an exhibition focused on gamed-based learning for Primary Schools at the city of Kavala in Greece. Regular Android smartphones with earphones, google cardboards and Bluetooth controllers were used to play the game.

Initially, students were introduced to the scope of the game and the technology used. Afterwards, they wear the cardboards and the earphones and started playing the game (Fig. 4). During the game, they had to complete at least three trials. The game endured about 15 minutes. Upon the completion of the game, students participated in a attitude-questionnaire about their experience and participated in focus group discussions.

Figure 4: Students playing the game

4.3 Research Instruments

Data collection was based on an attitude-questionnaire and focus group discussions. The questionnaire consisted of 23 7-point Likert questions and evaluated the usability and attractiveness of the VR game and the student's experience. Most of the questionnaires' items were derived from AttrakDiff (Hassenzahl & Monk, 2010), Flow State Scale (Jackson & Marsh, 1996), and Reality Judgment and Presence Questionnaire (Baños et al. 2000). The following variables assessed the engagement, the learning effectiveness, and the authenticity of virtual experience :

- *Pragmatic Quality* (4 items): Measures the extent to which the system enables a user to achieve his goals (e.g. *the environment was simple – complicated*);
- *Hedonic Quality-Stimulation* (3 items): Measures the extent to which the system is perceived as innovative and interesting (e.g. *the environment was conservative - innovative*);
- *Hedonic Quality-Identity* (3 items): Measures the extent to which the system lets the user to identify with it (e.g. *the environment was cheap - valuable*);
- *Autotelic experience* (3 items): Measures the extent to which the system offers user fulfillment (e.g. *the experience left me feeling great*);
- *Perceived learning* (3 items): Measures students' perceptions about the educational value of the system (e.g. *I would prefer to learn about history with similar environments*);
- *User Focus* (3 items): Measures the students' perceived focus on the learning activities during system usage (e.g. *I was completed focused on task*);
- *Reality judgment* (4 items): Measures the willingness to interpret virtual experiences as if they were veridical (e.g. *To what extent did your interactions with the virtual world seem natural to you, like those in the real world*)

All variables can be considered as consistent since they had satisfactory Cronbach's α as seen in Table 2.

The focus group discussions were conducted upon the completion of the questionnaires in groups of two students and aimed at capturing their qualitative views about the learning environment. The questions were focused on what they enjoyed and disliked and their perceptions in regards to the learning value and the learning efficiency of the environment.

5. Results

5.1 Attitude-questionnaire

As seen in Table 2, students' general assessment of their learning experience with the presented game was positive. Students' responses in the mini AttrakDiff questionnaire revealed that they considered the game as simple, practical, predictable and appropriate for learning about history. Most students also supported that the environment was stimulating, innovative, valuable and appealing without moments of boredom and discomfort (hedonic quality). Students' answers also showed that they identified themselves with it (Hedonic Quality-Identity) and they thought that it offered inspiring, novel and challenging functions and interactions (Hedonic Quality-Stimulation). Students' answers in the last variable was higher in comparison to the other variables.

Table 2. Students' attitudes towards the presented educational VR game

	Min	Max	Mean	SD	Cronbach's a
Pragmatic Quality	2.00	7.00	5.03	1.61	.71
Hedonic Identity	1.00	7.00	5.06	1.85	.91
Hedonic Stimulation	1.00	7.00	5.56	1.76	.91
Focus	2.00	7.00	5.71	1.30	.87
Autotelic Experience	1.67	7.00	5.82	1.47	.89
Perceived learning	2.00	7.00	5.32	1.68	.86
Reality Judgment	3.25	7.00	5.50	1.14	.77

The virtual reality app managed to retain their attention for the entire game duration. Students supported they were focused on the tasks to be done (M= 5.82, SD=1.3). They were also delighted with their experience (autotelic experience) and, for example, they supported that the experience left them feeling great (M= 5.64, SD=1.87). Most students indicated that they would prefer to learn about history with similar environments (M= 5.30, SD= 1,83) and with that way they would also learn faster (M= 5.48, SD=1.89).

Students also pinpointed that they felt like being in the places presented. A sense of presence in a virtual environment stems from feeling as if you existed within but as a distinct entity from a virtual world that also exists (Baños et al. 2000). For example, students felt as part of the virtual world (M= 5.96, SD=1.26) and considered themselves as active participants of the narrated story (M= 5.56, SD=1.22). This is quite significant since games work only if people feel that they are real (Baños et al. 2000).

When we examined Spearman's correlation between reality judgement variable and the rest of the variables (none of which followed the normal contribution), the reality judgement variable seemed to be correlated significantly with every other variable except Hedonic Identity. For example, it was related with focus (r= .70, p<.001) and autotelic experience (r= .69, p<.001) and also perceived learning (r= .45, p<.05). That means that making learning environment more real was crucial for its success.

5.2 Focus group discussions

Students' comments validated their answers in the questionnaires. At the beginning of the game, the students looked excited since most of them had never any experience with Google Cardboard and a VR game. They stated repeatedly that they were impressed with the 3D virtual environment of the Acropolis. Their comments confirmed the illusion of being in the place, the illusion of self-embodiment and the illusion of physical interaction, hence, the students fell like being a part of the virtual world.

> *"It was a great experience to move accross the ancient Acropolis, watching Parthenon and meet up ancient warriors. "*
>
> *"I thought that it could be real. It was impressive."*
>
> *"I had played other 3D games in my console. However the use of cardboard make me fill as it was real… I felt that I was part of this ancient world."*
>
> *"What I enjoyed more was moving around Acropolis and staring at the buildings and statues…"*

Students were also positive in regards to the trials design, the different steps required to be completed. Several of them mentioned that completing a trial gave them satisfaction and the feel of success. Both the quiz and the puzzle steps were considered as interesting and competitive.

> *"I feel great when completing a trial…"*
>
> *"The quiz questions where intriguing and I am happy because I answered all of them and completed the trials."*

The instructional design managed to hide formal learning processes under the umbrella of the VR game. Students commented that the game "Trials of the Acropolis" helped them learn or remember the myths that were part of the trials. Students supported that they learnt these myths in an enjoyable way. They also underlined that similar games for other learning domains would be more than welcome.

> *"I wasn't thinking that this was about learning. For me it was like any other role playing game."*
>
> *"I wish we could learn things this way. I could play, I mean study, for hours."*
>
> *"I learnt details about the myths that I didn't know till now. It would be great if other sections of the book could also be covered by this or a new VR game."*

When students were informed that this game was available for free at the Google play store and the low cardboard cost, they claimed that they will ask their parents to buy a cardboard and use their phones in order to play this game again and explore other VR games. Students comments seemed to confirm that VR educational games could be used for history learning.

6. Discussion and conclusion

Virtual reality enables students to explore worlds they never thought possible. There are a lot of virtual reality apps aiming at advancing museum's learning experience but there are less focusing on learning about history in traditional classrooms. In this paper, we proposed a virtual reality application focusing on historical skills and historical understanding, and we also presented the results a pilot study evaluating students' experience with it. Students' responses revealed their positive attitude towards the VR game since they considered it as simple, innovative, valuable, inspiring, challenging, practical, predictable and appropriate for learning about history. That's why they also supported that similar environments would have been of great value in schools. Students were focused when using the game and they felt present in the virtual environment. The current findings extend prior research in virtual environments and serious games and indicate that students can get acquainted with history in a playful manner using VR technology and game based learning. However, we have to underline that the learning experience had a short duration and that means that the interactive learning content was also limited. Therefore, such applications can function as complimentary activities in the context of a more integrated instructional intervention.

The proposed environment is based on the design framework of DPE (Winn, 2009), and exploits discovery learning, storytelling, game-based learning and self-assessment. Our study provides evidence that their combination may provide an efficient and effective learning experience for history learning. The consecutive execution of tasks such as navigating to the virtual world, interacting with digital storytelling, solving virtual puzzles and answering questions, worked as expected. However, there are a lot to be done in order to create a coherent framework of designing virtual reality apps for history learning.

The storification opportunities (Akkerman, et al 2009) of the virtual reality applications are many with different qualities. Storification refers to structuring, and simultaneously making sense of experiences. Storification is a means to combine, episodes, actors, actions, and accounts of actions in time and space (Akkerman, et al 2009). In this context, the designers have to select whether they want the students to become a) receivers of historical narratives in virtual worlds without having influence on the content or the structure of the plot b) constructors of the historical events by defining and organizing the narrative elements, by building the virtual world or c) participants in the historical narrative by acting out specific roles and influence the historical progress. The last two types of interactions are less usual and are the ones matching the needs of developing historical understanding. We aim at advancing the proposed virtual reality app in order to include all three types of storification modes.

Our study has several limitations. The most important one is that we present the perceived learning value of the students. Although their views are a good indicator, they cannot offer definite answers for the learning effectiveness of the virtual reality app. Additionally, we do not analyze thoroughly the different phases of the underlying learning mechanism, their separate contribution to the learning result and students' experience. These issues are the target of future research with the Trials of the Acropolis app.

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Technologies for Creating and Acquiring Knowledge in the Open Information Environment

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Abstract: This article contains solutions for creation of quality competitive e-learning courses placed in the open information environment. It is noted that a characteristic feature of the knowledge society is the active use of new knowledge placed in the open educational resources. At the moment, the trend towards increase in the number of those who learn using MOOCs is growing steadily. This is a real step towards making world-class education accessible to a huge number of people thanks to the mass availability of free e-learning content. Increasing interest in such courses is shown not only by academic, but also by corporate organizations with a view to training their staff. However, those mass courses, which we can see today, use a fairly simple pedagogical model of online learning. Basically these are lectures, mostly webinars, plus tests and literary sources. In some cases, group work is required, although in general such services are not always supported by the MOOCs providers. The most common models for creation of open electronic educational resources to date (cMOOC and xMOOC) for the most part express striving of their creators to implement specifically the principles of massiveness, openness and accessibility of materials and are characterized by different approaches to learning. However, development of activities in this direction requires placing greater focus on the quality of learning materials provided, which can be achieved only by increasing involvement of experts in the process of creation of open educational resources, providing user-friendly services in the process of completing a course, integrating repositories and a wider discussion of the learning materials. The technology for creation and use of open electronic educational resources is proposed, based on combining capabilities of a unified repository of objects of the professional community web portal and peer-to-peer communication in educational networks. Such combination of two paradigms is expected to help accelerate the evolution in creation and application of massive open educational resources by providing the necessary high quality educational material. The principal difference of the suggested technology from existing ones is the mechanism of automatic updating of the learning content of the course. Examples of implementation of the proposed model for creation and use of open electronic educational resources are given.

Keywords: open educational resources, massive open online courses, quality of e-learning content, adaptive learning

1. Introduction

Electronic forms of education are increasingly being introduced by various universities of the world into the practice of education. Among the priority tasks that ensure achievement of strategic objectives of the national policy of the Russian Federation in the field of education, the following tasks are identified:

- increasing the accessibility of quality education that satisfies the requirements of the innovative economic development model and meets the public needs;
- improving the quality, attractiveness and competitiveness of the education system in the world and regional educational space;
- ensuring the effective participation of the national education system in the global education development process;
- attracting the qualified personnel to the country in accordance with the economy and labor market needs.

Open educational resources (OER) play an important role in carrying out these tasks (Dik et al, 2014; Urintsov et al, 2014). Their appearance in Russia was until quite recently regarded as a new phenomenon, and educational institutions were motivated to use the OER in the educational process and to create their own learning courses that meet the OER development standards. Thus, a movement was initiated to introduce the open educational resources into the practice of the educational process as an innovative form of its development. The result of this process was not only the use of foreign open educational resources in electronic learning courses, but also creation of domestic OER. However, today it is no longer enough to consider the OER only as a certain desirable tool used in the educational process and demonstrating its participants' ability to use innovative forms of its development. Nowadays it is important to realize that our experience in development and use of the OER is still inferior to the achievements of the world's leading universities, and the result of this lag carries not only organizational, but also economic consequences important for our country.

In recent years, online education has undergone a qualitative shift, and from the end of 2011 the trend known as massive open online courses (MOOCs) is rapidly developing. With the launch of commercial start-ups, such as Coursera, Udacity, and non-commercial platforms edX from MIT and Harvard University, the massive open online courses have evolved from a modest experiment into one of the main educational areas. MOOCs have an advantage in attracting and enrolling a huge number of learners of all ages, providing them with quality and inexpensive training via the Internet. MOOCs can be a threat to those universities that ignore their potential and, at the same time, an excellent opportunity for development of new business models of first-class and innovative universities (https://www.gov.uk/government/publications/massive-open-online-courses-and-online-distance-learning-review).

An important event in the development of online education in Russia was the formation in 2015 of a modern educational platform "Open Education" (https://openedu.ru) that offers online courses in basic disciplines being studied at Russian universities. The platform was created by the Association "National Platform for Open Education" established by the eight leading Russian universities. All courses placed on the Platform are available for free and without formal requirements to the basic level of education. For those who wish to get a credit for the completed online course when mastering the curriculum in the university there is a unique opportunity for Russia to obtain certificates. Obtaining of a certificate is possible under the condition of passing control measures of the online course with identification of a learner and control of conditions for passing thereof. The project is aimed at broad cooperation between universities. Unlike other online learning platforms universities are given the opportunity to receive full information about their students' progress, if necessary, provide them with methodological support and participate in control activities performing the person identification function. At the moment, there are many platforms that provide both open online courses and various training materials for teachers. As an example, the "Teacher Academy" (https://www.schooleducationgateway.eu/en/pub/teacher_academy.htm) - a single point of access to professional development activities, as part of the School Education Gateway portal

(https://www.schooleducationgateway.eu/en/pub/index.htm). Activities include:

- Online courses specifically made for School Education Gateway
- The hugely popular on-site courses, which have already helped European teachers to meet their training needs
- Versatile teaching materials created by eTwinning teachers, other EU-funded projects and EU institutions. In

Russia there are also many websites with materials for use in the classroom, for example: https://infourok.ru/, http://window.edu.ru/ and others. But they do not allow the necessary material to be collected in one single interactive lesson. Teachers are ready to generate digital content themselves with the help of any tool, but the existing solutions are not suitable for the requirements that are put forward by teachers. Existing constructors are too expensive for an ordinary teacher, others require special programming and/or design skills. Work to create user-friendly online Builder classes, for example, "Rybakov Fund" (https://rybakovfond.ru/). According to the founders, the main principle of the "Rybakov Fund" is to find the most successful foreign models of socially — oriented projects and implement them in Russia. One of such adapted projects was the program of support of prospective students "Fund of Russian Economy", which Oscar Hartmann has been engaged since 2012.

Among the projects of the Foundation in support of education, we can note the "National open school" launched in 2016-an Internet platform with interactive video tutorials for the implementation of the so-called blended learning-which combines traditional lessons and learning outside the classroom using computers and mobile devices.

Directions for MOOCs Development

Currently, there are three main approaches to construction of MOOCs: cMOOC, task-based MOOC, xMOOC.

cMOOC uses a connectivity approach, the learning goal is determined by the learner himself, the instructor performs only the role of a colleague providing guidance on the choice of information, focused mainly on the study of humanitarian disciplines, the course is characterized by openness of learning, dialogue, etc. Success of the student in the cMOOC is ensured by his ability to orient in the web, well-formed personal learning environment and personal learning network, personal goals. Personality development and personal training is central to the cMOOC. Examples of such courses include “Personal Learning Environments Networks and Knowledge”: http://connect.downes.ca/index.html, “MobiMOOC”: https://mobimooc.wikispaces.com, “Change MOOC”: http://change.mooc.ca.

Task-based MOOCs (courses based on tasks) In such courses the learner is expected to perform certain tasks. Moreover he can perform them in a variety of ways, and they can have different forms of external expression (article, video, audio). Joint solving of certain tasks, creation of projects, etc. is possible. One example of such courses is the project ds106 “Digital storytelling” – http://ds106.us.

xMOOC uses a cognitive behavioral approach, the learning goal is determined by the instructor, these are based on the institutional model of the learning process and focused mainly on the study of technical disciplines, where it is possible to automate checking of completed assignments, there are practically no observers in the course, instructors serve primarily as supervisors, courses are open to all. Such courses are offered by the following projects: “Coursera” (https://www.coursera.org), “Udacity” (http://www.udacity.com), “EDx” (https://www.edx.org).

In addition, the pedagogy direction is developing in the context of P2P University (P2PU), which consists in the joint production of certain collective context – a joint product generated within a discussion on the basis of handling of learning tasks shared by all participants. In terms of ideology, the P2P course format is the closest to the task-oriented MOOCs, however the community in them does not always play the decisive role that is characteristic for P2P courses. In P2PU courses mutual learning takes place by declaring and documenting the tasks that the participants solve by themselves and help others to solve. In the task-oriented MOOCs you can solve tasks going “your own way” and being at the same time at the “periphery” of the community.

In comparison with cMOOCs, it should be noted that in the P2P courses the collective context is one for everyone and they all share it together. In the cMOOCc, on the contrary, there is no social object common to all. Instead, there are many smaller social objects that mediate private interactions in a disparate network of participants, some of which may have almost no relevance to the course. However, those mass courses, which we can see today, use a fairly simple pedagogical model of online learning. Basically these are lectures, mostly webinars, plus tests and books. Anyway authors try to make their lectures catchy and divide them into small portions backed up with online tests. In some cases, group work is required, although in general such non-scalable services are not supported by the MOOCs providers.

New initiatives by the leading universities indicate their readiness to not only make educational materials available to the public, but also conduct full-fledged online training of Internet listeners for free, provide them with methodological support and confirm their training with certificates.

However, the first wave of offering mass and open online courses will be inevitably followed by the stage of their competition in terms of quality of the provided learning material, services, possibility of obtaining a certificate. Such competition of universities for learners will inevitably contribute not only to introduction of new tools and methods of open e-learning, but also to pursuance of integration of efforts of various universities in creating quality educational content that meets the needs of both academic education and corporate training. Just as in the case of e-learning, when a number of universities joined together to create a common electronic materials repository, so is the situation with open educational resources, which requires combining the efforts of various developers and experts in order to create high-quality electronic educational content.

Despite the fact that the MOOC movement has arisen quite recently, it is already obvious that those universities that have not yet joined this work risk falling behind again.

In Harvard, in one year alone more people subscribed to MOOCs than was admitted to the university in its entire history dating back about 400 years. This is a huge success in open education. Such a great number of learners is difficult to accompany, for that reason introduction of SPOCs (small private online courses) is proposed as a solution to the problem (Coughlan, 2013). These courses are still free and delivered via the Internet, however access to them is limited to a much smaller number of learners – tens and hundreds, rather than tens of thousands. This means improvement of the applicant selection process and their readiness for more specialized knowledge. Harvard and the University of California, Berkeley, edX in alliance with the Massachusetts Institute of Technology promote this model. This does not mean that Harvard gives up on MOOCs. Rather, the situation resembles a matryoshka doll, when the course can be delivered to both a large open MOOC audience and to a much smaller number of SPOC students, and then to an even smaller number of students studying at the university through the Campus (Fig.1).

Analyzing the current situation in the area of online learning, we can conclude that:

- 1. In spite of the fact that the MOOC movement has arisen quite recently, it is already obvious that it is growing in strength. Huge numbers of subscribers to online learning demonstrate the extent of the unmet demand for higher education, but at the same time there is still no answer to the question of how to fully meet the demand for this education. Therefore, numerous studies aimed at finding effective models of mass online learning have been initiated and are being carried out.
- 2. Various "use cases" of online learning models (MOOCs, SPOCs, Specialization) offered today are nothing more than an attempt to fit developing learning technologies into obsolete pedagogical practices (so that the tutor could conduct and evaluate learners, carry out certification).

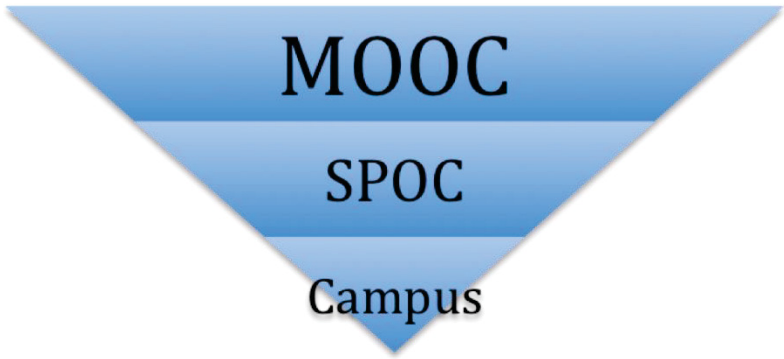

Figure 1: Course accessibility hierarchy (matryoshka doll)

Now that certain steps have been taken and experience has been accumulated in creating and applying e-courses, the tasks of developing high-quality content using global information resources and modern information technologies are becoming topical.

2. Analysis and results

2.1 Object rule for constructing educational material

In our opinion, along with the already existing achievements in the development and delivery of learning courses to learners, it is also necessary to automate the processes of learning, evaluation of results, certification. This is the only way to achieve effect from distance learning. This is viewed as a new business model for learning.

To achieve this it is necessary, first of all, to develop adaptability of courses, objective presentation of material, modularity, for which purpose to exercise greater responsibility in describing the required input competences for taking the course, offer various kinds of adaptability in the process of studying the material, and for evaluation apply adaptive testing using different degrees of detail of educational material and demonstration examples (Komleva, 2011).

Adaptability is the ability to interactively change the course in the process of its completion. Adaptability is achieved only due to the possibility of the user's backward interaction with the learning course and is presented in the form of suggestive questions or tests, by means of which the system can get an overview of the learner's knowledge. This allows the learning course system to change its "trajectory" and depending on certain results adapt to a specific user providing the opportunity to educate more effectively. The modern electronic course should adjust (adapt) to the learner. Creation of a quality electronic course that meets international educational standards is associated with implementation of a competence approach in education, which consists in shifting the emphasis from the content of learning to its result. This can be achieved with the aid of intelligent technologies for supporting the learning process that ensure achievement of the required competencies through introduction of adaptability in the learning process. The main objective is to ensure the optimal trajectory of the learner's progress toward the goal on the basis of controlled mastering of educational material in the learning system. Use of the object concept makes it possible to implement the adaptability of educational material with consideration of knowledge and preferences of each student and reduce the burden on the instructor working with a large number of students remotely, since such courses themselves contain learning elements. Adaptive algorithm may require re-study by the learner of certain objects (probably contained in other courses). The object, in this case, can be presented in a more expanded form, including references to additional sources, demonstration examples, detailed schemes. Interactive adaptive courses are characterized by the following advantages:

- Implementation of an individual learning trajectory;
- Ability to navigate in the learning plan by forming a chain of objects in such a way that the level of competence of the learner upon completion of study of the previous object serves as the input information to the next one.

Online education has become an entire industry in Russia and it is gratifying to note that today entrepreneurs and investors as the forecast for the future see in particular the adaptive content that adjusts to us, education that gives immediate financial effect. For instance, entrepreneurs, note: "Nowadays the vast majority of start-ups are exploiting the old model of learning, only slightly modernizing it. For example, the course at Coursera is still a professor's talking head, theses of his course in the form of a presentation and small tests on how the learner understands the material. Meaning that, in fact, nothing has changed, it's just that now professors broadcast their lectures in recorded form for a large audience. While the future lies in new approaches, in, perhaps, not yet discovered methods and techniques, in revolutionary interface solutions, in adaptive learning. Start-ups will soon be done with creating their own content, broadcasting someone else's and get on with innovations."

Creation of high-quality electronic courses requires ensuring continuous updating of educational content using open educational resources and other sources of the Internet. There is a need to automate the process of obtaining new information, its analysis and inclusion in the composition of existing learning courses. This will significantly reduce the cost of processing new data and will make it possible to receive quality content almost immediately after it is published on the Internet.

The basis of the new concept is the object principle of constructing learning materials. One and the same object can be used to achieve different learning goals, in different contexts and by different users: instructors in learning materials, students for self-study, designers for designing interactive courses or administrators to coordinate the learning plan.

The learning object possesses a property of repeated use and is an independent part of the learning material. Reusable learning objects are characterized by the following key attributes: accessibility, modularity, possibility of interaction and reuse. As a result, there is a transition from large non-flexible courses to reusable individual learning objects that are available for search and inclusion. In this case, it will be possible to interpret objects in the same way, compose (aggregate) larger objects of smaller components, include objects in logical sequences of the educational material, which, in turn, are constructed as objects. At the maximum level of abstraction, a course is a combination of objects among themselves in such a way that the level of competence of the learner upon completion of study of the previous object serves as the input information to the next one.

The technology for electronic course development should be based on the mechanism for implementing the visibility of objects used in object oriented programming. Objects belonging to classes can be combined into courses by implementing the mechanism of multiple inheritance, in which the derived class inherits more than one base class. Inheritance, just as in the object oriented programming, means that properties and methods of the base class are equally applicable to its derived objects. Repository of portal objects contains basic objects, derived objects, courses. Object variables are learning units (text, pictures, video clips), and methods are functions that process them (publication, discussion, assessment of the competence level, re-education). The professional community portal can be viewed as a class model, all members of which are initially private. This is the space for the work of discipline program directors and instructors. All new materials received via RSS channels from open educational resources and from other sources are published in the open (public) part of the portal, and in inheritance access control is exercised, however the method in the derived class includes the base method, if the material has received a high rating or is selected by the discipline program director, i.e. an event-driven mechanism operates. This technology allows you to control access to the class members (public, private, protected).

Open educational resources of various formats, such as texts, pictures, animation, audio and video fragments, Web pages, Web sites, PDF documents, PowerPoint presentations, are presented in the form of learning objects or components thereof.

One and the same object can be used to achieve different learning goals of the learning course, in different contexts and by different users: instructors in lecture materials, students for self-study, designers for designing interactive courses or administrators to coordinate the learning plan. As the size (volume, content, area of knowledge) of an object increases, the possibility of its repeated use decreases, as the internal contextual dependence and the number of links within the object increase.

With the use of the object approach to structuring of knowledge it becomes possible to optimize the learning process: building flexible, personalized learning technologies, fundamentally changing the content of pedagogical work of instructors (Skorikova et al, 2016; Dneprovskaya et al, 2016). Precisely these changes in educational technologies can parry the challenges of modernity – increase in the scope of knowledge and rate of updating thereof.

In the implementation of the competence approach and formation of key competencies a prominent place is held by assessment and monitoring of competencies. However, classical electronic testing systems are designed to assess “knowledge”, but not “competencies”, and therefore cannot solve new educational tasks. Such system should reveal not only knowledge and preparedness of the learner, but also his ability to orient and find solutions in new problem situations that require creative activity. In the assessment the subject should be put in situations that require practical application of knowledge, skills, have the opportunity to offer different ways to solve the problem, as well as demonstrate understanding of the complex interdependencies and the essence of the task set.

The unified testing procedure is the key to objective assessment, however it has one serious drawback – it does not take into account individual differences in the level of competence. This, in turn, can lead to serious decrease in the accuracy of testing, if the average complexity of the test assignments does not correspond to the level of preparedness of the test subjects. Use of adaptive testing algorithms can eliminate this disadvantage and significantly improve reliability and accuracy of assessment. This approach makes it possible to model step by step for each subject his own adaptive test having maximum efficiency in comparison with all other tests for assessing the competence of this subject (Komleva and Makarov, 2008).

2.2 Model of presentation of open electronic educational resources

Modern educational environments are characterized by a high level of adaptability and interaction with the learner. This is implemented by reviewing the concept of building learning materials and processes. Rapidly evolving information technologies require innovative approaches to learning management.

It is evident that provision learners with a learning tool that would be interesting to them, not just digitized material, is essentiall (Tikhomirov et al, 2015). It is necessary to make full use of modern technologies for creating and delivering knowledge to learners, provide various methods, completeness and even the pace of giving learning material. Thus, it can be concluded that practical steps on developing open educational resources are relevant in the face of global strategic and political problems of education informatization and transition to a knowledge-based economy.

Need for continuous content updating, as well as the high priority of the problem of creating competitive training courses, places emphasis upon the urgency and necessity of introducing virtual information environment to provide the opportunity to obtain relevant and high-quality information, generate new knowledge and use results of intellectual activity in the educational process and scientific research. This technology provides for the use of tools of collective work on creating electronic educational resources to ensure quality discussion and evaluation of materials being generated in the virtual environment, use of experience of the outside experts in this area.

Open access tools and information and communication technologies allow creating electronic educational resources, both in the form of ready-to-use electronic learning courses and offline coursebooks that meet the needs of modern students.

However, development of activities in this direction requires placing greater focus on the quality of learning materials provided, which can be achieved only by increasing involvement of experts in the process of creation of open educational resources, providing user-friendly services in the process of completing a course, integrating repositories and a wider discussion of the learning materials.

At the present moment, along with existing and well-proven models of the OER presentation, such as cMOOC and xMOOC, in our opinion, two main perspective models of OER creation can be offered, which we will figuratively denote as pMOOC and vMOOC:

- 1. pMOOC – Web portal of a professional community can serve as the virtual information environment for creating open electronic educational resources, where collective discussion and selection of materials result in formation of an electronic training course, which can then in the process of its use be developed and supplemented by all participants of the educational process. This technology provides for collaborative work of instructors, experts, graduates and other interested participants of the educational process, both in the actual creation of the electronic educational resource and in its subsequent updating. This approach based on combination of capabilities of a unified repository of objects and peer-to-peer (P2P) communication in educational networks demonstrates that such combination of two paradigms will help to accelerate evolution in creating mass open educational resources by providing the necessary high quality educational material (Komleva, 2013);
- 2. vMOOC – Evolving Apple technologies provide the user with ample opportunities for creating active learning content. The technology provides for creation of an offline coursebook on the basis of the popular iBooks Author application. Despite the relevance of the topic, at the moment there is only one well-developed project Bookry.com that uses the iBooks Author application. By simply dragging objects with the mouse you can add text and images to the coursebook. Using Multi-Touch widgets allows you to include interactive photo galleries, movies, Keynote presentations, three-dimensional objects and much more. The coursebook is accessible on iPad at any time, it can be saved in the iBookstore, placed on iTunes U server or shared with any iPad user. In this case the coursebook created by the author serves as the virtual environment that provides a rich set of tools for its subsequent updating.

The models offered correspond to two structural approaches to program design taken in programming, respectively, top to bottom and bottom to top. Analyzing the presented models, we note that the most common models for creation of open electronic educational resources to date (cMOOC and xMOOC) for the most part express striving of their creators to implement specifically the principles of massiveness, openness and accessibility of materials and are characterized by different approaches to learning. However, development of activities in this direction requires placing greater focus on the quality of learning materials provided, which can be achieved only by increasing involvement of experts in the process of creation of open educational resources, providing user-friendly services in the process of completing a course, integrating repositories and a wider discussion of the learning materials.

Comparison of models of open electronic educational resources is given in the table 1.

The principal difference of the OER models suggested from existing ones is the mechanism of automatic updating of the learning content of the course. Only in the vMOOC model the course should first be developed by the instructor(s), after which it is updated by updating the objects as a result of their discussion in social media or on other sites (for example, by updating a YouTube video or comments from Twitter). Individual trajectory of studying the course is implemented in such a way that the learner can choose by himself the set and order of studying the objects, but only those that are contained in this coursebook.

In the pMOOC model the objects that received high marks as a result of their rating evaluation are first discussed and selected to the storage (repository) on the portal. And then the course that implements the required goal and competencies is automatically built from the selected objects.

Table 1: Comparison of models of presentation of electronic educational resources

	cMOOC	*xMOOC*	*vMOOC*	*pMOOC*
Goal	determined by the user himself	determined by selecting a course	determined by the user himself or by the learning plan contained in the system	determined by the user himself or by the learning plan contained in the system
Course development	instructor(s)	instructor(s)	instructor(s)	automatically by the system in accordance with the required competences
Learning	not regulated, no control by the instructor	strictly regulated, control by the instructor	can be regulated or not, control effected automatically	can be regulated or not, control effected automatically
Individual studying trajectory	chosen by the user himself	determined by selecting a course	automatically by the system in accordance with the results of knowledge control	automatically by the system in accordance with the required competences and results of knowledge control
Discussion	chaotic, mostly on third-party sites	mainly on the site, where the course is placed	on third-party sites, social media resources	on the portal, where the course is placed
Updating	performed by the author(s) himself(themselves)	performed by the author(s) himself(themselves)	performed by the author(s) himself(themselves)	resulting from discussion on the portal (automatic updating of learning objects)

Moreover, this course trajectory can both be built "from scratch" using the repository objects and complement the already existing course also stored in the repository, updating it with the objects that received a higher rating. This model allows for better implementation of adaptability by forming a chain of objects in such a way that the level of competence of the learner upon completion of study of the previous object serves as the input information to the next one. Moreover, in the repeated study the object can be provided in a more extended form with a larger number of demonstration examples and explanations. Here, an individual trajectory can be implemented on the set of objects of the entire repository and not only those that were originally included in the course, as in the previous model.

To ensure technological development of the process of creating open electronic educational resources, availability of the following tools provided by the virtual environment is essential:

- 1. Tools for discussing and evaluating materials by users of the virtual environment for operational management of the OEER creation process at all stages.
- 2. Tools for analysis, visualization and processing of information.
- 3. Integrated system of rating-based evaluation of materials that acts as one of the built-in tools for analysis and processing of data.
- 4. Tooling for making decisions on the further use of material for educational and scientific activities. Achievement of the user's goal consists in establishing an individual trajectory that ensures formation of the required competencies. The decision is based on the integrated evaluation of the material.
- 5. Centralized storage of materials (repository) with differentiation of access rights for users.

In this regard, information security shall be observed on the main points:

- 6. Management of identification and access to the system.
- 7. Administration of the rights of access to the virtual environment materials.
- 8. Protection and encryption of databases.

Therefore, the challenge is to provide users with convenient tooling for integration of information resources (web services, links, materials), simplification of data handling and information analysis. This implies automation of data preparation (creation of dynamic tables, conversion between different formats), possibility to visualize large amounts of information.

3. Conclusion

Application of the latest information technologies and implementation of innovative ideas will allow for construction of flexible education personifying technologies and changing the content of pedagogical work of instructors. At the same time, it becomes possible to radically improve the quality of education by organically integrating in the educational processes the systems of monitoring, analysis of the competences obtained and correction of the learning process algorithm with a view to achieve optimal results.

Economic advantages lie also in the learning courses themselves that are offered on the portal. They contain such tools as varying degrees and methods of delivering learning material, testing that takes into account the individual abilities of the learner, adaptability in the choice of the learning objects. All of these things make it possible to ensure significant cost saving in distance learning, since the courses themselves are educational. Such courses can be offered both to Campus students receiving distant education and for corporate training.

Use of adaptive educational process in the context of the object concept of presenting learning materials for distance learning ensures the required level of the learning quality, while requiring less time than is needed for the traditional process.

Use of the object-oriented method of production of learning materials in some cases can greatly increase the labor productivity of specialists and, as a result, significantly reduce costs. Marginal costs of development of a learning object decrease with the increase in the number of learning objects in the repository, and economic profit increases with the increase in the number of reusable objects.

Thus, ensuring of the required quality of learners' training and reduction of expenses of the networked educational process can be achieved by developing intelligent technologies for supporting the learning process and adaptive information technologies. This, first of all, includes application of the object concept of creation of open educational resources, introduction into the learning process of courses based on the principles of self-learning and adaptability, changing of the role of instructor in distance education, significant increase in productivity of his work and, as a consequence, reduction of expenses for training of a new specialist.

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Organization of a Teaching Network Routing Algorithms Scenario in a Learning Management System (LMS)

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Abstract: This paper presents the process of organizing a teaching scenario through an online Learning Management System (LMS). For our scenario, we chose material from the teaching of the course of Computer Networks. In particular, we focused on Dijkstra's, Bellman – Ford's, Floyd's and Johnson's algorithms, as they are used for packet transfers on the Internet. We took advantage of synchronous and asynchronous online learning activities and focused on recent innovative practices such as those involved in blended educational processes. We believe that Information and Communication Technologies (ICT) will not be able to solve the problem of the learning process without taking serious consideration of the students' learning aspirations. For this reason, we have applied the Problem Based Learning (PBL) as the educational methodology for our scenario. We have tried to implement learning activities through specific directions within a modern learning platform organized on the basis of the Drupal Open Source Model. Students through a multitude of activities provided to them on the platform improve their cognitive skills and develop their ability to manage digital material. We present the organization of the LMS for the scenario and how we have planned the material management and implementation. The article closes with a qualitative assessment of the scenario and proposals for future processing. Finally, reference is made to a number of criteria whereby the introduction of new technologies could be considered as a substantial innovation and, hence, these criteria can be treated as a suggestion of a modern educational reform.

Keywords: educational scenario analysis, algorithm teaching, learning management systems, mixed learning, micro-teaching

1. Introduction

Our paper tries to give answers on how teachers could manage analytical programs in the Web - 2.0 era. In this particular article, we have tried to provide solutions to unanswered questions that are in the minds of many educational, engineering and theoretical educators, such as:

- How can the 21st Century teachers use the web for teaching purposes?
- How the development of online communication at different levels of education (Higher Secondary Education - Vocational Education and Training (VET) - Higher Education) should be exploited?
- How to achieve and update and with what means and objectives the teaching of the 21st century?

To answer the above questions, we set out specific goals and objectives and we adopted Problem Based Learning (PBL). PBL cover the directions from the point of view of the educator. On the other hand, there are students who would like to use traditional teaching in combination with the resources of web-based structures. A modern system must support those types of students. We ended up in a mixed-type teaching that concerned the algorithms we need in Computer Networks. As far as Web 2.0 education is concerned, it is now established that "new technologies, such as presented through teacher training", (Mysirlaki and Paraskeva, 2018), contribute to the creation of new types of "learning communities" (Tan and Lee, 2018) and to the creation of new representations. Moreover, the feedback of the learning material, as Blau et al (2018) mention, assists "in the teaching of students with special needs but also in personalized teaching" (Boyle and Scanlon, 2018) and, finally, to organize "learning structures of special groups" (Wang, 2018). The overall structure of education is ultimately influenced by both the amount of information available in the social networks and the way of exchanging opinions, criticisms and knowledge from the various web communities that "a new generalized strategy and a new generalization of the knowledge are formed" (Bolisani and Bratianu, 2018). The interoperability of today's ever-evolving personalized communications devices and the ability to transfer social data directly, such as in Facebook, Twitter, Flicker and many others, shape the way public opinion and knowledge standards are organized. Social networking applications and services affect learning terms and conditions, shaping what has been called informal knowledge (Narula et al, 2018).

According to the Italian philosopher Luciano Floridi (2018), today, whether we are offline or online, we are increasingly living in the special internet site. ls the "infosphere", in this exuberant, "flawless" reality that shapes the digitality of the data. The “infosphere” finally shapes a new ethics about life, digital and managing the elements of our everyday life. Finally, the Web 2.0 era in education, the new tools such as blogs and microblogs, wikis, podcasting and the impact of social networking are contributing to a trend that tends to replace traditional passive teaching with more active methods of transferring and building knowledge, including learner-centered learning, co-creation of knowledge and modern assessment strategies.

By analyzing education as a structure, we are following three key theoretical perspectives of learning:

- The structure of the teaching scenarios
- The communication within the learning processes, and
- The way that each trainee integrates knowledge and shapes their individual learning profile.

Yim et al (2018) state that those three key elements have changed and continue to change radically in recent years.

As a subject of teaching, we chose the field of network lessons and more specifically the part concerning the algorithms examined there due to the plethora of material on the internet. Nevertheless, we chose only valid high quality material. Based on the references to research-related material, we formulated the individual sections and the individual research questions, while giving some initial indicative answers. In this article, we present exactly how our learning tools should be updated nowadays and the sections and thematic areas that are born from today's scientific necessities and guidelines that use web portals as learning tools. To organize our research, we collected and analyzed data and views from the international educational practice. Using the comparative pedagogy for the teaching of algorithms as they are organized within the framework of the course of the networks we will highlight in the next section updated bibliographical references and articles related to the subject.

2. Educational scenarios – method of teaching

The teaching scenario in which we will attempt to integrate elements from the new data we have mentioned concerns the teaching of algorithms as it is involved with the theory of networks as Kotsifakos and Douligeris described (2015). We consider that the flow problems in the Internet are among the most critical for the evolution of network theory and are the ones that shape the rapid technological changes in the field of data transfer. Furthermore, in each and every category of modern Telecommunication and Internet protocols there are huge changes and that is the reason why the lesson of the networks is able to highlight their prospects. The problem of keeping in touch with these developments, in combination with the sharp increase in device computing capacity, poses new challenges for designers and network administrators as the algorithmic thinking that organizes them all is an important tool to support and map this trend as Douligeris pointed out (2015).

As the core of our micro-teaching, we chose the algorithms to find the least paths. “These algorithms are used to find the path from a start node to a final node with the minimum total weight” (Nikolakaki et al. 2018). This problem is one of the oldest and most important of the Theory of Graphs. It presents a variety of applications in Business Research, Networks, Internet, and more, while it often appears as a sub-problem in other more complex problems. The initial queries that the learner is asked to deal with concern the selection of the most appropriate algorithm that will be responsible for the finding of the minimum path. Which criteria are used to select the algorithm for each problem? The educational methodology which we have applied is about learning based on solving one or more problems (Problem Based Learning, PBL). Problem Based Learning is considered by many researchers as the most innovative educational method available to teachers today as noted by Meltzer (2018) and “can be used with positive results in the field of applied sciences and engineering” (Mills and Treagust, 2003).

This way of learning begins with “concrete and real problems and activates self-directed and cooperative learning in small groups” (Marton, 2018). These components are radically different from traditional teaching methods and inevitably significantly affect the dynamics between instructors and learners during PBL (Savery, 2015). In PBL, trainees become the founders of their own learning, researchers and problem solvers during the learning process and are no longer receivers of passive information as Kolodner et al. (2003) describe. By following this method, trainees are not only required to redefine their roles in the learning process but also “redefine their learning habits” (Mattar, 2018). In conclusion, many researchers estimate that understanding about the solution of a problem depends on the involvement of trainees in the construction of the solution as well as on individual and collective perceptions, backgrounds and trends as Anderson (2016) state.

3. The learning of algorithm thought in the network lesson

An algorithm satisfies the criterion of correctness and is said to be correct if it solves correctly all the snapshots of the problem for which it was designed. In other words, “the algorithm must produce the right result for all the legitimate sets of inputs” (Prakash, 2018). But since we do not know before and what is the right result for any legitimate set of inputs, how do we judge whether the algorithm is the right or not? One choice is to prove it mathematically, but it often requires quite advanced knowledge concepts. There is also the empirical way: “we experiment with many screenshots for which the result is already known” (Dasgupta et al., 2006). If we have success in all experiments and their results are representative of the cases that will occur in practice, we hope that the algorithm will be accepted. To examine the accuracy, the structure of the algorithm in sub-algorithms (program in sub programs) is quite useful: if smaller parts are simple enough, perhaps we can prove - or experimentally - that each is correct. This helps us to “achieve the same conclusion for assembling the parts which comprise the original algorithm” (Massey, 2018). As the main criteria for the evaluation of algorithms we consider the cost for the construction and for each execution of a corresponding program as Zimniewicz et al (2018) says. This also depends on special circumstances that change over time, such as the available hardware and software, or programming language, the developer’s skills and style, the general computing environment etc. Such factors are important for cost, but:

- We can not know them exactly, since the only thing we have is the algorithm,
- We do not care to include them in detail because we want our conclusions to be valid regardless of these specific circumstances, and
- It is not particularly useful to take them into account: our conclusions are going to be used mainly for algorithm comparison, so we hope that the effect of these variables will be more or less the same for all competing algorithms.

4. Analytical teaching program

The elements of the lesson relate to a part of the Network Teaching and concern the Shortest Path Algorithms. The algorithms we propose to study concern the following algorithms:

- Dijkstra’s
- Bellman – Ford’s
- Floyd’s and
- Johnson’s.

We follow the Problem Based Learning (PBL) methodology. The main motivation in our choice concerns a new trend in the teaching of algorithms that emphasizes the “understanding and design of new algorithms for cutting edge technologies used in computer networks” (Anshelevich et al., 2003). The communities of trainees involved in the subject are Vocational Lyceum (VL) students (Specialty of Information Technology and Electronics) who see these algorithms in the course of networks according to their curriculum, students of Universities and College of similar directions and to students of Informatics or other relevant direction who cover in their curriculum these algorithms. The design and utilization of the teaching scenarios of each module leads to the understanding of each algorithm individually for every student. The overall framework concerns a mixed teaching method where the organization of the material does not always function according to a contemporary manner but constantly in combination with its teaching. The goals that will be set for the students are:

- To be able to fully understand the differences between the algorithms, this means to acquire through the teaching material the knowledge of the theory.
- To be able to choose the appropriate algorithm for each different problem that may arise.
- To be competent in the end to explain why they chose this algorithm.

The initial problem the trainees face is how to work with the topology of the Figure 1. The scenario raises the question: "In what way and by what criteria would you calculate the shortest route from node 2? In each way, indicate the steps of the route you chose and its total weight (distance)”. The teaching method to solve the problem - A course description with a corresponding technique and means at each step:

- 1) In the beginning students are given the theory that supports this material. This material is a simple description through which students are capable to understand each algorithm separately. Then, they will be asked to think about the solution to some problems that will be given to them. In this way, they will realize at the end of the course how exactly the algorithms of finding the least paths work and how important a role they play in the operation of the networks.
- 2) Then, they will watch educational videos about the problems they were originally given in order to see if they really reacted correctly and if not how they should have dealt with the problem.
- 3) The next step is to present the new teaching material containing even more details, through hardware that can be downloaded by each trainee to their personal computer. The presentation of the new concepts will be compared to the previous ones by the students themselves.
- 4) Then, the material should be studied so that the trainee is ready to be evaluated and to see if this way of learning had the desired outcome.
- 5) Search for evaluation methods: After the end of the above steps, the trainee will organize some worthwhile actions which will be recorded in case that the idea and the steps of the algorithms to find the least paths were fully understood.
- 6) At the end, the evaluation will be officially recorded and announced.

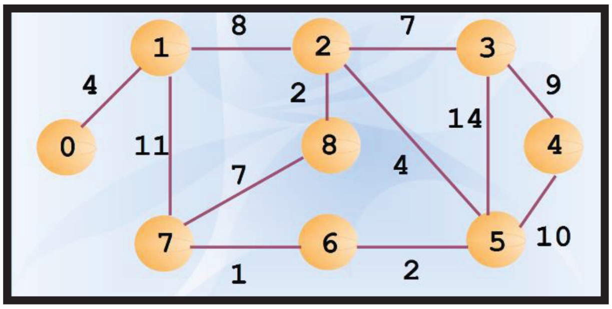

Figure 1: Route topology

The assessment is done in a number of ways:

- With multiple choice questions in terms of understanding the subject.
- With questions of right - wrong, especially when it comes to theory questions.

These two ways have been organized on an LMS, http://elearning.deye.gr/, in which the trainee enters an individual code (Figure 2).

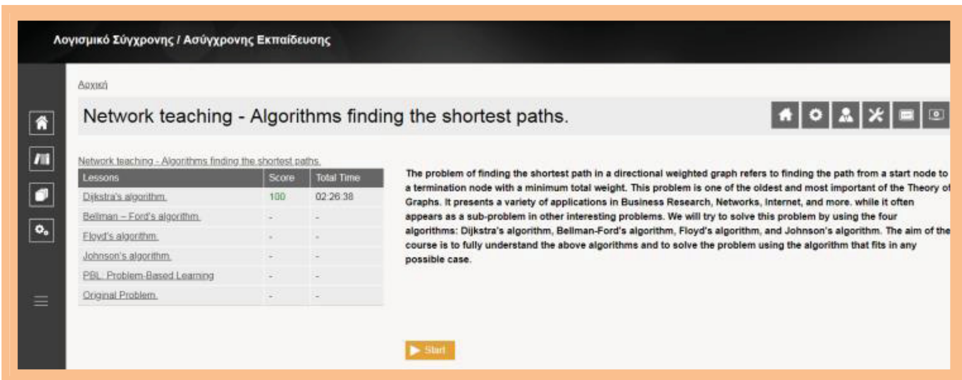

Figure 2: LMS work screen

Students through the multitude of activities provided to them on the platform personally improve their cognitive skills and develop their ability to manage the digital material. The title of the module created in the LMS is called Networking Teaching - Minimal Path Algorithms, and it has six lessons. Students can choose the module they want to work with and navigate accordingly (Figure 3).

Network teaching - Algorithms finding the shortest paths.

Lessons	Score	Total Time
Dijkstra's algorithm.	100	02:26:38
Bellman – Ford's algorithm.	-	-
Floyd's algorithm.	-	-
Johnson's algorithm.	-	-
PBL: Problem-Based Learning	-	-
Original Problem.	-	-

Figure 3: Learning sections

We have tried to implement learning activities through specific directions within a modern learning platform organized on the basis of the Drupal Open Source Model. The reason why Drupal was used, and not another CMS platform, is “the flexibility that offers to both the creator and the user” (Adamopoulos et al., 2016). Drupal is an open / free software content management system (CMS) written in the PHP programming language. It allows the system administrator to organize content, customize presentation, automate administrative tasks, and manage site visitors and contributors. Even though there is a complex programming interface, most work can be done with little or no programming at all. Drupal is sometimes described as "web application infrastructure" (Content Management Framework) instead of "Content Management System" (CMS), as its capabilities go further than managing content, allowing for a wide range of services and transactions as Lockett et al (2018) mention.

Drupal can be run on various platforms, including operating systems (Windows, Mac OS X, Linux, FreeBSD), or any platform that supports either the Apache HTTP Server or Internet Information Services, as well as the PHP programming language. Drupal also requires a database like MySQL and PostgreSQL to store its content and settings, while from its kernel it is able to support all relational databases with the use of modules and the most popular non-relational ones. Drupal as a system has been praised by webmasters, designers and developers for its modular design, providing its core layer, or "kernel" to “provide the basic features of Drupal in its default installation” (Martinez-Caro et al., 2018).

Additional functionality and presentation features can be extended to the kernel by adding attachments and theme variants. Drupal’s drives are used to "overcome" the built-in kernel attributes, expanding or replacing Drupal's default behavior without interfering with the Drupal core code. This ability to modify the kernel functionality has an impact on Drupal's flexibility as well as on its security, especially on security issues such as SQL injection (SQL injection) as Chandramouli et al (2018) describe. Custom thematic variants, which can be added without affecting the Drupal kernel, use standardized formats that can be created by “third-party theme design engines” (Jonke and Volkwein, 2018). Moreover, the developer can offer except from the ready-made packages by the Drupal community, incorporation of its own code in order to get the desired result as Kotsifakos et al (2016) state.

5. Organization of the LMS

Figure 4 shows a schematic illustration of the operation of the educational software. As it turns out, once the students study the course material and makes the tests, they are asked to solve an initial problem posed by the teacher. Should they succeed in solving it, they have certainly consolidated the matter, which is the desired result.

Figure 5 shows the use case diagram of the relationship of dependence, generalization and connection of both the trainee and the teacher with the system. Trainees can log in if they already have an account or enroll in the application if they are new users. In any case, they enter their personal data, codes, year of study, specialty, etc.. Once connected to the LMS, the student can stores online the learning material but also can save it if they want to have it, on their own personal computer. When the study has finished, they can do the tests to see if they have fully assimilated the matter, but also the level at which they have understood it. Finally, they can be disconnected from the system. On the other hand, the teacher can also sign in if they already have an account or enroll in the application if they are new users. They also have the possibility to study the teaching materials contained in the LMS, with the opportunity of renewing it by uploading new content and notes. At the same time, they are responsible for assessing students, since as teachers they create and correct their students' tests. Of course, they can be disconnected from the system as well. Figure 6 shows the sequence diagram showing how different objects cooperate with each other in a time sequence. This diagram shows the objects, their relationships, the messages exchanged and the duration that objects last.

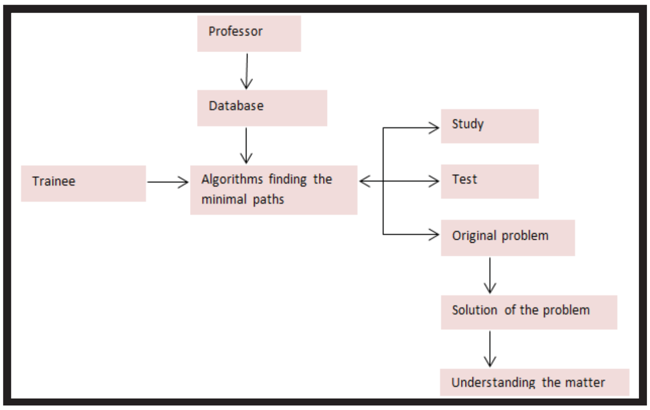

Figure 4: Schematic illustration of the training platform

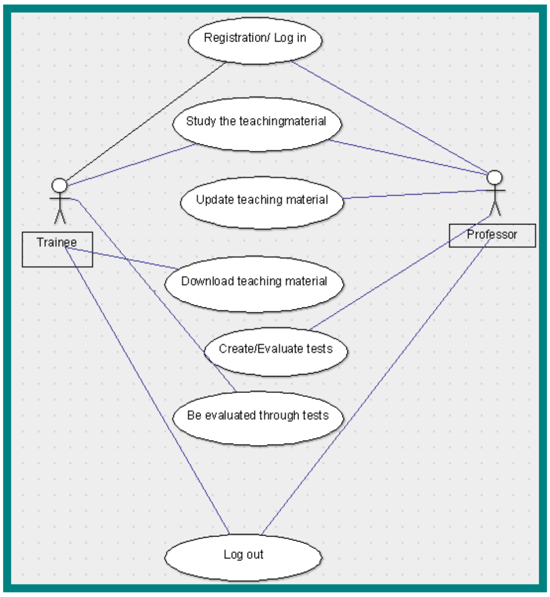

Figure 5: Use case diagram

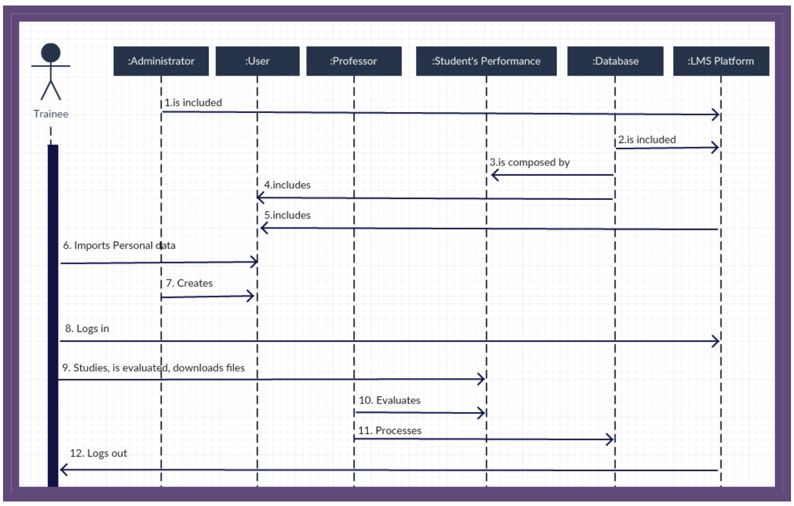

Figure 6: Sequence diagram

As shown in Figure 6, the Administrator is managed the web environment in the LMS Learning Platform. Each user's data is contained in the database and on the training platform as well. The database also contains the students' performance. The students need to enter their personal elements in order to log in to the platform. If the trainee is a new user, the administrator must create the registration. Then, the trainee can connect to the training platform, study the material, be evaluated by the teacher, and download files. Once the evaluation is done, the teacher processes the database, passing the student's scores. Finally, the user can be disconnected from the platform. Figure 7 shows the class diagram. The class diagram is a structure diagram that contains the classes together with the corresponding dependencies, generalization and association bonds. Thus, this diagram can illustrate the use of inheritance in design using generalization bonds.

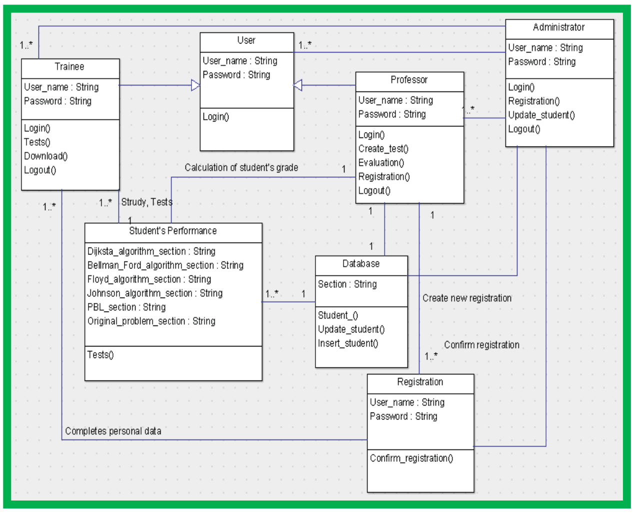

Figure 7: Class diagram

As shown in Figure 7, there   the following classes can be identified:

Administrator: logs in / logs out from the training platform, creates new users and updates student data.

User: the user connects to the system and depending on the attribute given to him by the administrator; they may be a student or a teacher.

Professor: logs in / logs out from the training platform, creates tests, evaluates students, introduces new members.

Student: logs in / logs out from the training platform, makes the tests to be evaluated, downloads material from the platform.

Registration of the Student: a new student is enrolled after the manager or professor confirms the request.

Student’s Performance: the assessment of student performance is done through the tests created by the professor for the 6 different sections that exist in LMS.

Database: contains the student's details from their registration and is informed of their evaluation’s results.

6. Material management and implementation

Trainees have the ability to navigate through the courses in order to read information, view videos, download files on each section, and perform the tests to see how well they have experienced the subject matter.

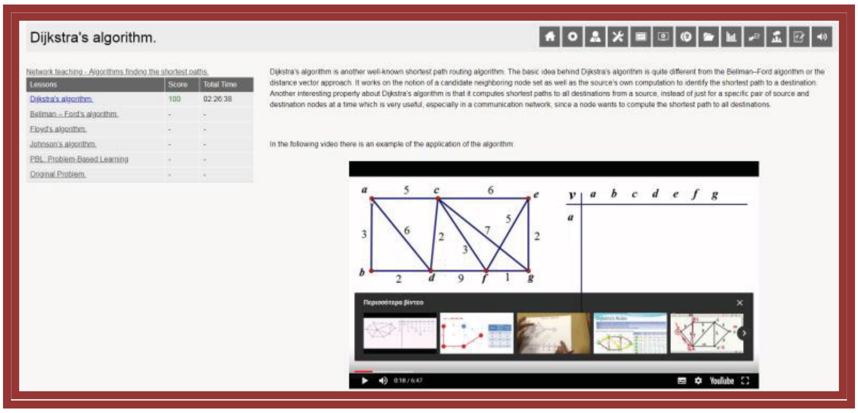

Figure 8: Using embedded video for learning

The videos contain examples of each algorithm in order to understand the lesson through an exercise (Figure 8). In addition, trainees can use and download files that are relevant to each section to study further. According to the planning of LMS, only the professor or the teacher has the right to be upload files or create activities. In LMS there is the possibility of granting extra rights, if this is desirable (Figure 9).

Figure 9: Ability to process files on the module

7. Evaluations of trainees

The assessment and the performance of knowledge in this scenario have been organized on the basis of self-assessment standards. The tests that are created on the platform are in the form of multiple choice and true-false questions (Figures 10 and 11).

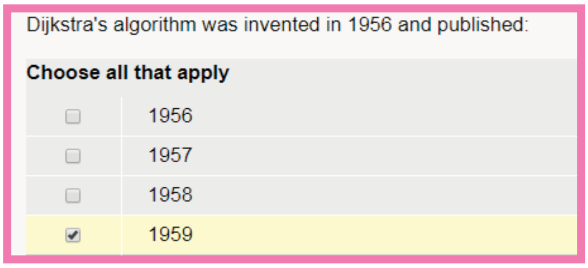

Figure 10: Multiple choice questions

To assume that a trainee has successfully digested the unit's material, they must have gained a success rate of over 75%, which can be redefined based on platform settings.

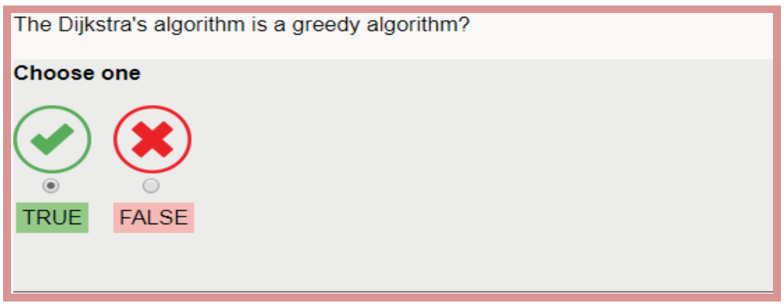

Figure 11: True-False questions

The enrichment of the assessment may in some cases also need to be expanded, as in the example of Figure 12. For this category of evaluation, there should also be an explanation after the end of the test to answer the question. The supervisor professor in any case may add some explanation that will appear after the end of the question to help understand the correct answer.

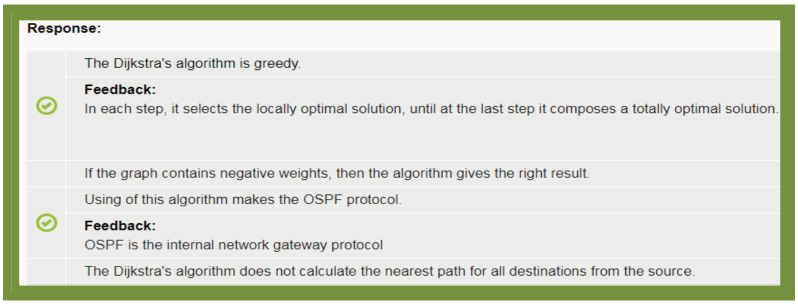

Figure 12: Use of explications in response to evaluation

8. Conclusions and future work

In this paper, we addressed the issue on how to improve the delivery and use of digital material in a learning process and how to enrich the cognitive horizon of the students. Such initiatives within a digital class lead to an empowerment of positive standards which have the indirect effect of establishing greater self-confidence in the handling of digital information. Moreover, collaboration and interpersonal communication is achieved via the proposed online class between the platform learners.

One weak point of our case concerns the guarantee of ensuring internet provision by schools. In case that either the school unit is unable to cover Internet access, or it does not provide personalized computer use, the entire digital scenario remains inactive. In such cases, approaches using mobile devices, individually owned or shared, must be explored.

Many current studies address the impact of the use of online teaching scenarios that depict algorithm functions for educational purposes (Foutsitzis and Demetriadis, 2010). In this work, we discussed the results obtained from the context of a web-based collaboration activity for the "algorithm analysis" as it is applied to the computer networks course. For this purpose, we designed and implemented a web-based environment that provided the platform for our project. During the activity, students interacted with the LMS and followed the steps of the proposed collaborative scenario. The learning scenario led them to ask key questions and urged them to deal with crucial questions about the function of algorithms. In the foreseeable future our plans have to do with organizing data logging in the context of the data analysis of education and connecting individual performance with the overall education of trainees as well as to extend the instrument to new subjects even beyond the course of the Networks. All things considered, the need map and the learning conditions for learners with special learning needs have to be planned in order for our intentions to be accomplished.

Acknowledgements

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Augmented Reality and the Symbolic Play of Pre-School Children With Autism

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Abstract: The aim of this study is to examine whether an augmented reality (AR) application can support the engagement, motivation, and quality of symbolic play of children with autism. The symbolic play of autistic children has been characterized as "inadequate" or "impaired" in a number of studies. In this paper, we describe the design and implementation of an AR application using the augmented reality platform Aurasma (now HP Reveal). The interventions took place in a kindergarten class, which also included an inclusion class. The participants of this study were three autistic children, aged 6, from the inclusion class. We used a qualitative research approach. Data were collected via non participatory observation, field notes, and video recordings. The data were analyzed using Kasari et al. (2000, 2006) classification of symbolic play and Ferre Laevers et al. (2005, as cited in Panagopoulou 2015) scale of involvement. Our results indicate that the designed AR applications supported the emergence of symbolic actions of autistic children during play and the engagement of the children.

Keywords: augmented reality, symbolic play, autism, mobile learning, preschool education

1. Introduction

The aim of our study is to examine the role and impact of an augmented reality (AR) application on the symbolic play of pre-school children with autism spectrum disorder. Symbolic play, as described by Vygotsky, emerges at the age of 3, when the child differentiates play from reality, in the context of pretend play (Rosenblatt, 1977, McCune-Nicolich, 1981, as cited in Baron-Cohen 1987). It involves the use of an object or an action as a representation of another object or action. The element of "double knowledge" or "as if" quality involved in the pretend play, distinguishes it from other kinds of play (Reynolds, 1976, Fein, 1981, as cited in Baron-Cohen 1987). Properties of pretend play include the "Deviant Reference", in which objects are substituted for one another (e.g. "this banana is a telephone"), the "Deviant Truth", in which "false" properties are attributed to objects (e.g. "this doll's face is dirty"), and the "Deviant existence", in which absent objects are present (e.g. "this [empty] is full of tea") (Leslie, 1985, as cited in Baron – Cohen, 1987). Symbolic play seems to be quite critical for the development of the child, as it has been linked to the development of cognitive, social, and emotional skills (Sigman & Ruskin, 1999, as cited in Kasari et al., 2000).

Research, though, has identified deficits and limitations in the symbolic play of children with autism, and particularly the engagement with spontaneous symbolic play. In conditions, though, of elicited play, play guided through a structured activity, children with autism were able to demonstrate symbolic understanding and symbolic play (Sigman & Ungerer, 1981, Riguet et al., 1981, Boucher & Lewis 1988). Furthermore, research has indicated that activities targeting specifically at developing symbolic play skills rather than activities that combined language or other skills, were more effective for autistic children (Stahmer, 1995, as cited in Kasari et al., 2000). Lifter et al. (1993, as cited in Kasari et al., 2000) also suggested that the play has to be analogous to the child's chronological age and the developmental phase of the child. Under such conditions, the children show more variety and more sophisticated play.

Previous research has shown positive results of AR environments on the development and the pretend play of children with autism (Escobedo et al., 2014; Bai et al., 2015). One of the main properties of an AR system is to infuse digital content into the real environment (Azuma et al., 2001). Our main motivation for this study was to examine whether such an application could enhance the mental representations (imaginary situations over real-world situations) of the children.

In this empirical study, we use an AR smartphone application and through a structured activity involving symbolic play we examined the engagement of children and whether AR could support the generation of mental representations of objects and actions. Our first research question was whether the use of an AR application could motivate children with autism to engage in symbolic play. Our second research question was whether an AR application could support the emergence of more creative symbolic play by children with autism.

2. Research methodology

2.1 Participants

Our participants were three children, who attended the kindergarten (early childhood education) and they also studied in the inclusion class. All participants were male and all of them were 6 years old. The students were diagnosed with autism. We did not, however, approach the design of the symbolic play activities, as will described in the following sections, through their diagnosis, but rather our aim was to develop activities based on their interests and their language skills, which are factors that have been described as significant (Kasari et al., 2000). See Table 1 for the description of our sample.

Table 1: Profiles of the participating children

Age	**6 years old**	**6 years old**	**6 years old**
Grade	Early childhood education	Early childhood education	Early childhood education
Sex	Male	Male	Male
Diagnosis	autism	autism	autism

2.2 Data collection and analysis

Data were collected through non participatory observation (field notes) and video recordings of the AR interventions. Videos were further coded and analyzed in relation to our research objectives. For examining the emergence of symbolic play in children, we coded the videos using Kasari et al. (2000, 2006) chart of the developmental progression of functional and symbolic play skills (see Table 4 in Appendix). The Kasari et al. chart describes the developmental process of play from the more limited actions of play (indiscriminate actions) to the more developed (thematic fantasy play). For examining the involvement of the children our coding was based on Ferre Laevers et al. involvement scale (2005, as citied in Panagopoulou, 2015) (see Table 5 and Table 6 in Appendix). Ferre Laevers et al. evaluated the involvement and well being of the children based on signs of children behavior. The level of involvement was also assessed from 1 to 5 as well, since higher levels of involvement seem to have a developmental effect on the children.

2.3 “Aurasma” as a platform for the AR activities

The augmented reality application that we used for developing the AR activities was Aurasma. We selected this tool mainly because of its ease-of-use. Aurasma supports both devices with Android and iOS and needs installation in the device and access into the mobile device’s camera. The general concept for the design of AR applications with Aurasma is that a real-world object is marked as a “trigger” object. The digital content appearing on the screen as a result of the camera focusing on the “trigger” object is the “overlay”. Such activities including a “trigger” and the respective “overlay” are called “Auras”. For the design of the digital content or “overlays” we also used “Windows Movie Maker” so as to combine a sound effect that would appear on the screen when the children would focus the phone camera on the correct real-world objects.

2.4 The design of the AR activities

As mentioned earlier, two AR activities of symbolic play were designed, based on the children’s interests, and language development level. These were identified during previous non participatory observation of the children and also a pilot intervention described in a following section.

The 1st activity was named *“Baking cookies*”. It took place in the kitchen interest area of the kindergarten. The purpose of the play was for the children to bake cookies with the support of the AR application. We wanted to examine whether the AR would reinforce the mental representations that the play required. More specifically, the children using the application would focus the smartphone or tablet camera on specific real-world objects (“triggers”) placed in front of them. The “aura” would “transform” those objects into the relevant ingredients that the “recipe mix” required in order to make the cookies. For instance, when the children would focus the camera on a pink plastic mug, the mug would be "transformed" on the screen through the AR application into a juice jar ("overlay"). All the ingredients, one by one, would be placed, by the children, into the imaginary recipe mix and later into the kitchen's oven for baking. Finally, the baked cookies ("overlay") would appear on the device screen (**Error! Reference source not found.**Figure 1). The objects, which were used as triggers, were plastic mugs-toys in different colors, that didn't look like the imaginary required ingredients in order to avoid an overlap between functional and symbolic play. For the "overlays", we used three ingredients: the juice, the flour and the sugar. Also, a printed copy of the ingredients required for the recipe mix was shown to the children to help them organize the process). The objects, which were used as triggers, were plastic mugs-toys in different colors, that didn't look like the imaginary required ingredients in order to avoid an overlap between functional and symbolic play. For the "overlays", we used three ingredients: the juice, the flour and the sugar. Also, a printed copy of the ingredients required for the recipe mix was shown to the children to help them organize the process.

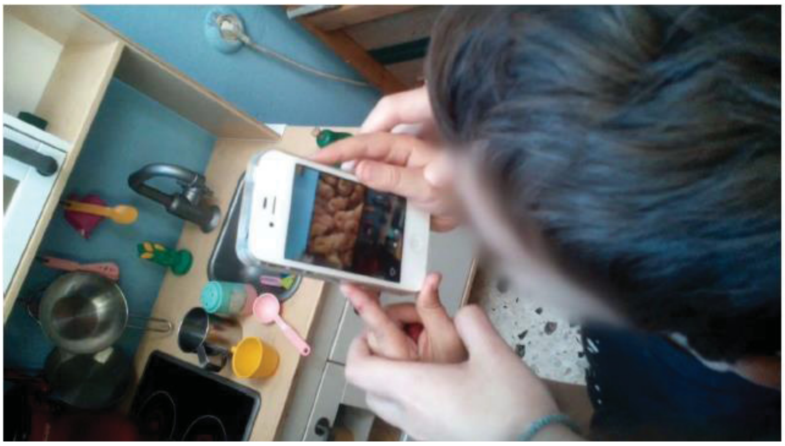

Figure 1: Child watching the "overlay" of the baked cookies

The second activity was named "*Ghost*". The structure of the second activity was simpler as it included only one "trigger" and one visual element ("overlay"), the "ghost" but it was developed under certain conditions. More specifically, one of the three children showed no interest whatsoever in the first activity ("Baking Cookies"), but rather showed, during the free play time, a particular interest in the construction of buildings with the wooden building blocks in the kindergarten. The child built the construction and told us that he had made a haunted building. We considered this as a good opportunity to develop, on the spot, a new "aura" with the child's construction as a "trigger" and a virtual ghost as an "overlay". This activity was implemented and readjusted a number of times. .As well as both activities were adjusted and took place over five not consecutive days.

Figure 2: The images used as "overlays" depicting the ingredients for the cookies

2.5 Pilot studies

Before the main interventions involving the two activities described in the previous section, we initially observed the children during their spontaneous (free) play so as to identify factors such as their developmental level on the symbolic play, their interests and preferences. We then run a number of pilot studies using AR activities which were designed based on these observations. The resulting pilot AR activities involved variations of the cookies baking activities. For the pilot study as well as the main intervention, we decided not to use "trigger" objects that looked like the referenced ingredients (e.g. a toy gas cylinder and a green object that looked like a pear), in order to avoid the overlap of functional and symbolic play, as mentioned before, and also so that we could observe the emergence or not of the children's symbolic thinking (when they first saw the objects). These pilot activities helped us identify design and implementation issues and adjust the AR activities.

One of the problems identified was the number of ingredients. At first, the ingredients which were used for the 1st activity were four (flour, sugar, juice and oil). However, one ingredient was removed in order to avoid technical problems relevant to the functionality of the AR platform and the device. Another challenge was the placement of the real-world "trigger" objects: these should be placed at a distance from each other so that the application could recognize them more clearly. We, therefore, had to decrease the number of ingredients to three so that they could fit in the limited space of kitchen and also be recognizable by the application.

Another aspect that had to be considered was the introduction to activity. The introduction would be used as a guide for the activity, so that the children know what they would have to do, and as way to motivate their participation. We initially used a short video of children of around the same age making cookies. The video, though, was replaced by a printed diagram, which showed the way and the order the ingredients should be used, acting as a recipe for the cookie baking.

The second activity ("Ghost") had to be re-adjusted a number of times, until it finally motivated the engagement of the child. Child 3 had declined to participate in the pilot interventions of the cookie baking. We, therefore, had to further observe the actions and behavior of the child in order to understand the real interests of the child. Child 3 was particularly interested in the kindergarten's building materials, and was creating facades of tall buildings. In our first attempt, we used an "Aura" to "transform" the child's building into a virtual palace. The child, though, didn't accept the symbolism saying "*It is not like that*". This led us to understand that the child had a specific idea about his building. Consequently, when the child finished his building, he explained to us that the building was actually a haunted building. At this point, we immediately, on the spot, created a new "Aura", which would trigger the overlay of virtual a ghost. The ease-of-use of the Aurasma platform allowed us such flexibility and on the spot adjustment of the activities. The outcomes of the activity were positive, as the child didn't turn down the representation. The outcomes will be further discussed below.

Another interesting outcome during the pilot interventions was the spontaneous participation of other classmates beyond the inclusion class. The children together "transformed" their ingredients (for the first activity) and the outcomes of this cooperation were encouraging.

3. Analysis and results

3.1 Emergence of symbolic play

"Substitution without object" was the category with the highest frequency of occurrences. 26 events or actions were observed and coded as instances indicating the emergence of "substitution without object" (see Table 2 for the frequencies of each category). However, every intervention was different as well as every child. We therefore need to study the children individually. From the 26 occurrences coded in this category, 14 referred to Child 3 during the condition of the "Ghost" activity. In this condition the child engaged in a subjective without object environment, which explains the majority of the codes. Furthermore, the situation was repeated the next day by the same child, as he wanted to see again the "ghost" coming out of his construction. 7 of the coded items in this category referred to Child 1 involving the "functional play" and its subcategories, and 19 for the "symbolic play" and its subcategories. For Child 2, we identified 1 coded item for "functional play", 11 for "symbolic play" and its subcategories (2 codes involved both Child 1 and Child 3) and 1 coded item in "sociodramatic play/thematic fantasy" (Child 2 intervenes in the activity of Child 3, he waves his hands and changes his voice while saying "Over here, it is the ghost!'').

Table 2: Coding of events indicating the emergence of symbolic play

Play	Play Categories	Frequency total
Functional	*Functional*	5
	Conventional Combination	2
	Single scheme sequences	1

Play	Play Categories	Frequency total
Symbolic	Substitution	12
	Substitution without object	26
	Multischeme sequences	5
Sociodramatic play/ Thematic fantasy		1

3.2 The involvement of the children

The category that presented the highest frequency of coded items was the "body expression" (31 coded items) based on the video recordings (see Table 3 for the frequencies of each category). This category included signs of non-verbal actions of the children combined with other indications such as persistence, concentration, energy or face expression and language (comment of the child) for the situation. For instance, while Child 3 was focusing the phone camera on his construction so that he could see the ghost again, he wasn't paying attention to his peer that tried to interrupt him. That was a clear example of the "body expression" criterion combined with other criteria such as "concentration".

"Energy" also presented a high frequency of coded items (30 codes). In this category we coded actions of children that aimed to continue the play with the AR (willingness of the child), or the energy from the voice intensity of the children during the play. For instance, when Child 3 saw the ghost on the screen, it screamed loudly and lied on the floor, pretending to be afraid.

In the "language" category, we coded all the verbal signs of interest expressed by the participants during the play situations. The children often expressed the emotions they had about the play e.g. "I like it" "I would like to do this again". However besides interest, language could express the child's lack of interest of the child for the play (Child 3 said "it is not like that" during the pilot study for the condition of the play). Nevertheless, in this category we included events where the children expressed their satisfaction directly, or a requested to repeat the activity. Such events were coded both in the "language" as well as the "satisfaction" categories.

The "face expression posture" was also observed in high frequency (24 coded items). We have to mention that the facial expressions could only be assessed when the faces of the children were clearly observable on the video recordings. A face posture as a smile was classified under the "satisfaction" category, while a serious face of a child during the activity, where the child is focused on the smartphone screen, was coded and as an indication of "concentration".

"Persistence" (22 codes) refers to all the occurrences where the children presented determination and willingness to continue the play, despite the fact that the activity was completed or the child was interrupted by external factors or technical issues. For instance, when the application malfunctioned and stopped "transforming" the objects in the kitchen, Child 1 continued the activity and completed the cookie recipe as he had done during the pilot study.

The "reaction time" or "rapid reaction", included signs of direct reaction to the activity or the stimulus (19 codes). This indication concerns acts or comments (language) of the children that happened immediately after a transform with the AR (1-2 seconds).

The "complexity and creativity" category refers to indications and actions of that children exhibiting a behavior that wasn't a routine, where children would show their "very best". Under this category, we coded instances where the children displayed imaginative approaches or took initiatives.

We further observed instances relevant to the "precision" category in lower frequency (5 codes). This referred to the diligence on the details of their work that the children displayed. We have to note that for the "precision" and the "persistence" categories we re-examined and excluded cases (removed codes) that may have been indications of stereotypical behavior of the children rather than acts of precision and persistence.

Finally, all the instances coded under the category "satisfaction" (20 coded instances) were also coded to other categories as well. That was because satisfaction could only be determined by indications referring to other categories such as the "face expression posture" and the "language" of the participants.

Table 3: Coding of events indicating involvement

Involvement Scales	Frequency total total
Body Expression	31
Energy	30
Language	27
Face Expression Posture	24
Persistence	22
Satisfaction	20
Reaction Time (rapid)	19
Concentration	19
Complexity and Creativity	13
Precision	5

Concerning the assessment of the level of involvement, Child 1 showed high levels of involvement from 4 (high) to 5 (extremely high). Child 2 constantly showed involvement at an extremely high level (5). Child 2, however, was always more enthusiastic and willing than the other children. At the beginning of the pilot interventions, Child 3 had no involvement in the activities. His involvement levels were assessed as 3 (moderate level) and eventually 5 (extremely high) when the AR activity matched his personal interests (i.e. the "ghost" condition).

Limitations of the Implementation of the AR Application

One of the challenges for the use of the AR applications was the placement of the real-world objects. For the AR application to be used more efficiently by the children, the interest area (e.g. kitchen) had to be clear of irrelevant objects and toys and only include the objects required for the intervention. Also, these objects had to be placed in a fair distance from each other and fixed positions so that they could be captured by the camera. Objects should not be moved from their initial positions. The lighting of the room was another factor that had to be considered: if the room was poorly lit the overlay would not be triggered by the AR application. In general, though, the application was satisfactorily usable by the children. The initial errors and malfunctions gradually decreased and at the end they would not prevent or impair the quality of the play. In some cases, such errors provided us with interesting insights. For instance, when the "Aura" would not appear on the screen, we observed that the children spontaneously displayed symbolic play acts, so that they could continue their play. Nevertheless, the children familiarized with the AR technology with no particularly difficulties and when they needed our support, they would freely ask for it ("*Hold it with me, so it can focus right* [on the trigger object]" Child 1).

4. Discussion and conclusions

Concerning our first research question, on whether an AR activity can support engagement and motivation of the children on symbolic play, the results of our study showed that the children exhibited all the indications of involvement (i.e. energy, persistence, precision, language, complexity and creativity, rapid reaction time, satisfaction, concentration, body expression, face expression posture) and mostly at a high involvement level (rated 4-5 in the assessment scale). Furthermore, categories of non-verbal acts of the children were at the highest rates of the scale. Indeed, the category of body expression showed the highest frequency indicating spontaneous and real involvement of the children. Indications of verbal involvement alone would not be a sufficient sigh of real involvement. The AR activities, when compatible with the developmental stage and the interests of the children, could support their motivation throughout the activity.

Our second research question concerned the potential of the AR activities to support symbolic play. Our analysis indicated that the children did actually get involved in symbolic play and more specifically the sub-categories of "substitution without object" and "simple substitution" (high frequency of coded instances). Most of these instances were observed during the play of Child 3 ("ghost" activity). We have to note, though, that the "Ghost" activity was indeed an activity designed and structured so that it would require and promote actions of "substitution without object" by the child. Nevertheless, the high levels of involvement, as well as the emergence of acts of "complexity and creativity" by the children were strong indications of the motivational advantages of the AR activities and their potential to support creative symbolic play in autistic children. This is certainly a case study, with a limited sample, and a qualitative research approach. Results cannot be generalized, but rather shed light on issues and phenomena for further research. An experimental research design, comparative or longitudinal studies involving AR interventions on symbolic play, with larger samples would help us answer questions on whether, for instance, AR activities can actually improve symbolic play skills of children with or even without autism. Other types of AR activities or platforms could also potentially be tested.

Appendix 1

Table 4: The development of functional and symbolic play skills (Kasari et al., 2000, 2006)

Play Categories	Definitions
Indiscriminate actions	All objects treated alike (e.g. Child bangs all toys)
Discriminate actions	Differentiates among conventional objects , preserving their physical characteristics or single objects (e.g. squeezes stuffed animal)
Takes apart combinations	Separates configurations of objects (e.g. takes all pieces out of puzzle)
Presentation combinations	Re-creates combinations of objects according to their presentation (e.g. puts puzzle pieces into puzzle)
General Combinations	Creates combinations of objects that result in simple, configurations such as container (e.g. puts puzzle piece in the cup)
Functional play	In this category child may relate objects to himself (e.g. brings empty cup to mouth to drink) and Pretend self. Actions are appropriate for the objects (e.g. uses a cup for a cup in play) . There isn't necessarily something pretend about them.
Specific Combinations/ Physical attributes	Preserves unique physical characteristics of objects in a configuration of their physical attributes (e.g. strings beads)
Child as agent	Extends familiar actions to doll figures , with child as agent of the activity (e.g. extends cup to dolls mouth)
Conventional Combination	Preserves unique conventional characteristics of objects in a conventional configuration of their attributes (e.g. places spoon in a tea cup)
Single scheme sequences	Extends same familiar actions to two or more figures (extends cup to baby doll , to stuffed animal etc)
Substitutions	Uses one object to stand in place for another (e.g. puts bowl in head for hat)
Substitutions without object	Pretends that there is something that is not there or use something that is not there (e.g. the cup is full of tea)
Doll as agent	Moves doll figures as if they capable of action (e.g. Child makes a doll move or talk)
Multischeme sequences	Extends different actions to same figure (e.g. Child feeds the doll with the spoon and then put it to bed)
Sociodramatic play	Adopts various familiar roles in play theme (e.g. plays house)
Thematic fantasy play	Adopts roles of fantasy in play theme (e.g. plays superman)

Table 5: Children's involvement scale (Ferre Laevers et. al., as cited in Panagopoulou 2015)

Involvement Scale	Definition
Concentration	The concentration that the child shows to the activity. Nothing can distract him from his/her deep concentration.
Energy	The child invests much effort in the activity. The child is eager and stimulated. Such energy is often expressed by loud talking or pressing down hard on the paper. Mental energy can be deduced from facial expressions which reveal 'hard' thinking.
Complexity and Creativity	This signal is shown when a child freely mobilizes his cognitive skills and other capabilities in more than routine behavior. The child involved cannot show more

	competence-he/she is at his/her very 'best'. The child is at the very age of his/her capabilities.
Facial Expression Posture	Nonverbal signs are extremely important in reaching a judgment about involvement.
Body Expression	Also nonverbal signs as moves or absence of moves of the child
Persistence	Persistence is the duration of the concentration at the activity. Children who are really involved do not let go of the activity easily, they want to continue with the satisfaction, flavor and intensity it gives them and are prepared to put in effort to prolong it. They are not easily distracted by other activities .Involved activity is often more prolonged.
Precision	Involved children show special care for their work and are attentive to detail. Non-involved children gloss over such detail, it is not so important to them.
Reaction Time	Children who are involved are alert and react quickly to stimuli introduced during an activity.
Language	Children can show that an activity has been important to them by their comments
Satisfaction	The Children display a feeling of satisfaction with their achievements.

Table 6: Measuring children's involvement indications (Ferre Laevers et al., as cited in Panagopoulou 2015)

Level	involvement	Signals
1	Extremely low	Activity is simple repetitive and passive. The Child seems absent and displays no energy .They may stare into place or look around to see what others doing.
2	low	Frequently interrupted activity. The child will be engaged in the activity for some of the time they are observed, but there will be moments of non-activity, when they will be stare into space, or be distracted by what is going around.
3	Moderate	Mainly continuous activity. The child is busy with the activity but at fairly routine level and there are few signs of real involvement. They make some progress with what they are doing but don't show much energy and concentration and can be easily distracted.
4	High	Continuous activity with intense moments. The child's activity has intense moments and at all times they seem involved .They are not easily distracted.
5	Extremely High	The child shows continuous and intense activity revealing the greatest involvement .They are concentrated , creative, energetic and persistent throughout nearly all the observed period.

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A Review of Pedagogical Support for Online Learning in the 21st Century "Please State the Nature of the Educational Emergency!"

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Abstract: This paper seeks to critically review online learning support in the 21st Century from a practitioner's perspective. The paper is a review of 25 years of experience tutoring on distance learning courses with the Open University in the United Kingdom during which time there has been a considerable change in the use of technology to support learning. The Open University is now in competition with many Higher Education Institutions in the UK who seek to have a more significant digital footprint in the provision of Higher Education. However the role of the Pedagogue in the delivery of this learning is often unclear. The fundamental question that needs to be addressed is "Has technology enhanced the interaction between Tutor and Students and is the Tutor role still important?" This paper will argue that the live Pedagogue is more valuable than ever but that the role of the Tutor in supporting the 21st Century Learner now requires the Tutor to be much more pro-active in the use of technology. The need to be proactive is a result of the availability of Information and Communication Technologies (ICT). This distance learning approach has moved away from the idea that "Subject 101" is on a Thursday afternoon from 1pm to 3pm in Semester A and embraces the idea of "Learn what you want when you want" but still achieve the same end goal in terms of skills development and critical thinking. The learn "What you want when you want" is at the heart of the distance learning mantra and this paper will discuss the role that Technology has played in supporting this approach in the delivery of Higher Education at a distance. The paper will conclude by considering what the future may hold for distance learning approaches and will speculate as to whether the future involves some form of personal support system that students call up when they need some form of help. The speculation revolves around the idea of an expert system fronted by a holographic projection of a Pedagogue with whom the student will interact. This type of approach may fit better with the asynchronous behaviour that students show in the way they utilise some of the ICT technology available today.

Keywords: distance learning, online tutorials, delivery mechanisms, online support mechanisms

1. Introduction: Tutor support in distance learning

As an institution the Open University (OU) was founded to provide distance learning and to reach out to potential students for whom attending a conventional day University was not possible. Modules and programmes are provided by academic staff and requires teams of people working to produce material for student self-study by students across the United Kingdom and beyond. This approach is summed up by "Our mission is to be open to people, places, methods and ideas" (Open University Mission, 2018). In terms of technology it is the words methods and ideas that are important in this paper.

In this context the approaches used by the OU to delivery learning for almost 50 years are seen to be alternatives to what we think of as "traditional" learning where the teacher is at the centre of the learning activity and where learning takes place in the classroom. With distance learning approaches the emphasis is on the material that is used to provide the direction on what to study and practice. (Garrison, 2009) The pedagogical input is still there but has been focused on producing distance learning material rather than Teacher led activities.

In the strictest sense distance learning involves no in person contact at all for the student, however this has not been the ethos within the OU. Although there is an increasing move to online provision there has always been the opportunity for the student to contact a named Tutor for advice regarding a particular piece of work in their studies and this is still the case 50 years after the creation of the OU.

In the context of this paper it is the role that technology plays in supporting tutor/student interaction that will be explored along with the technological journey the author has experienced as a Tutor in providing this support. (Duties, 2018), (AL Support, 2018)

Tait (2003) discusses the impact that the OU has made to Higher education and identifies the important role that the Tutor plays even with the growth of online provision. Tait states that "the core role of the tutor who works with a group of students of no more than 25 in number, and who teaches and grades their work, continues to be seens at the heart of learner support." This is still the model that is used in the 21st Century as the OU continues to adapt to provide structured learning for groups such as graduate level apprentices. (Graduate Apprenticeships The Open University, 2018) (Graduate Apprenticeships Skills Development Scotland, 2018)

As we will see the core role that the Tutor plays has not changed but the requirements are now much greater because of the use of technologies that were not readily available 25 years ago when the author started tutoring with the Open University. It is the relationship that the Tutor has with technology that is the subject of this paper.

There is a fundamental question here whether technology is helping the Tutor carry out the pedagogical role. This paper will attempt to critically appraise the contribution Technology has made to the Tutor's role and will investigate the changes utilising online technology has brought.

2. Distance learning provision and support

The commentary in this paper regarding delivery mechanisms primarily relates to the delivery of technology and computing courses which are the subjects the author has experience of delivering. The author's first experience of distance learning 25 years ago consisted of a number of components.

These were:

- The provision of printed material (in some instances supported by audio, visual and broadcast material)
- Practical exercises build into the printed material
- A printed study calendar

Duties 25 years ago are primarily the same as today (Duties 2018):

- Supporting students study through tutorials and additional contact
- Providing feedback on student assignments

However the job specification for an OU Associate Lecturer does now include specific reference to using Computing and Information Technology as part of that support (Open University Generic Person specification 2018). This indicates that a clear change occurred in the perceived role of the Tutor and the change required a specific level of computer literacy.

Over a 25 year period the provision of distance learning has made an increasing use of communications technologies to reach out to students and now fully embraces online technologies built on top of the internet. It is now possible to delivery not just an individual module online but an entire degree programme. In distance learning mode as offered by the OU it is possible to gain a Degree and not have attended any Face to Face or online activities. This would however go against the ethos of the OU which makes considerable effort to help students to interact with their Tutors and with each other.

Distance learning has always consisted of a blend of activities. Definitions of blended learning generally make reference to the use of digital technologies which make use of various platforms to deliver content. (Bonk and Graham, 2006) However in the early days of the OU the blend was printed material, broadcasts and audio tapes, later this was printed material, video tapes, CDs and then DVDs. In 2018 the internet plays a central role in distance learning.

For the purposes of this paper Technology can be split into 2 categories

- Technologies to support the delivery of content
- Technologies to provide support for students in their pursuit of learning

Technologies supporting the delivery of content help to:

- Provide the information that you want to study using HTML material/Web applications etc./pdf documents/eBook formats
- Pace the study that you are engaging in online Calendar of Activities/online activities/online submission of assignments

Technologies which support students in their pursuit of learning include

- Tutor group forums
- Synchronous communication with Tutors

All of these approaches utilise Information and Communication technologies and sit on top of the Internet. The real question here is whether technology as we are experiencing it is enhancing the relationship between Student and Tutor or whether it has just made it a different role. The author is reminded of the quote from Industrial Engineer Allen H. Mogensen who in the 1930s suggested that we should work “Smarter not Harder”. (Wikipedia, 2016) Looking ahead Figure 1 maps the transition to the use of ICT technologies in the support of learning over a 25 years period. The main point from this table is there seems to be a lot more pieces of technology that the Tutor and student need to engage with on a regular basis and there are now more opportunities for students to interact with their Tutor and each other.

Looking at Figure 1 an interesting observation that can be made at this stage is the emergence of a number of asynchronous technologies where someone does something and then waits for a response or someone checks a “location” for an update of some form. Technologies that fall into this category include email, Forums, Course Web Site and Social Media. Lambie and Law (2017) found that many students prefer to interact in an asynchronous manner with their Tutor rather than engage in synchronous activities such as online Tutorials. Further Lambie and Law (2017) found that even when they did engage in synchronous activities they preferred to use the chat box option rather than speak and engage directly with the Tutor or with fellow students.

In order to put the role of Distance Learning and the contribution the Open University has made to distance learning in to perspective a review of relevant literature will be carried out in order to provide some context for the authors observations.

3. Literature review: Distance learning and technology

Moore et al (2011) indicated that terminology in the distance learning area is used inconsistently so care has to be taken when using terminology in this area. Perraton (1988) identified that distance learning is characterised by the separation of teacher and student. This separation can be either in space and or time. Keegan (1986) and Garrison & Shale (1987) indicate that this gap is mediated by a combination of printed material and the use of technology. This is clearly the case with OU courses. It is the role that technology plays in the pedagogical process that is at the heart of the discussions in this paper and how this use of technology is influencing the role of the OU Tutor. In the 50 year history of the OU broadcast technology has played an important role in bridging this gap between student and teacher. Schamber (1988) and Barron & Orwig (1993) provide a discussion of distance learning system and the role that broadcast media and recordings play in that process. Porter (1994) identifies the lack of 2 way communication with broadcast media and identifies that there is still an important role for the Tutor to play. This role is specifically related to helping students understand abstract concepts and was also identified by (Tait, 2003) and (Goodfellow, 2014) as being a vital role in supporting OU students. Looking ahead, Figure 1 seeks to summarise the range of technologies that have been used in the 50 year history of the OU and clearly identifies broadcast media as an important contributor. The year 2007 was a significant landmark for the OU because it was the last year that it used television broadcasts as a means of distributing course related material. (BBC News, 2006) In 2007 technologies such as DVDs were proving to be a much more attractive way of distributing course materials. As we will see today DVD technology has now been superseded to a large extent by the internet as the key medium in allowing access to course material. The relatively easy access to the internet either via a wired connection or via WiFi is a significant factor in accessing course material.

3.1 Distance learning approaches

In order to discuss the role that the OU Tutor plays in supporting students it is useful to try and identify a model to which the learning that is being delivered adheres to. In modern terms the “Flipped Classroom” and “Blended learning” are terms that may be used to describe the delivery of OU modules. There are certainly elements of the flipped classroom evident in the OU approach. However for the flipped classroom to be successful students need to buy into attendance at the classroom events. (Bergman and Sams 2012), (Mok 2014). In the vast majority of OU courses there is no compulsory attendance at either Face to Face or online Tutorials. For many students there is no regular quality classroom time where the teacher engages them in activities related to the topics they have been studying. For the students who do turn up at Tutorials this quality learning is there and students do get the benefit from attending these sessions. A similar argument can be made for online tutorials where problem solving type activities are used. (Goodfellow, 2014), (Lambie and Law, 2017) So support is available but students need to want to engage with it. However for many students the model is one of directed self-learning governed by the assessment strategy of their course. (Lambie and Law, 2017) found that there were some students who simply did not want to attend any Face to Face or online sessions and there was another group for who were ambivalent as to the role that online Tutorials could provide in supporting their study. So for some students it would appear that the availability of technology has no specific impetus in terms of attending online Tutorial sessions. (Umrani-Khan et al, 2009)

(Bonk and Graham, 2006) define a blended learning system as "…face to face instruction with computer mediated instruction". The author would argue that the OU has always provided a form of blended learning but increasingly in the 21st Century the blend is built around access to the internet with many of the learning activities utilising online tools and online resources. There has been a clear progression from printed material and synchronous broadcasts through printed material and electronic media (CDs containing audio and visual material) though to printed material with audio and visual material available online for consumption by the student at times to suit their studies. Utilising changing trends in media formats has been a core activity for OU development teams.

A fundamental feature of engaging with distance learning material is you need to be an active learner who is keen to participate in the process. In order to make the best use out of distance learning you cannot be a passive learner who waits for the information to be provided.

3.2 Progression towards technologies to support the delivery of content

Writing and then Printing made a significant contribution to learning because information no longer had to be passed by word of mouth. So from an early stage technology has played a vital part in education. It has been stated a number of times that printed material is core to the distance learning approach provided by the OU and this still is the case almost 50 years after the inception of the OU.

The main factor today is the significant shift to the use of online technology in the provision of material and in the support of students. The key here is the term "significant shift" rather than whole sale move. Although much of the material and activities associated with studying an OU module are available on line there are still opportunities for Face to Face contact and there are still pieces of technology such as the telephone which can be utilised. Telephone tuition does not just involve the student contacting the Tutor but has also involved the Tutor organising conference calls with the students phoning a specific number at an OU regional centre. This approach is now superseded by online conferencing as provided by products such as Blackboard Collaborate, Adobe Connect etc. While the telephone is still an option available to the Tutor, in its day it was the main medium of reaching out to students unable to attend tutorials perhaps because of their remote location with telephone conference calls a means of trying to provide a group presence for some remote students.

Printed material is supplemented by HTML content, pdfs and eBook reader formats. This multifaceted approach helps with the flexibility of delivery of content and allows students to choose which format fits their approach to study and learning. It could be argued that it is consumerism as much as anything that is at work here with low cost availability of technology to access HTML, PDF content etc. that has resulted in this style of delivery. (Shapiro, 2013)

3.3 Technology usage: The situation today

Figure 1 shows the predominant technologies used 25 years ago and the equivalent technologies that are used today. In some cases the technology is still there but is not utilised and in some case there is an alternative ICT technology that is being used because it has gained favour in some way.

One distinction that can be made is between physical technology and the services provided through the Physical Technology. Internet access and Wi-Fi connectivity to the internet are seen as essentials in life and this has produced a generation of students who are always online. In the 2018 side the entries represented in bold are all services that sit on top of the Internet. It is these entries in bold that have in the author's experience resulted in a changed job role with a requirement to be far more proactive in utilising these services in order to support distance learning students.

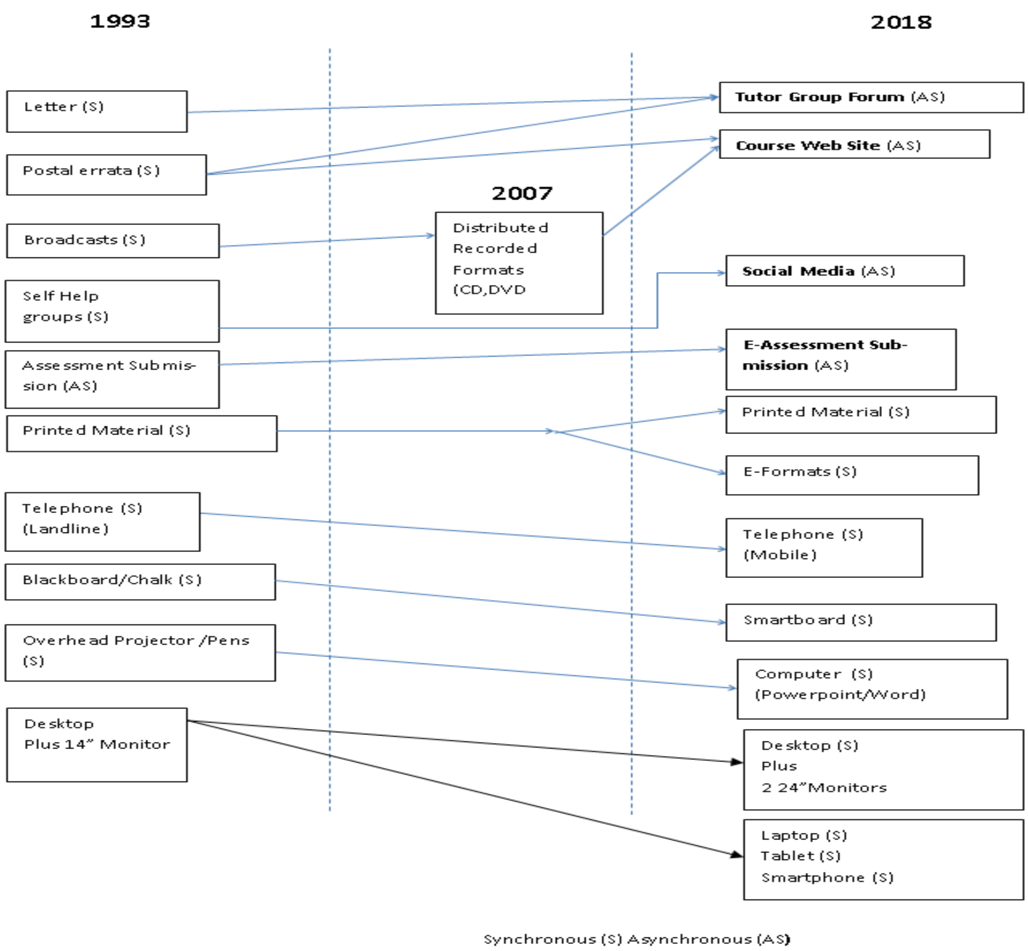

Figure 1: Technology transition in distance learning over a 25 year period

In terms of the physical technology that is available today it is clear that consumerism is at work in making products such as laptops, netbooks, tablets and smartphones available. This makes it possible for so many students to be able to access these services. It should be noted that most of these technologies involve asynchronous access at a time to suit the students lifestyle and the study "what you want when you want" philosophy of distance learning. In terms of the availability of this physical technology there is certainly evidence that Moore's Law (Moore, 1965) is at work here in terms of the raw processing power of this technology and there is clear evidence of the Ubiquitous nature of the computing equipment that is available to both tutor and student. In many cases a laptop is preferred to a desktop machine because of the portability offered. Whether or not Moore's law is still applicable, there has certainly been a significant advance in ubiquitous technology that is affordable to the general public (Cusumano and Mazur, 2016). These devices are also very personal to the user which is in contrast to the view of Mark Weiser in his 1991 paper the 'The Computer for the 21st Century". (Weiser, 1991). Weiser suggested that Tablet sized computers would become so cheap they would be treated like scrap paper and left lying around. This vision has not come to fruition partly because the cost of even the cheapest tablet computer is still not as cheap as a sheet of paper and devices such as Tablets and Smartphones have also become very personal devices. However they are sufficiently cheap that this technology can be considered to have been seamlessly integrated into society and have been integrated into the distributed learning approach (Schmidt, A. et al, 2012), (Ebling and Baker, 2012). Course material can now be downloaded to these devices or accessed from these devices and has contributed to the range of places and times that students can study. Cost effective computing devices along with the ubiquitous nature of Wi-Fi is clearly a driver in the move to online provision. (Shapiro 2013) discuss a range of electronic devices which help to support the flipped classroom. Further, (Shapiro 2013) identified the impact that Smartphones and 3G networks were having on internet access in Africa. The author would argue that this is a natural progression of technology and that the development and availability of information technology is driving learning into the online world. The author would go as far to say that students expect material and services to be online and to be able to access this material from their mobile devices. This expectation is also apparent in the developing world. However this flexibility has come at a price for both Tutor and Student with Figure 1 showing that building services on top of the internet means there are more options to interact with learning materials and services.

These services include Tutor Group forums which provide options and/or requirements for collaborative working of some form. It is interesting to note that (Richardson,2009) found that students did not indicate that they believed there was any significant difference in the academic quality of courses which provided support using online technologies. (Richardson, 2009) also indicated that training for staff and students in using online technologies was important. This is a point that should be considered by course teams and senior management in Higher Education institutions.

(Ng, 2007) noted that staff delivering courses using online tools expressed concerns about the workload associated with these online tools. This is illustrated by Figure 1 which shows that there are a number of pieces of technology which both staff and student have to engage with on a regular basis. It is clear from Figure 1 that the learning landscape today is very different from 25 years ago and while consumerism has driven this shift to a greater extent the demands on using these technologies are also much greater.

3.4 Face to face technology

The technology used in Face to Face Tutorials has also changed. The multimedia experience of today is no longer coloured chalk or coloured pens but rich delivery based around products such as PowerPoint or Word with embedded video and animation etc. The expectation today is to have some form of information technology to support Face to Face learning. So in the Face to Face environment Blackboards have been replaced by Whiteboards and marker pens and in many cases Smartboards are the Standard for classroom activity.

3.5 Assessment and feedback

In the early days of working for the OU assignments were submitted via the Postal service or were hand delivered by a student. They were generally hand written and were mark marked by hand using coloured ink. The author recalls one colleague who would mark the assignment with the student when it was hand delivered hence providing a very personal form of feedback on the work produced. However for at least the past 12 years OU assignments get submitted electronically via an Electronic submission systems with students expected to submit in an appropriate Microsoft Word format. Comments on the student assignment are still provide in coloured ink with general comments aimed at helping future learning provided in an electronic form rather than on a paper form. Poor handwriting is therefore pretty much a thing of the past having been replaced with typed documents resulting in a reduction in the amount of paper that both the OU and the Tutor has to handle. Students can now submit right up to the deadline for an assignment which is good for the busy student. In terms of marking r the minimum resources needed are non-trivial. Figure 1 indicates the Author now has 2 large 24” monitors compared to a single 14” Monitor of 25 years ago! Both monitors are certainly needed when marking electronically allowing direct access to the marking scheme and to the students work. The author next upgrades will have a graphics card capable of supporting 3 screens to allow the windows that are open during the marking process to be “spread” out more efficiently for easier viewing. Again consumerism is at work here with the cost of a 24” flat screen monitor significantly less than the £500 cost of a 17” monitor upgrade 15 years ago. (Fong, 2012) identified the contribution the miniaturisation had made in the production of consumer electronics. So while marking as an activity has moved online there is a need for a significant amount of equipment to make the marking process straightforward. It is interesting to note that from a Student and Tutor perspective marking assignments and the feedback generated is the one activity where both parties meet, all be it in an asynchronous manner.

4. Methodology

This paper has sought to review the changes in the use of technology over the past 25 years and to chart these changes in a visual manner as shown in Figure 1. The contents of Figure 1 are a representation of the journey that the author has experienced carrying out his duties as a Tutor with the OU over this 25 year period. In order to put the journey experienced into the E-Learning context a review of appropriate literature was carried out to provide some substance for the observation that were made.

5. Conclusion

Today we are dependent on the Internet for a range of activities. The Students of today are very much the "always on" generation. This infrastructure is central to the success of technology for distance learning students and specifically mobile technology. It is clear from interacting with distance learning students that the ability to access material on the move (trains, buses etc.) is important allowing them to read material and to carry out activities such as reading emails and receiving course related announcements. So electronic media and Ubiquitous devices such as tablets have reduced the bulk of study materials that need to be carried around. This is a positive step.

However we do appear to be in a position where an organic "Being" is still involved in the education process and it is this person that marks assignments etc. and provides advice. So it would appear that technology is still very much in a supportive role rather than replacing the Pedagogue in the education process.

5.1 Online technology: Friend or foe?

So as a Tutor would I want to go back to the earlier days of less available technology and a greater reliance on paper and face to face activities? The answer is probably not! While the core role of providing support to students is really the same the requirements of the job are in the authors view different, with that requirement being a greater role in using technology that was not available 25 years ago. The availability of internet technologies from a Tutors perspective has increased the workload with the need to communicate using different internet based services, but on the flip side it makes some aspects of communicating with students more flexible. Foe example greater use of email removes the need to synchronise over the telephone. This is a positive step.

There are constraints and online Tutorial provision for example does provide a different experience from a Face to Face Tutorial provision. Lambie and Law, (2015), Lambie and Law (2017) showed that the lack of visual and aural cues from students in the online world makes it more difficult to run a synchronous session online. Lambie and Law (2017) indicate that students are less likely to want to speak in an online environment and are happier using the chat box feature in Tools such as Adobe connect to communicate with the Tutor. This may be in line with the way students use social media many of which are based on asynchronous approaches. Lambie and Law (2015), Lambie and Law (2017) further indicate that when put into breakout rooms in the online world students are more likely to want to collaborate and work on problem solving type activities. This however needs to be a planned activity from the start to ensure that the various pieces of technology within Adobe connect are set up and ready. This is another example of the increase in workload that arises from utilising online technologies. It would also appear that students do not like "Big Tutor" watching rather than just "Big Brother".

5.2 Moving into the future in the online world and beyond

The title of this paper does seek to provoke some element of thought as to what the near future may hold in terms of terms of technology usage. The statement "Please state the nature of the education emergency "is a play on words from the TV series "Star Trek Voyager" where the crew only have a holographic Doctor to help with medical matters as travel the Universe. The holographic Doctor is of course simply a manifestation of an expert system which captures the medical knowledge from appropriate experts and an appropriate bedside manner thrown in for good measure. (Antoniou, P. et al, 2017), (Čopič Pucihar, K et al,2017) There may be some scope for students being able to "call" up a manifestation of an organic "Being" as and when they see fit. (Lin, Qi et al, 2012) This would fit in with the synchronous nature of student requirements as discussed by Lambie and Law (2015), Lambie and Law (2017). Whether the replacement of the organic being by a holographic image is the future it is clear that wearing some form of headset in order to enter some form of augmented reality word to participate in some form of activity is available now. This type of technology is likely to become Ubiquitous. So on the way to interacting with a holographic image an augmented reality headset may be the intermediate step and as technology advances the headset will become less bulky. (Dalsgaard, P. and Halskov, K., 2011) As Weiser, (1991) suggests interacting with computers should be the same as taking "a walk in the park". The internet has provided access to vast amounts of information but we are still dependent on keyboards and monitors and are forced to enter the computers world rather than have the computer enter our world. The argument here is that as technology advances it will be absorbed into education but will not necessarily be a form of learning in itself.

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Tutor Perception of Delivery Mechanisms for Online Tutorials

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Abstract: This paper builds on previous work by Lambie and Law which investigated the role of online Tutorials as part of a flipped classroom approach to teaching and the perception of students to their engagement with online Tutorials. Online tutorials for distance learning students is now an established approach in supporting students at a distance. From the Tutor's perspective a fatal pitfall is to assume that the online tutorial is a direct replacement for the traditional lecture. A passive or semi passive approach to online Tutorials offering an asynchronous delivery may discourage student participation and does not work well in a flipped classroom approach where students have already engaged in active learning. At the heart of the student centred experience offered by the Flipped Classroom approach are: problem based learning, exploratory learning, peer interaction, communication building skills and the overarching need for the student to display their learning. In order to gain maximum benefit from the online tutorial, the student should be encouraged to prepare prior to attendance at the tutorial in order to discuss the topics being covered. Preparation may take the form of preparatory reading, completion of an example question, viewing a video etc. The key is to encourage the student to prepare prior to online tutorial attendance to maximise the benefit of attending. Interaction throughout the online tutorial is paramount, a synchronous approach to tutorial delivery will be beneficial to both the participating student and the tutor. Approaches the lecturer can deploy include group and individual work, problem solving, guided practice and question and answer sessions. The paper seeks to investigate the types of Tutorial Activity that Tutors provide and the level of Engagement that Tutors perceive students exhibit within these activities. A Focus Group was used to investigate Tutor perception of the role that an online Tutorial plays in supporting students studying at a distance and attempted to examine current practice in the field by instigating discussions in a structured manner with tutors on computing and technology courses, identifying good practice and making recommendations on how to encourage best practice among practitioners.

Keywords: e-learning, distance learning, synchronous communication, flipped classroom

1. Introduction

This paper seeks to build on the work of Lambie and Law (2015, 2016, 2017) which explored the participation of Open University students in online Tutorials on a particular Technology and Computing course (TU100 My Digital Life). This course has now finished and has been replaced by two courses (TM111 and TM112 Introduction to Computing and Information Technology 1 and 2). The new courses cover very similar material and have a very similar approach to providing support for students who either want or need support via a series of Face to Face and online Tutorials. All of these courses are distance learning courses built around printed and online material and activities with support provided by a specific Tutor who generally deals with around 20 students.

This paper seeks to investigate the perceptions of Tutors who are responsible for running the online sessions, in order to try and determine what delivery styles are used in the provision of online Tutorials. In order to do this the authors have used their observation and experience of participating in online sessions with colleagues over a number of years and particularly on the new TM111 and TM112 modules. In particular the authors discuss how online Tutorial activities are used to support the Flipped Classroom approach which is at the heart of OU study.

The research is driven by a need to understand attitudes to the use of online support methods and the level of engagement with synchronous activities. In this paper, the effect that Tutors running the synchronous sessions have on the session will be examined with the intention of identifying best practice.

2. Literature review

The literature review presented in the following sections, outlines the manner in which Open University (OU) students study along with the perceived model of study in relation to the classroom activities that are supported and used in both Face to Face and online synchronous tutorials.

At the core of the Open University approach is high quality printed material. Presently, this material is also available electronically with week to week guidance provided by a diary based website which also provides varying forms of interactive activity.

Traditionally Face to Face and telephone contact were used to provide support for students studying at a distance. Both these approaches are synchronous activities which require some form of rendezvous between Tutor and Student(s). Technology and specifically, internet technologies, provides a number of options which allow both synchronous and asynchronous communication.

The courses for which the authors' are currently Tutors on makes extensive use of tools including Adobe Connect to support students studying at a distance. In the case of distance learning students there is only a limited opportunity to attend Face to Face sessions simply because of the nature of the study. Distance learning students study part time and may be working during the week or even in the evening or at weekends depending on their job. With the development of online technology there has been increasing use made of online tools including Blackboard Collaborate or Adobe Connect to try and bridge this gap by widening access to synchronous activities between Tutor and Student. There was an expectation that numbers attending online Tutorials would be greater because of the relative ease of access. This, however, has not been the case with the numbers attending online Tutorials, in the authors experience, not being any better than those attending Face to Face Tutorials.

One factor may be the tools that are being used. Alonso et al. (2005) observe insufficient pedagogical teaching principles in the software design of e-learning tools, such that, the tutors using these tools are defining the pedagogical implementation and approach for their use. Abeysekera and Dawson (2015) state that changing the delivery mechanism of a "transmissive class" will not lead to learning gains, instead, there also needs to be a change in pedagogy.

Interestingly, Lemmer (2013) notes that "pedagogical goals" should be the guide to technology use and not the other way about, also, discerning the level to which "technology supports identified course learning objectives and desired outcomes, and how it enhances or supplements, rather than simply supplanting, the traditional teaching strategy."

Does this then leave the lecturer/tutor trying to shoehorn pedagogical approaches into e-learning tools that are not suitable for the purpose? If so, this will impact on the engagement of the student during participation of online tutorials and hinder the ability to deliver problem based active learning. Lambie and Law (2015) indicate that delivering online Tutorials was not an easy task with a lot of preparation required. So, it is likely that Tutors will be cautious in the effort they expend on preparing material for online delivery. It would appear that training in using an online tool needs to be accompanied by education in the associated pedagogical factors

There are a number of approaches that may be taken in providing material for distance learners with most approaches involving some form of blended learning where at least part of the provision is online. There has been much discussion in Higher Education of the flipped classroom approach to help students prepare for classroom activities in which they have direct contact with a subject specialist. The concept of the flipped classroom originates from a continued exploration of the combination of blended learning and problem based learning, coupled with using "active learning techniques" and "new technologies" to offer greater involvement for the students (Arnold-Garza, 2014). Jarvis et al. (2014) add peer instruction to this list of concepts. The concepts of problem based learning, active learning and peer instruction, can be harnessed for good effect when delivering online tutorials. The concepts are similar; the need for the student to be involved rather than passive and to demonstrate their understanding of the material being studied. It is therefore apparent that the role of the Tutor is important in conducting these activities.

With distance learning courses including those outlined above the classroom is in some respects completely flipped and attendance at "classroom events" is optional. In terms of preparedness this can be a problem for the Tutor in that there is no guarantee that a student attending a Tutorial has covered specific sections of work, so in the flipped classroom sense this can be an issue. This is a point identified by Abeysekeraa and Dawson (2015) who note their concern with "issues of student motivation" posed by the flipped classroom. As they see it, the "success of in-class activities" relies heavily on the students attempting and finishing the pre-class preparatory work which will allow them to maximise the benefits of the in-class activities, although, gauging the level of the student's preparedness, knowledge level and usefulness of their preparation process is not easy to judge. Mok (2014) indicated that one way to check on student engagement prior to a classroom session in the flipped classroom model was to include quizzes as a means of monitoring student engagement.

Distance learning students choose to study by that method because the approach suits their lifestyle. However, with an increase in the use of online activities including forum contributions and synchronous conferencing using products like Blackboard Collaborate and Adobe Connect there was an expectation that students studying through distance learning approaches would be keen to utilise these products in order to participate in sessions with their Tutor. This expectation was based on the growth of products including Facebook etc. and other social media products. The fact that students overtly utilise technology is no assurance of “informed learning” and could hamper the procurement of knowledge and understanding (Lemmer, 2013), (Umrani-Khan et al, 2009). So it would appear that Technology itself is not necessarily a factor in encouraging students to be active learners. This is in line with the authors’ experience.

Abeysekeraa and Dawson (2015) suggest a strong link between active learning and the flipped classroom; their research points to the passive role that students adopt during the traditional lecture, as such, students are more inclined to “procrastination” and or “surface approaches to learning” leading to a detrimental influence on their performance. The link between the flipped classroom and online Tutorials does not appear to be apparent in the authors’ experience. This is based on low numbers of students attending online sessions. So the opportunity to utilise technology does not appear to be a motivating factor for OU students studying at a distance. Abeysekeraa and Dawson (2015) focus more on traditional classroom activities following some form of flipped study by the student. It is interesting to note that (Goodfellow, 2009) found that students who did attend tutorials found them useful and is further supported by the findings of (Lambie and Law, 2017).

McLaughlin et al. (2014) cogitate “higher-order thinking, problem solving, and critical analysis” are aroused through active learning, furnishing the tutor and the student with feedback. Furthermore, active learning can enhance student “motivation and attitudes” (McLaughlin et al., 2014)

The use of quizzes is part of the TM111/TM112 course philosophy and there is scope for using this as a test of readiness for an online problem solving session. Maher et al. (2015) indicate that flipping the classroom allows the students to focus their in-class time on more productive learning activities of “solving problems, writing code, design tasks, or discussing concepts with others.” creating a peer based collaborative learning environment improving “overall learning, increases student confidence and makes coding fun.” Use of quizzes within the flipped classroom are a productive mechanism for tutor and student intercommunication enhancing student learning (Maher et al., 2015). Maher et al. (2015) used various techniques to maximise the student learning during the in-class activities including pair programming, group problem solving and flexible quiz activities. Using quiz activities as learning activities, Maher et al. (2015) state “retrieving information from memory improves long term retention” and the quizzes reinforce “conceptual knowledge”.

There are two specific factors here that need to be considered.

- Getting students to attend in the first place,
- Getting students to return after their first experience of an online Tutorial

For a Tutor running regular sessions with different groups of students this, is likely, to be quite a challenge.

2.1 Approaches to running face to face tutorials

Face to face Tutorials are the traditional way to support students and to provide direct feedback on their work. Perhaps there will be a point in the future where face to face tutorials are no longer needed or used but for many teachers they still play an active role in the lessons they delivery in a wide range of educational institutions from schools to universities. From the authors’ experience tutorials are based on questions related to core theory and to problem solving approaches to the application of this theory. So this activity implements a flipped classroom approach where students have already carried out some study and are ready to discuss this activity. The authors are not suggesting that Face to Face tutorials are some form of panacea. Face to Face tutorials can be hard to run and often feel like one is trying to pull teeth. Face to Face tutorials at least allow you to see the nuances of the participants and to judge whether they have completed the preparatory work. This is much more difficult in the online world where these nuances either are not available or are difficult to see (insufficient visual cues for example along with reluctance on the part of the student to speak)

2.2 Approaches to running online tutorials

How then does a Face to Face Tutorial morph itself into an online Tutorial and what points must a Tutor consider when designing an online activity?

There are a variety of possible approaches that can be taken when delivering an online Tutorial session. These include:

- Session which is mostly talk by the Tutor
- Session where students are expected to present/discuss their solutions to problems set prior to the session
- Session where the Tutor leads the students through a number of different questions
- Problem solving session in which students actively collaborate and try to solve a problem that is related to their topic of study
- A combination of the approaches above

There are difficulties that need to be overcome with approaches 2, 3 and 4 in that, experience has shown, students are often reluctant to speak in an online situation as identified by Lambie and Law (2015, 2017). This is particularly apparent when the students remain in the main online room with the Tutor(s) present.

Approach 1 is really just a mini lecture and as such would be better considered as some form of podcast that students can download and view at their own convenience. Approach 2 is best achieved with the students all in the one place and requires students to be active in the discussions as different answers/approaches are discussed. Approach 4 is best facilitated in breakout rooms where students are put into small groups for a period of time with a specific brief of a problem that they are required to solve. The Tutors can then move in and out of the rooms to check on progress. Lambie and Law (2015, 2017), Horn (2013) suggests the flipped classroom offers the student an enhanced capacity for boosting their learning through a “feedback cycle” that allows the tutor to answer questions and monitor student progress. Online sessions involving problem solving tasks would certainly provide opportunities for the student to get feedback. Jarvis et al. (2014) further postulate that social constructivist theories of learning support both the flipped classroom and active learning; the fact that students learn through interaction with their peers, attaining fresh understanding while reinforcing and enhancing current or previous knowledge affirm the idea that “thinking takes place through communication”.

Using cooperative activities promotes learning together, self-reliance and activeness, however, this needs to be “structured and built” (Alonso et al., 2005). Alonso et al. (2005) suggest three elements are required: Activities, Participants and Instructor. Activities should be collaborative in nature, aligned with module learning outcomes and attention should be paid to the group size and participant background to maximise potential group interactions (Alonso et al., 2005). Participants must exhibit the essence of participation as this is central to “a successful learning community”; also, respectfulness and a work ethic (Alonso et al., 2005).

The Tutor(s) running the online session need to be clear in their own mind what the main purpose of the session is. There may be situations where it is appropriate to give some form of mini lecture to clarify specific points but there needs to be opportunities for students to discuss points that are covered in the lecture. If there is no option for discussion it would be simpler to make a recording of some description and allow the students to view this asynchronously. So from experience of running online Tutorials and from the literature it would appear that developing active problem solving sessions is beneficial to students.

The tutor also needs to play their part in facilitating a successful session; to this end the tutor must be: welcoming, encourage student participation, supply timely feedback, offer direction and articulate themselves clearly (Alonso et al., 2005). This reinforces the authors’ experience that online tutorials can have a high workload (Lambie and Law, 2015). Where numbers demand and where it is possible the online session should be run by two Tutors working in collaboration with each other.

McLaughlin et al. (2014) suggests student’s capability to “read and learn information on their own”, however, their needs would be better fulfilled with the tutor providing a coaching/mentoring role sparking and provoking their thinking, offering problem solving guidance and “encourage their learning and application of the material.” So again it would appear that the Tutor role is very important.

The fact that students directly utilise technology is no assurance of "informed learning" and could hamper the procurement of knowledge and understanding (Lemmer, 2013).

Participants must exhibit the essence of participation as this is central to "a successful learning community"; also, respectfulness and a work ethic (Alonso et al., 2005).

The tutor also needs to play their part in facilitating a successful session. As previously stated the tutor must be: welcoming, encourage student participation, supply timely feedback, offer direction and articulate themselves clearly (Alonso et al., 2005). This is also reinforcing the experiences of the authors that the Tutor need to be practiced in the setting up and running of the problem solving sessions. The Tutor must not only be familiar with using the online tool but must understand the rational/theory behind the selected approach.

Further, Alonso et al. (2005) postulate that the "e-lesson" is "the minimum self-contained learning unit." comprising "a set of facts, concepts, processes, procedures, and principles" the learning of which is predicated on the learners' current knowledge base. Alonso et al. (2005) define the taxonomy of an "e-lesson" as being split into six sections: Presentation, Objectives, Necessary Knowledge, Learning Tasks, Practice and conclusion, postulating that this format provides "a consistent framework".

Alonso et al. (2015) further elaborate on these six sections as paraphrased here; the presentation element chronicles the subject material being delivered by the "e-lesson" delivering "guidance" and motivation to the participants regarding the "knowledge they are to acquire."; the objective element should specify to the student what the outcome of the learning is to be, and, outline "the tasks that learners will be able to perform."; the necessary knowledge element should offer advice and direction with regard to the exercise being undertaken to advance the student learning during the "e-lesson"; the learning tasks element provide the vehicle for acquiring the skills to be learned; the practice element is used to reinforce and underpin the material delivered in the necessary knowledge and learning tasks elements through the provision of practical exercises and the utilization of group activities and discussions to "drive community learning."; the conclusion element is used to strengthen and reiterate the "key points" of learning delivered through the "e-lesson" concentrating the student's thinking and challenging them to reflect on their learning deciding if they have understood, processed and can apply the knowledge delivered by the "e-lesson".

Alonso et al. (2015) position the six elements of an "e-lesson" into two classifications: content and context; content comprising of necessary knowledge and learning tasks and context comprising of presentation, objectives, practice, and conclusion.

The six element "e-lesson" format certainly offers a template that can be manipulated to suit an online tutorial. Many of the aspects presented in this format are achievable through the use of the Open University's current synchronous learning tool, Adobe Connect, which offers breakout rooms for active and problem based learning, facilitating peer discussion, screen sharing, slide sharing, chat boxes etc.

Embracing active learning as part of the online tutorial pedagogy should motivate and establish the student's ownership for their learning, subsequently, allowing the Lecturer/Tutor to incorporate problem based learning as a student engagement mechanism (Lemmer, 2013). Lemmer (2013) suggest using a problem based learning approach as this necessitates the student to "analyze the problem presented, identify information needed to devise a solution, locate and study the needed information, and apply the newly acquired knowledge to the problem."

In the authors experience problem based learning works when students are put into separate breakout room and are "visited" from time to time to check on progress. This is also an opportunity to provide feedback on progress with the task being carried out.

3. Research methodology: Focus group

To help gauge the range of opinions within Tutors supporting these courses, a short focus group was held online as a means of gauging Tutors opinions. The decision to use a focus group was based on the idea of a group interview of Tutors to determine if similarities in teaching approaches prevailed; in the believe that in-depth information on perceptions, insights, attitudes, experiences, or beliefs could be gathered in an open and frank exchange. As facilitators, the Tutors were guided based on a predetermined set of topics. The hope was to create an environment that would encourage the Tutors to share their perceptions and their practices of running online synchronous tutorial sessions. Choosing a focus group methodology did mean that the data collected was qualitative, descriptive and subjective in nature, therefore difficult to measure numerically.

Having previously used a questionnaire based approach to ascertain the students view of participating in online synchronous tutorial sessions, the decision to canvas Tutors using a focus group would provide quicker access to Tutor views with a minimum of setup for the facilitators and the potential for the participants to better articulate their perceptions, insights, attitudes, experiences, or beliefs.

3.1 Conducting the focus group

Both authors participated in the focus group session with the lead author in the role of facilitator and the second author in the role of note taker. The lead author acting as the facilitator, guided the participants of the focus group through the research topics maintaining the groups focus. The second author acting as the note taker and using an online Google Document recorded the comments of the participants, trying to maintain, as far as possible the essence and manner in which the comments were provided. The focus group was conducted using an online Blackboard Collaborate room, for which participants were provided a link for attending The session had a duration of just short of 90 minutes. A plan for the focus group was devised which included the topic area for discussion and relevant sub-topics and an approximate timing guide.

Specifically, the authors sought to gauge opinion on:

- Style of delivery of an OU module
- Approach to running a Face to Face Tutorial
- Approach to running an online Tutorial

Discussion of the approach to running a Face to Face Tutorial and an Online Tutorial were sought in order to carry out some form of comparison of opinions.

4. Focus group findings

The organisation of the focus group arose from activities and discussions at the Open University Scotland annual Staff development session in November 2016. A number of comments were made at one session which identified a focus on online “tool usage” rather than on the pedagogy of delivering online sessions and the relationship of this activity to Face to Face sessions.

A number of comments stood out from the focus group discussions. These were:

- Uncertainty as to whether students were keen and motivated to attend
- Value attached to attending by students was variable
- A great deal of variety in the styles experienced
- Scope for a better explanation of Tutorials (both Face to Face and online)
- Students were often passive
- Lack of opportunity to perform just in time teaching based on student needs
- Students were more active in their course Facebook Groups than in their course Forums
- Numbers attending were low

It is clear that there are a number of factors at play here and are related to course/institutional attitude, student attitude, tutor attitude/delivery style.

A diagram was constructed using these factors in order to try and relate these factors in some way. This diagram is shown in Figure 1.

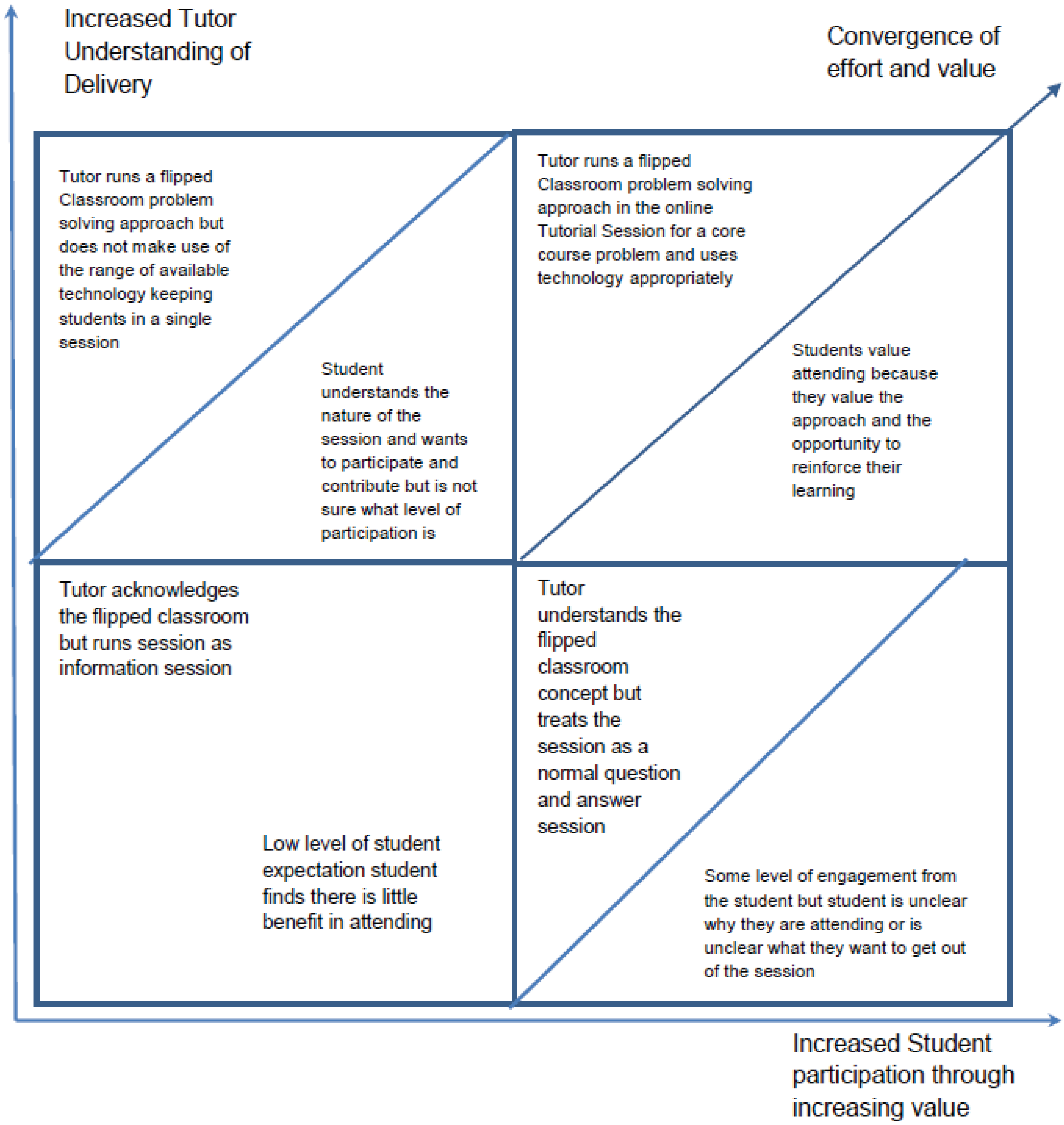

Figure 1: Attitude and engagement interactions

The goal is to have both Students and Tutors working together in the top right hand corner of the diagram. From the discussion in the focus group it would seem that there is scope for explaining to Students that online Tutorials are safe places in which to reinforce the work they have been carrying out in isolation and is an opportunity to have any questions related to their current studies answered.

5. Conclusion: What is best practice?

From the discussion in this paper and from the discussions in the Focus Group it is clear there are a number of factors at work when it comes to providing and organising online Tutorial sessions to support the flipped classroom approach. These factors are related to course/institutional attitude, student attitude, tutor attitude/delivery style and can be represented on a plane as represented in Figure 1. From the authors' experience and from a review of the literature it is clear that there is a great deal of merit in pursuing problem solving activities as a delivery style for online Tutorials and this is certainly an example of "good" if not best practice (Lambie and Law, 2017), (Maher et al., 2015), (Mok, 2014). But how do we get there? To have the Student/Tutor interaction in the top right hand corner of the diagram shown in Figure 1 will require a good deal of work on everyone's part including the OU as an institution. With the move to a greater use of online tools to support students there is a need to provide training in the use of the selected tool. This training has to extend beyond the mechanical usage of the tool to include staff development on the appropriate pedagogical considerations of using the tool and how best to engage with the Student group when using the tool. (Price et al, 2007) identified that the Tutor's approach to using the online environment was an important factor in developing a positive student experience in the online world, so it is important that the Tutor is well versed in the underlying theory of online support and delivery. This approach may go some way to reducing the variety of delivery approaches and help to provide a more consistent experience for students. This may also help to counter low attendance.

The starting point is already very well established with OU courses in that the learning components needed all appear to be there with good quality teaching material at the heart of the delivery and a active adoption of a particular online tool. There does need to be a change in attitude across the board starting with student education on the benefits of Tutorials as part of their studies. While it is probably naive to expect a wholesale change in student attitude to Tutorial attendance the target may be to identify specific groups of students who may benefit from attending problem solving type activities in a safe environment (Lambie and Law, 2017). To facilitate this there is a need to provide more in the way of education and training for Tutors in the pedagogical aspects of learning and how these problem solving ideas can be applied in the online world. With the continued growth of online provision and the growth of wired and wireless networks there will be a need to continue to adapt pedagogical approaches in order to deliver support over the internet using tools as Adobe Connect and Blackboard Collaborate.

To investigate further the intention is to conduct structured interviews with Tutors in small groups utilising tools such as Adobe Connect and Blackboard Collaborate. This will build on the contributions provided in the Focus Group and provide an opportunity to investigate them more deeply. The principle areas of interest are:

- the level of Tutor understanding of underlying approaches to online learning
- the role online tutorials have in supporting distance learning students
- the effect that different approaches have on student participation

The intention is to encourage the development of strategies that get Tutors and Students engaging in activities that are in the top right hand corner of Figure 1. The desired outcome is to use the results to demonstrate that there needs to be a change in staff development activities from a mechanical approach of "this is how to use the online delivery tool" to an approach where Tutors are reflecting on appropriate pedagogical approaches to providing support for online tutorial activities. One of the finding of Lowe et al (2016) was that Tutors leading online sessions should share best practice. The challenge is of course to encourage Tutors to discuss what they think is best practice and there is scope for doing this as part of their staff development activities.

Based on the authors' observation and investigation the following recommendations are made:

- Staff development should involve practitioners discussing what they believe is best practice for delivering online tutorials.
- Staff development should provide an opportunity for Tutors to discuss appropriate pedagogical underpinning for their online delivery approach
- Students are provided with the opportunity to identify what they would like to get from the Tutorial

Encouraging a more reflective approach would help to focus Tutors thinking on how best to use the tool rather than mechanics of the tool itself. Discussing with students in a Tutor group may also help to generate a better feeling of community and result in better attendance.

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Teaching Introductory web Development Using Scrimba: An Interactive and Cooperative Development Tool

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Abstract: New software applications may influence the way we teach. Scrimba facilitates live stream coding, ease of sharing code and an interesting new video format. What looks like a video is actually an audio stream combined with a dynamic code display. The viewer hears the audio while the code is generated as if it were a normal video tutorial. However, as the format is audio combined with text, the viewer may at any time stop the "video" and edit the code. How can educators use Scrimba to activate students and engage them in cooperative activities? We have investigated different use cases using Scrimba in two introductory web development courses. After an initial pilot, we evaluated the use of Scrimba in a course with 200 students. Data was collected through a survey (N=107) and semi-structured interviews with ten students. The students provided multiple reasons why the live stream of the coding in a classroom was useful. They also saw the value of being able to watch something that looks like a video, but with the possibility of jumping into the code and start to build upon it. The main finding, however, was how the ease of sharing code within a classroom setting created new opportunities. The entire class could engage in debugging activities, they could display multiple solutions for each other and they could create cooperative assignments. These are not new activities, but the activities were enhanced because of the reduced time in order to be able to cooperate and interact. We argue that the students became live coding participants and not only spectators through the introduction of a new software application. We further discuss these findings in the context of blended learning. Our findings should be relevant and interesting for anyone involved in teaching computer programming topics, and especially within web development.

Keywords: blended learning, web development, tool, Scrimba, cooperative learning, active learning

1. Introduction

Ki and Lai (1996, pg. 1) pointed out that "The use of the computer as an interpersonal or group communication medium is a relatively new phenomenon". Researchers such as Kiesler (1992) and Kaye (1992) had by then already written articles on use of technology as a means of creating a learning environment in education including collaboration. Kiesler (1992) outlined changes to the educational environment which included active and collaborative learning with students talking, teaching, learning from each other and exchanging experience-based and socially constructed knowledge. More than 20 years have passed, and technology has evolved with web applications enabling communication and sharing of information, maybe reaching yet its climax in social medias as Facebook and Instagram.

Langton, Hickey and Alterman (2004) integrated software tools creating the educational groupware tool GHT (Group Homework Tool, later developed into GREWPtool), including code editor, chat, whiteboard and resource page. GHT was created to promote cooperative learning through collaborative coding for novice student programmers. The study included students working in pairs out of each other's sight. Some main implications of the use of GHT was how it opened for collaboration in the form of the students planning how to code together and discussing and reviewing each other's code.

GREWPTool is a tool that facilitates student collaboration when creating web sites and programs. The software includes tools allowing the teacher to debug code with students in the classroom, a skill that is of importance for students (McCauley et al, 2008), and for students to write code together online. A study combining Moodle LMS and GREWPTool, Cavus, Uzunboylu & Ibrahim (2007) found clear statistical differences between students using standard and advanced tools for collaboration, where the use of the latter had higher success rate. The advanced tools included the possibility of compiling and running code in the tool, and for instructor and students to see each other's outputs during a session.

The use of technology in education is driven forth by among other results in research on active learning, blended learning and collaborative learning. A main goal is to create an interactive and dynamic setting where the student is made active through amongst other group work, discussions, tasks given in class etc. Although one has found that use of technology can promote active learning (Laird and Kuh, 2005), the normal way of giving lectures seem to still be face-to-face, tutorials, mentoring and project work (Boe, 2014); one possible explanation being that there is a lack of technology literacy amongst teachers. A 2000 study showed that introducing peer instruction and collaborative learning resulted in reduction of withdrawal and failure from 56% to 33% (Chase & Okie, 2000) and some studies show that active learning, versus traditional lectures, can result in higher grades (Freeman et al, 2014).

When talking about active learning it is of importance, in the context of use of technology in education, to talk about blended learning. Blended learning is in its simplest application giving a course face-to-face, in a classroom setting, in combination with online delivery (Dziuban, Hartman & Moskal, 2004; Okaz, 2015). However, the application of technology is only the start of blended learning; it isn't enough for a teacher to use an LMS and expect that what is blended learning and active learning. There seems to be several failures and very different achievements in implementing blended learning. One reason for the failures in implementing blended learning seems to be the lack of a strategic implementation of technology to obtain blended learning and active learning (Cavanagh, 2012; Jeffrey et al, 2014; Okaz, 2015; Boe, 2014). I.e. teachers are making use of technology and because of use of technology are calling it “blended learning”, even though it may be on the level of only making use of an LMS to give material to the students.

Implementing blended learning in education in a conscious and strategic way one may achieve learning opportunities that not found in other cases which may lead to improve both the social and cognitive skills of students. And the online material may be of many types, each with different opportunities. Some of the positive results for the students of using blended learning, in addition to the above mentioned, to promote active learning are: more accessible information, easier to work independent, at own time and pace, facilitation of collaborative learning experiences, easier to communicate and encourages information exchange also for introverted students (Carrington, Kim & Strooper, 2010; Jeffrey et al, 2014).

In the context of active and blended learning, we look to explore the following research question:

How can educators use Scrimba to activate students and engage them in cooperative activities?

While doing so, we find it of value to also investigate if the students believe that using Scrimba contribute to the learning outcome in an introductory web development course.

2. Methodology

In December 2016, a start-up company called Scrimba approached Westerdals Oslo ACT with ideas regarding a development tool under development. The tool (also called Scrimba) could facilitate new interesting activities within web development education. Since then, Scrimba and Westerdals have cooperated on using the tool in an educational setting. In the first half of 2017, we conducted a pilot in order to see if the tool initially was well accepted within a small group of students. In the second half of 2017, we tested the tool at a larger scale.

2.1 Pilot

The course included 26 digital marketing students and the dedicated module within the course was introductory web programming with HTML, CSS and JavaScript.

2.1.1 Initial use cases

We defined three use cases for testing the tool: *Live coding*, *Collaborative assignments* and *Recording outside class*.

Live coding: A teacher may develop code using Scrimba, and students may follow the coding live in their own laptop browser. In a classroom setting, this could replace the display of the code from a central "big screen" to multiple local student screens. Alternatively, the code could be displayed on both the big screen and multiple laptops. This provides the students with options: Follow the creation of code through the actions of the teacher, or write your own code by following the steps of the teacher. And between those two options, there will be an easily available opportunity for a transition. You can decide to start watching the teacher code, and when you feel ready, you can use the lecturer's code as the starting point for your own code. In Scrimba, this action of using existing code as a starting point for a new project is called “to fork”. The user “takes” existing code and uses the code as a starting point.

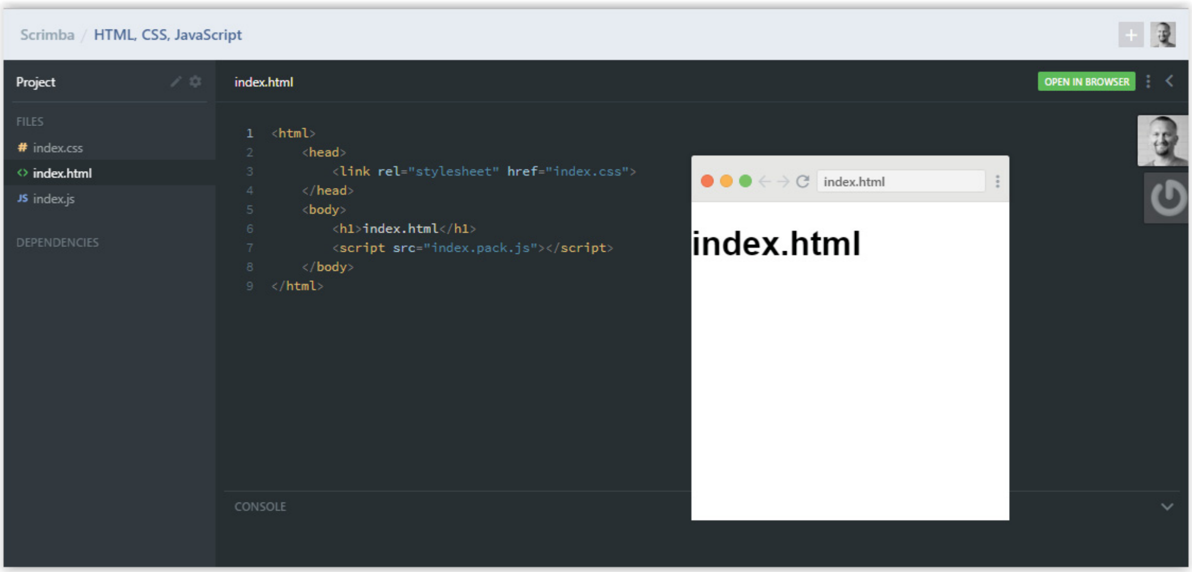
Screenshot 1 displays the Scrimba user interface. The left panel shows the different files involved in the project. The middle panel holds the code – in this case; HTML code. We also see a moveable panel displaying the result. To the right in the screen shot, we see the same profile image displayed twice. The upper profile image is the image of the logged in user, in this case the teacher. The lower profile image indicate that the teacher is the owner of this specific code. Below the lower profile image, we see an additional image: A rotated letter G. This G-image indicates that student with this profile image has forked the code at display.

Collaborative assignments: When a student can follow a live coding session and create her own forks at any time, new opportunities for collaboration arise. A teacher may start coding, let us say, an example HTML page. The students may be asked to expand or complete the example and use the existing code as the starting point. When some students have completed the assignment, the teacher can jump into a student’s fork and easily display the solution for the entire class. Continuing with the Screenshot 1 example, the teacher may click the G-image to display the student solution. If further development of the student code can bring additional learning opportunities, the teacher may live edit the student work on display. When multiple students have forked the project, multiple student profile images will be displayed in the list.

The teacher may give small assignments in class where students are to collaborate with each other. This could for example be one student producing HTML code, and letting another student style the page with CSS (and vice versa). Alternatively, it could be a student creating an HTML page and introducing errors for another student to find and correct.

Recording outside class: In Scrimba, it is easy to record a coding session. We call the recording is “a cast”. A cast is not on video format. The cast looks like a video, but is actually a simulation of code being written with an optional audio stream. The viewer may at any time in the cast fork the code. Casts may be used when preparing for class. When student preparation is an important part of a course delivery (e.g. in a Flipped Classroom setting), casts produced prior to the classroom activities may be examples of such class preparation resources. Alternatively, when questions arise during class, the teacher may find it reasonable to, at a later stage, create casts in order to explain what was found difficult during a class.

Screenshot 1: Scrimba user interface.



The initial use cases were evaluated and the results from the evaluation can be found in in Gonzalez and Lauvås (2017).

2.2 Large scale

These three use cases where refined and further tested in the next semester. Web development was still the topic, this time in the course "Creative web project" (code:PRO100) with approximately 230 students. The evaluation of the use of Scrimba in PRO100 was conducted through a survey, interviews and observations.

2.2.1 Survey

A questionnaire with 22 questions was presented to the students. From 232 students, 107 answered the survey (46% participation). The following topics were included in the questionnaire:

- User experience when using Scrimba.
- Scrimbas effect on learning outcome in different learning activities (lectures, assignments etc).
- Usage patterns.
- Recommendations for further use.

2.2.2 Interviews

From the pool of students in PRO100, we interviewed 10 students. Six of the interviews were performed during the course delivery. These semi-structured interviews provided valuable background information that we used when creating the questionnaire for the survey. Through the survey we could then further check if the stories from the six students matched well with the general opinion of the whole class. The last four interviews were held after the course had ended. By doing so, we could talk to students about the results from the survey. All interviews were transcribed and all quotes have been approved specifically.

2.2.3 Observations

The lecturer in the course have many years of experience teaching web development. The lecturer's observations, when using Scrimba in the course, is part of our collected data.

3. Results

We describe our results by topic rather than by method. By doing so, we highlight the topics we found to be most interesting and may describe them using data collected from multiple methods.

3.1 Student view on learning outcome

One of the questions in the questionnaire regarded different course activities and how the students evaluated the effect they had on their learning outcome. Table 1 displays the results. The leftmost column is the activity. The students evaluated if the activity contributed to their learning outcome. We explain "Playground" and the mandatory work requirement in chapter 3.2: Cooperative assignments.

Table 1: The activity contributed to my (the student) learning outcome in the course

	Totally disagree	**Somewhat disagree**	**In the middle**	**Somewhat agree**	**Totally agree**
I can follow the lecturer's live coding in my own browser.	1	1	10	37	47
In class, the lecturer displays student solutions on in-class assignments.	1	0	16	36	44
In class, the lecturer further develops a student solution that Is not working. The class can help finding the errors.	1	3	18	33	42
The mandatory work requirement	1	1	12	36	47
Prior to a lecture, the lecturer can share a video describing code. We may further develop the solution before the lecture.	2	4	25	31	22

	Totally disagree	Somewhat disagree	In the middle	Somewhat agree	Totally agree
In an exercise lesson, we made "Find 5 Errors"-tasks to each other.	6	8	30	28	21
I can visit other students' Playgrounds, and investigate code that is located there.	3	8	21	37	24
I can watch video describing code, jump right into the code, and edit it.	3	3	22	37	31

The interviewees provided additional input on how these activities affected them as learners. In a classroom with many students, there are many different preferred learning strategies. Some will feel that writing code and paying attention is hard:

> *"Because it's extremely hard to start writing and be able to keep up with everything at the same time. Therefore, it was very good to be able to take live code from the screen and take it right on my screen. That was the biggest benefit to me; that I did not have to hear, write, follow along and everything at the same time."*

Live coding can be a challenge, especially if you fall out along the way:

> *"If you have coded something wrong then you can go into the lecturer's code and you can find the error instead of falling out completely."*

> *"Because sometimes you code things differently or shorten the code. You get inspiration. You can do things differently and train your eyes to find errors even if it's an unfamiliar setup."*

The students really enjoyed how easy it was to share code within a classroom. To see other student's solutions was both fun and rewarding:

"It's fun to see how others have solved a task. No matter if it is incorrect or correct." The lecturer also observed this enthusiasm in the classroom.

"You can learn a lot from it, at least I've had a few aha experiences. The lecturer may find an error or someone else can find an error, and then he explains why it is wrong. And then there are things I have learned that I have not experienced before."

A key factor of the success was how easy it was to share code, or even more precise: How fast it could be done: *"The most important thing about Scrimba is that you do not have to spend so much time. You switch from one project to another very fast as a lecturer. That is very important. Instead of sitting there as a student waiting."*

To develop debugging skills is important when we learn how to write code. When it is easy to share code in the classroom, it is also easy to include the students in debugging activities:

> *"I feel it's a good learning activity to look for mistakes together. Not just together, but debugging in general. If you have code that has bugs that you do not know about, it gives a more real view of it all. And it's a little fun to be able to find the mistake first, among other things."*

Not only did the students find it rewarding, they also explained that it activated the students. It appeared as if more students got involved when sharing code was easy:

> *"There is a lot of people nervous about putting the hand in the air and saying: 'I don't get this', or 'Mine isn't working'. There is a general reluctance to do that. However, some people did do that, and it worked fine. So, instead of him [the lecturer] having to run all the way up and sit down and look at somebody's computer he could literally bring it up on the big screen."*

To share code became more normal, even though it reveals that a student has written code that does not work: *"But I feel that there is no derogation for the student who has the code on the board. (…) I do not think anyone has anything against…. You raise your hand because you may want to have your code on the board if you are wrong - to fix it."*

The interviews indicated that some students were not aware of the possibility to watch a video that the lecturer had posted and then be able to edit the code easily. However, those who knew about it described it as something that could lead to more coding activity:

> *"So I would use his [the lecturer's] code and fork it off to play around with that. Because my understanding was not comprehensive to be able to sit down and write something fresh. But I could take something he'd done and go on and modify it and play around with it."*

> *"You remove a barrier. It's actually easier for people to watch and experiment."*

3.2 Cooperative assignments

Scrimba was in use in multiple cooperative settings. One of the possible activities was a mandatory course requirement. The students decided for themselves if they wanted to solve the assignment alone or with a fellow student. When they cooperated, one student wrote HTML code for another student to style through CSS. Afterwards, they switched seats. According to the survey, 2/3 of the students chose to work alone. The other 1/3 used Scrimba.

The interviews revealed some reasons behind the student's choices. Those who chose to cooperate saw it as an opportunity to learn more, both on the subject matter, but also to develop cooperative skills, which the school encourages. Those who chose to work alone often had practical reasons behind the decision. As an example, the students could be more flexible about when to work on the assignment:

> *"I could work alone in the weekend. Nobody wants to work in the weekend."*

Others came to realize that they had to do more work if they cooperated:

> *"I didn't have too much time as I delayed the start a little too much. Then I saw that some of my friends had done it alone too. When you work in a group, you have to write more, is what we found out. So we just… We did not have enough time, so we did it on our own."*

In Scrimba, you may create a "playground". A playground is a user area within Scrimba where the user's projects can be shared. Other users may visit the playground and fork the code found there. We asked the students if they visited other student's playgrounds and if forking was in use. Figure 1 displays the results.

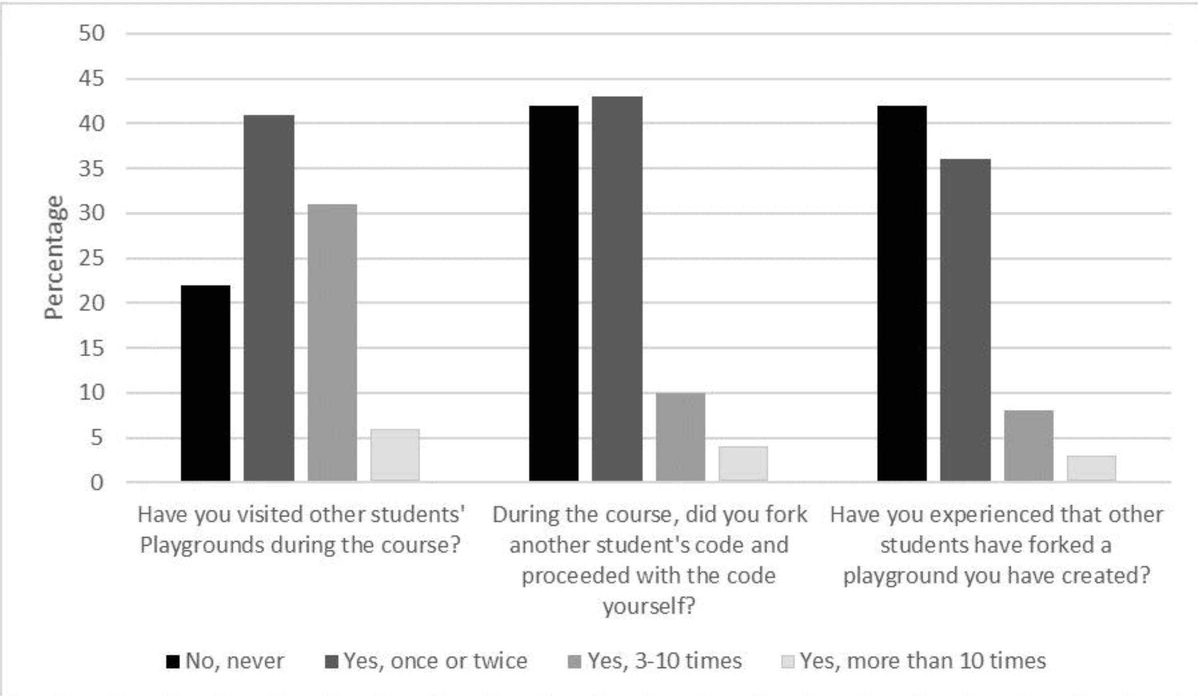


Figure 1: Student activity regarding playground visits and forking

Those who did visit other student's playgrounds found it to be a rewarding activity:

> *"And what I think is very positive is that I have my own playground with the people I'm hanging with. We can make our own web pages and look at each other's code."*

Finally, we asked if the students had forked the lecturer's code and further developed his code - without the lecturer telling them to do so. Figure 2 displays the results.

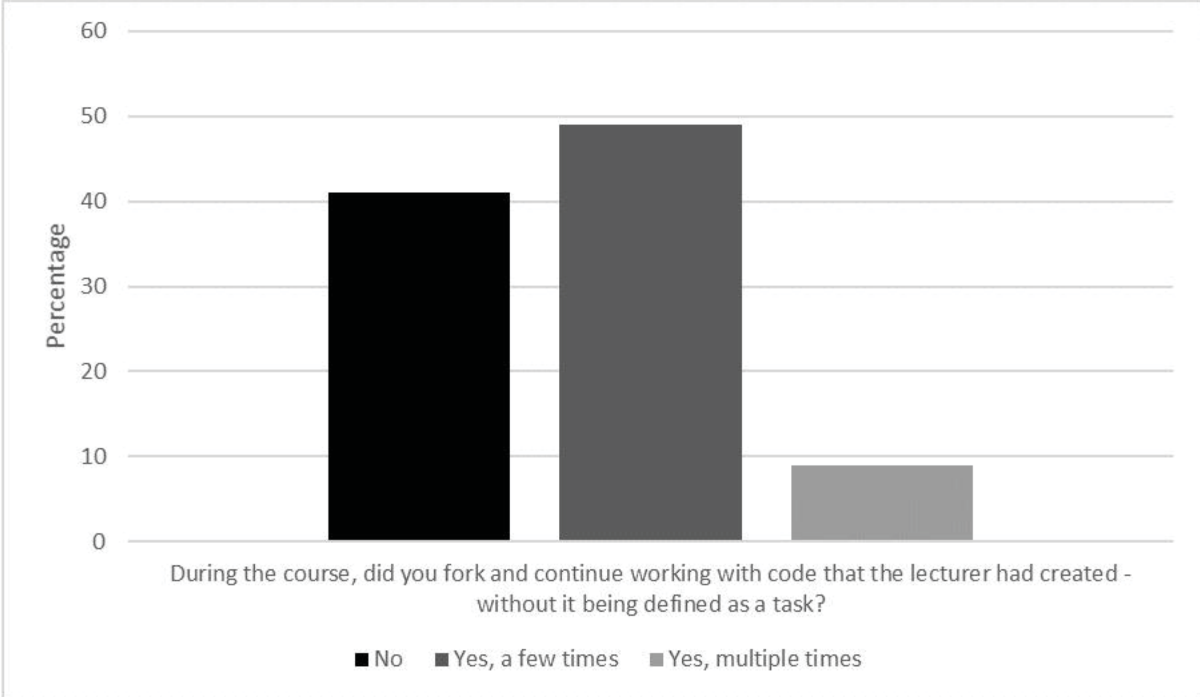


Figure 2: Students forking the lecturer's code at their own initiative.

We see that cooperative activities also happened outside of the classroom. A key factor is still how it easy it was to collaborate. A student who needed help from the lecturer explained it like this:

> *"There was some parts where I didn't understand what I was doing wrong where I could just send a link to our lecturer, and he could live look at my code right on the spot and say: 'Ok, here is the issue'. And I could go: 'Oh. Ok.' That was great."*

Another student described it like this:

> *"Yes, but it's much easier to get a link. Then you can just click on it and you have the solution there. In Brackets you must have an entire zip file, then you need to unzip, then open the correct index file, and then you must know that the CSS is linked correctly and all that."*

4. Discussion

When the students evaluated in what degree the different activities contributed to their learning, we saw that several activities contributed to their learning outcome. In the mandatory course requirement, we saw that only one third of the students chose to use Scrimba while the others chose to work alone using a different tool. The interviews provided insight into why so many students choose to do so.

A promising finding was the evaluation of in-class activities where Scrimba provided an easy way of sharing code. The live stream and the possibilities of forking made it easy to cooperate. One of these in-class activities was debugging – an important skill for IT students (McCauley et al. 2008). Debugging as an in-class activity is nothing new, but our results show that having a tool that facilitates the activity in such a way that there is practically no waiting time for the students is essential.

Another promising finding was the student's evaluation of the possibility of jumping into code in a cast. 68% of our respondents agreed somewhat or totally that it contributed to the learning outcome. Using video in education is not new (Smith et al. 1999), especially in the context of Flipped Classroom (Dazo et al. 2016). Scrimba makes the *transition* from watching a video to editing the code inside almost non-existing.

Scrimba also made it easy for students to see each other's code. Students found it interesting to see how others would code a solution, a possibility that is harder to accomplish without a tool to facilitate it. This inspired students and made them get new ideas and realisations about the variety of ways a certain web page or part of a web page could be coded. With Scrimba, it is easy to exchange different experiences and ideas on how to code among students and between a student and a teacher. The students describe how the help of technology, as described by Laird and Kuh (2005), activated them. We can argue that the students became live coding participants and not only spectators through the introduction of a new software application.

Our setting when testing Scrimba in education was initially an introductory web development course for digital marketing students, and later for IT students. The students who have no prior experience in coding may find it difficult to follow along with everything going on in class. A challenge in live coding is the fact that if a student has an error in his or her code, it may cause the entire program or web page to fail. With Scrimba and its live code streaming possibilities the students can easily jump between their own code and the teachers code, making it possible for the student to again and again build upon the working code of the teacher.

One of the more surprising results in our study was the high activity of students visiting each other's playgrounds. We find it surprising as the in-class activities were initiated and controlled by the lecturer (as well as some of the outside of class activities such as the mandatory course requirement). The visit to other students playgrounds was done on the students own initiatives. More than 75% of the students had visited another student's playground at least once (Figure 1). More than half of the students had forked another student's code. More than 40% of the students had experienced that another student had forked their code. More than half the students had forked and continued working on the lecturer's code without it being defined as a task (Figure 2). Although we do not have any numbers to compare these results with, we believe that the ease of exploration through a tool may to a large degree explain why so many students explored other user's projects. This adds to the observation that technology can activate the students, this time into cooperating among themselves when writing code. This collaboration between students is something we should encourage. The expected result of it is exchange of knowledge and skills, and increased engagement (Teague & Roe, 2008).

5. Conclusion

This paper presents the results of testing different use cases enabled by the web application Scrimba in a classroom setting of 200+ students. Applying Scrimba in a classroom setting forced us as teachers to begin thinking in new ways and implementing interesting cases that created a more dynamic classroom with students that became more active. We found several use cases that the students found to be contributing to their learning in an introductory web development course.

Scrimba as a tool for easily sharing code and being able to go into others code allow for situations that not as easily would occur without it. One could say that it is already possible to share code through other software such as an LMS, GitHub etc. However, the ease of and how quickly it is possible to do so, is crucial within a fixed duration of a lesson. When the teacher displays code with errors for the students in the classroom this makes possible for live debugging where the students become participants in detecting the errors, creating a more active environment with reading of code, talking and sharing of thoughts and ideas.

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Improving Interactivity via iControl: A Presentation Mobile app

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Abstract: Quality teachers are ones who have positive effects on student studying progress via blended teaching and learning (T and L) of content, pedagogic, communications and interpersonal skills. They have integrated information technology (IT) tools in T and L inside and outside the classroom. T and L while controlling IT tools such as computer, PowerPoint, Media Player, wireless presenter and etc. can be very troublesome especially when multiple tasks are in progress. The teacher usually has difficulties to juggle between controlling the computer and interacting to the students who are sitting far away from him or her. In order to improve interactivity between teacher and students in an integrated learning environments, this study aims to design and develop a mobile app (*iControl*) that can remotely control a specific connected server computer for presentation. *iControl* aims to turn a smartphone into a presentation tool. *iControl* can remotely control a connected computer for presentation on the go. Among the usages of the app include functioning as a controller for mouse, keyboard, presentation, media player, camera for current screenshot, file transfer, file downloader and system power. An empirical test of 196 students has been carried out for investigating the effectiveness of the developed mobile app. The results show improvement on interactivity between teacher and students with the developed mobile app.

Keywords: Interactivity, presentation, integrated learning, teaching and learning

1. Introduction

1.1 Research background

Past research (Lucas, 2017; Krusche, et al., 2017) demonstrates the use of information technology (IT) applications improves interactivity between teachers and students which resulting better performance of teaching and learning (T and L). IT applications such as game based learning (Pedersen, et al., 2016), augmented reality (Ravé, et al., 2016; Yu, et al., 2016) and virtual reality (Roussou & Slater, 2017) have been implemented for improving T and L performance. Control devices or applications such as team viewer, VLC Mobile Remote, ASUS Remote Link, DMKHO Remote Control PC, MPC-HC Remote, PPT Remote, Wi-Fi Presentation Remote are commonly used nowadays for effective presentation. However, these control devices or applications are merely for presentation only. They are not suitable as well as no interaction is provided for T and L environment. Moreover, the control devices or applications are pricy and incur an extra cost for teachers or learning institutions.

1.2 Problem statement

In spite of many research (Pedersen, et al., 2016; Yu, et al., 2016; Ravé, et al., 2016; Roussou & Slater, 2017) have been conducted to identify the factors of improving interactivity using IT tools, but the delivery methods and use of the IT tools are generally antiquated and ineffective particularly in solving the issues of student-teacher interaction (Lee, et al., 2015).

Hence, creating a conducive T and L environment does not just depend on implementing technology in a traditional classroom, rather it depends mostly on the mechanism that learning technology is being delivered to students. Hence, technology should create a driving force in changing the interaction among the teacher and students that were lacking in the traditional T and L environment.

1.3 Research question

(1) How to improve interactivity between teacher and students via a mobile app as presentation tool

2. Literature review

2.1 Interactive learning

Interactivity happens when an interaction between human and human or entity. In the context of interactivity learning, communication is essential either in the form of vocal or silent between teacher and students (Abykanova & Nugumanova, 2016). Although some research are addressing the issues of student interaction with the system but still there is lacking of teacher-student or student-student interaction in interactive learning system (Lee, et al., 2015).

Interactive teaching style was encouraged among students especially for students who cannot concentrate and lose attention in lecture-style teaching and learning (T and L). Interactive T and L styles promote an atmosphere of attention and involvement with producing the class more interesting, fun, exciting and telling the students the class is not teaching, listening and learning (Concordia, 2017). The ARMA International Center for Education proposed a set of interactive-focused guidelines of educational teaching styles such as inspiring student to involve, asking questions to stimulate answers, directing discussion, having hands-on practical, using teaching aids to facilitate responses, catching and maintaining the student's interest, preparing a team work atmosphere and engaging students in T and L (Toryanik, 2014).

However, learning is mostly a one-way traditional teaching style in a traditional classroom environment where the teacher is the one mainly teaching in front of the students. This delivery method arise a problem of student participation (Krusche, et al., 2017) especially teacher is juggle between multiple hardware and software while interacting with students who are sitting far away from him or her. Thus, it has become a necessity to implement appropriate technology in an integrated learning classroom in order to facilitate more interactivity between teacher and students.

Interactivities in class allow students to conceptualise the knowledge better thus facilitate a deeper cognitive understanding. Studies suggests that interactivity plays a very vital role on students learning efficiency (Blasco-arcas et al. 2013; Lin et al. 2017). Therefore, interactivity not only allow students to learn from human, it gives a platform for conceptualising the learning concept through discussion with teacher or peers.

Prince (2004) defines active learning as a method that engage students in learning process. This IT integrated learning environment is an interactive learning that enables active learning mechanism (Krusche et al. 2017). A technology can be considered as interactive when it allow interpersonal interaction and create a social presence of others (Lin et al. 2017). In an interactive learning environment interactivity can be categorised into two sectors including Human-System and Human-Human (Blasco-arcas et al. 2013). Human-Human interaction can be categorised into Teacher-Student and Student-Student when it comes to pedagogy and Human-System is the interaction provided by a learning system (Blasco-arcas et al. 2013). Hence, introducing iControl is a study to boost interaction of Teacher-Student.

Active engagement and collaboration has an effect on students' performance of learning (Zerihun, et al., 2012). So it can be said that learning through interactivity has a significant impact on the students' performance of learning. Thus, *H1* and *H2* are hypothesized accordingly (please refer to section 3.1).

2.2 Existing mobile applications

Existing applications were explored and reviewed using systematic literature review (Kitchenham, et al., 2010; Lew, 2017).

Eight applications were found useful from Google Play Store for the present study. Further exploration was conducted and Table 1 compares the eight existing applications. The "Ninth" application, namely iControl was designed and developed in this study based on the findings of literature in this section.

Table 1: Comparison between existing applications

		Mouse	Keyboard	Snapshot	File Transfer	System Power	Media	Power Point	Last Updated	Installed
	Team Viewer	✓	✓		✓		✓	✓	2018	10, 000, 000
	VLC Mobile Remote				✓		✓		2018	1, 000, 000
	ASUS Remote Link	✓	✓				✓	✓	2017	10, 000, 000

	Mouse	Keyboard	Snapshot	File Transfer	System Power	Media	Power Point	Last Updated	Installed
DMKHO Remote Control PC	✓					✓	✓	2013	100
Remote Control [Open Source]	✓				✓	✓		2017	100
MPC-HC Remote				✓		✓	✓	2014	100, 000
PPT Remote	✓						✓	2012	50, 000
Wi-Fi Presentation Remote							✓	2017	50, 000
iControl	✓	✓	✓	✓	✓	✓	✓	2018	-

*Note: ✓ - Available

3. Conceptual framework

3.1 Research model

This research model includes two groups of variables. The variables are assumed interdepended and strengthen each other. These variables are based on theoretical considerations as described above and presented in Table 2.

Table 2: Summary of variables

Independent Variable	Sources
The use of iControl	*Not applicable
Interactivity	(Abykanova & Nugumanova, 2016; Lee, et al., 2015; Concordia, 2017; Toryanik, 2014)
Dependent Variables	
Interactivity	(Abykanova & Nugumanova, 2016; Lee, et al., 2015; Concordia, 2017; Toryanik, 2014)
Learning Performance	(Zerihun, et al., 2012; Blasco-arcas, et al., 2013; Lin, et al., 2017)

*Note: iControl was newly developed in this study

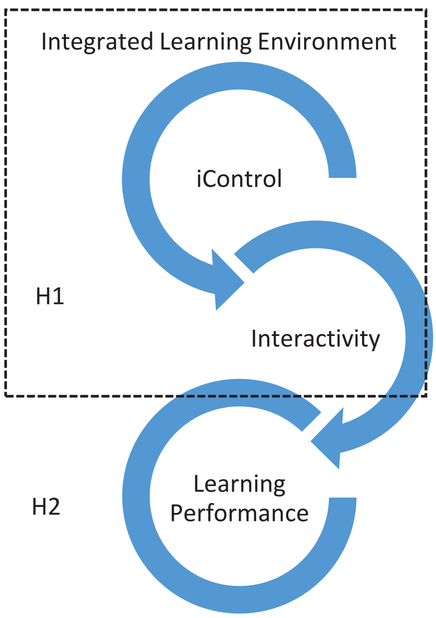


Figure 1: Proposed research framework

This study considers the interaction of teacher and students as part of Human-Human interaction and hypothesizes:

H1: iControl improves interactivity between teacher and students.

H2: iControl improves learning performance.

3.2 Mobile apps development

The design and development of an interactive learning environment will be based on Savery and Duffy's (1995) instructional model for how to design a constructivist learning environment and applied their guidelines in the planning of our interactive prototype. This model mentioned features and functions to be developed must be in actual activity or replica in learning environment (Savery & Duffy, 1995). Jonassen and Rohrer-Murphy (1999) supported constructivist learning environment. Designing of the actual activity should be real. Learning objects, instructions and instruments can be reproduced and imitated in an activity.

3.3 Research design

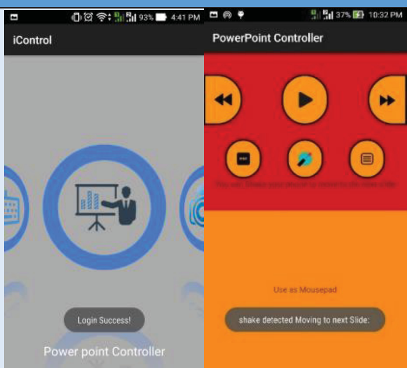
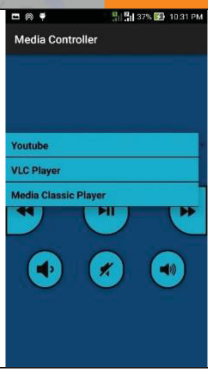
A quasi-experimental group with pre-test and post-test design was used (Bowling, 2009; Sekaran, 2003). Two selected delivery methods were tested in an integrated learning classroom; one used common presentation tools while the other used the iControl. Data of attitude, interest and knowledge abilities were collected with the two groups of students after their classes. 196 undergraduates who are studying TKM1231 Knowledge Management were the respondents. The IT students were selected for its nature of IT discipline and knowledge which is believed more relevant to the current scope of study. 3 structured questions from the lecture contents and a survey questionnaire testing attitude, interest and knowledge. The survey questionnaire was pre-tested by 20 students and evaluated by 3 experts. The results of pilot study, suggestions and comments of experts were assessed and appropriate amendments were made. In this study, missing data was treated by list wise deletion. Cronbach's coefficient alpha was used to confirm internal consistency reliability.

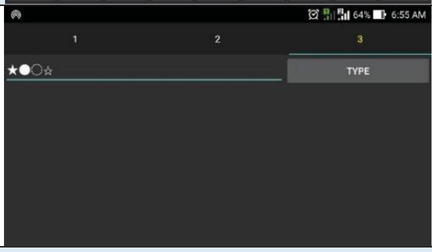
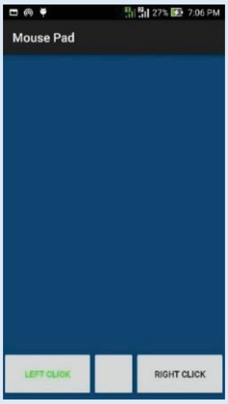
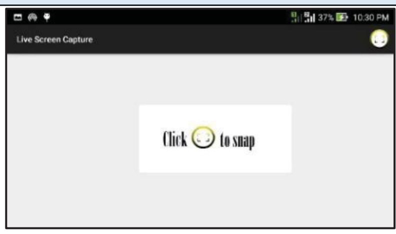
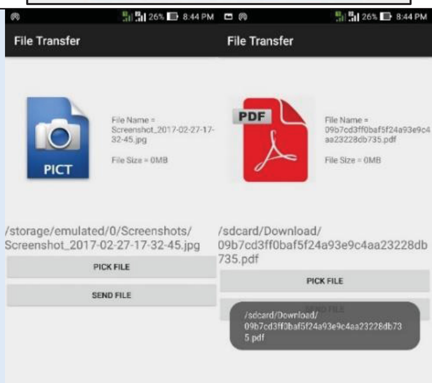
4. Results

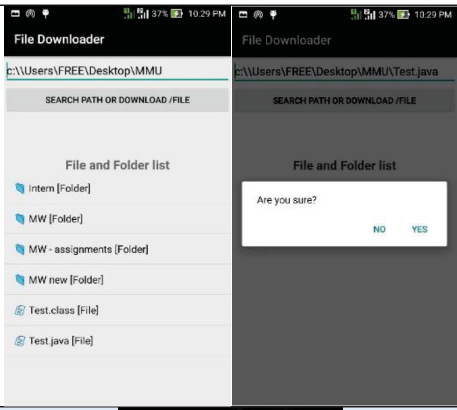
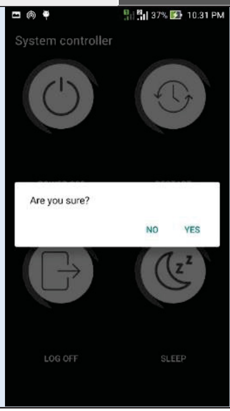
4.1 Main Features of iControl

Table 3 presents the features by the mobile apps of iControl and its description.

Table 3: Description of features

Feature	Screenshot	Description
PowerPoint Controller		The communication processes in all the features are done by delivering commands to the server computer when user presses the buttons on their mobile phone. This is the remote control for PowerPoint presentation activity. Presenter features such as "Back", "Play", "Forward", "Pointer", "Escape" are available. "Shake" the phone is also enabled for fast command to move to the next slide.
Media Controller		This represents media control activity. Three common players are available: YouTube VLC Player Media Classic Player

Keyboard		This represents keyboard activity. Keyboard process is done by sending the keycode commands to server computer by user. The green coloured button indicates the long press by user to execute hold button process in PC keyboard.
Typing in Keyboard		This is the third page of keyboard. This process is not the same as the keyboard button typing as above feature. This activity uses Android API keyboard in order to type the characters. This will enable users to type emoji as displayed in the screenshot.
Mouse		This represents mouse control activity. Users can use their fingers to touch and drag in mouse pad area. The mouse pad area will capture the x, y positions when user touches. The client will send the command codes to the server computer immediately. The codes will be executed in the server side using robot and move the mouse remotely. The codes sending progress will be ended when user lifts up their fingers from the mousepad. If the users use double touch to scroll or fling, the program will send the y position send the codes to server. When the server receives y positions, it will execute scrolling function remotely. The green button indicates a long pressed by user to executed hold click in the server side.
Screenshot Capture	 	This represents screenshot capture activity. When user presses the snap icon, current screenshot is captured. The image can be dragged, moved and zoomed by user.
File Transfer		This represents file picking process in file transferring activity. User can pick the file from the Android file browser and send to server computer.

File Downloader		This represents file downloading process. User can download file from the server computer to Android phone. The file will be stored in "iControl" folder.
System Power		This represents system power control to sever computer from Android application [client]. This activity consists of 4 power options such as "sleep" mode, "power off", "lock/log off" mode and "restart" mode. By clicking any of these button and after getting confirmation by the user, the command will be executed by the server system immediately.
Multi User Mode		Multi User mode is also available for Keyboard, PowerPoint and Media control. More than 1 up to 255 users are allowed to control concurrently.

4.2 iControl versus presentation tool and remote desktop

There are a lot of applications for presentation in the market and used for education. Unfortunately, they are mostly not supported for a classroom interactivity learning environment. Remote desktop such as Team Viewer and wireless presenter were explored. As shown in Table 4, in terms of connection, stability, purpose, suitability in classroom, interactivity in classroom and number of users, iControl will be a better solution for improving interactivity in an integrated learning environment.

Table 4: Comparison of presentation tool versus remote desktop

	Remote Desktop	Mobile Application Presenter	Normal Wireless Presenter
Example	Team Viewer	iControl	 Logitech Wireless Presenter
Connection	Internet / Local	Intranet (Wi-Fi / Hotspot)	USB (Bluetooth)
Connection Stability	DEPENDS on Internet / Data Connectivity	STABLE	STABLE
Purpose	Connect to a PC which are in ANOTHER LOCATION	Simple Control of PC and Wireless Power Point Control	Wireless Power Point Control (Additional features with extra $)
Suitability in Classroom	X	✓	✓
Interaction in Classroom	X	✓	X
Number of Users	25	> 255 Users (Restrict by Wi-Fi Capability)	1
Product Price	FREE	FREE / (RM 0.99 / 1 time)	$ 20~$ 100+ Approx. (RM 50 ~ RM 400+)

*Note: ✓ - Yes; X - No

4.3 Testing on iControl

The Cronbach's Alpha measures with all above 0.70, indicating internal consistency reliabilities (Bowling, 2009; Sekaran, 2003). Completed surveys were received from 190 individuals (96.9%). After treating the missing data using list wise deletion; leaving 188 questionnaires (95.9%) for analysis.

Based on the questionnaire, from a total score of 5.0, all the mean scores were increased (Attitude: 3.2 to 4.5 points, Interest: 3.1 to 4.6, Knowledge: 3.5 to 4.7).

Results from the structured questions were also improved from a mean score of 6.6 to 8.5 from a total of 10 marks.

5. Conclusion

An efficient interactive learning system can improve learning performance by providing a conducive learning experience for the students. This study has proposed an interactive learning system by developing a mobile app for integrated learning environment. The system promotes human-human interaction which incorporates features to support teacher-student interaction and eventually affecting the performance of learning.

The findings of this study reveal students' willingness to interact with their teachers when iControl is used in classroom teaching and learning (T and L). Therefore, teacher-student interaction in conducive T and L environment does not just depend on how to implement technology in a classroom (which was investigated in most of the past research), rather the delivery method used to students that designed and developed in this study.

As a conclusion, this application will reduce the use of some of the external wired devices. This application will be very helpful for many kinds of users such as employees from different fields, students and lecturers. It is hoped that this application will be able to be more effective to achieve the objectives in a positive manner.

6. Recommendation

Human-Human interaction was improved by engaging students with their teachers via iControl without investigating on Human-System perspective. Hence, future study is recommended to incorporate features enhancing Human-System interaction provided in an integrated learning environment.

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Using Academic Analytics to Predict Dropout Risk in Engineering Courses

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Abstract: The increase of data generated and stored in the educational databases makes it possible to obtain essential information about the teaching and learning process. School dropout and performance problems continue to represent issues which challenge teachers, researchers and higher education institutions to seek solutions. Through the use of academic analytics techniques for data analysis, a sample of 1,844 students between graduates and dropouts on the period between 2007 and 2015 were used as the basis. The methodology followed is essentially quantitative and it allowed to compare student profiles and degrees based on scores, number of attempts and other performance indicators. The data set was processed using Excel software for statistical analysis and R software for data mining using the k-Means and C5.0 algorithms. The propose of a model based on decision trees has as main objectives the generation of standardized instructions, easy interpretation and allow the addition of several possible outcomes, contributing to the decision-making process. The results of this study resulted in contributions which enable higher education institutions to identify students with performance problems and those at risk of dropout and, therefore, allow teachers and course directors to adopt better strategies to increase success and reduce dropout.

Keywords: academic analytics, higher education, dropout, education, engineering

1. Introduction

Students dropout and performance problems have been some of the main themes discussed by higher education institutions around the world. These involve not only characteristics regarding the educational environment, but also characteristics inherent to the methodologies used, for example.

The enormous increase in the amount of educational data generated and stored in the databases of higher education institutions makes it possible to obtain valuable information about the teaching and learning process namely information from students who may be at dropout risk or who need specific activities to increase their success. In this way, it is possible to notice that data analysis is a key factor for understand the situation of each student and to choose the best approach to proceed accordingly.

Handling large data sets is often a slow and complex process. The data mining assists in the process of knowledge discovery through its various algorithms and tools that process this data in order to find important correlations between them. In this sense, the search of how to better understand the data generated by the students, how to predict their behavior, and how to improve teaching and learning, makes Academic Analytics an essential area nowadays.

Through the application of Academic Analytics techniques, this work aims to identify patterns related to the academic performance of the engineering students from a public Portuguese higher education institution. The objective is to identify the profile of the students who dropped out and, thus, to implement a model for the classification of dropout risk based on decision tree.

In order to achieve the research objective, the following goals were defined:

- Assess the evolution of dropout, and describe how it behaved over the nine years;
- Identify possible characteristics that can show that the age of access is a factor that can influence the dropout;
- Assess the similarities and differences between dropout and graduate students;

- Define the profile of the students that are at drop out risk.

The data supporting this research refers to the period from 2007 to 2015 and was based on a sampled of 1,844 students where 745 are students who dropped out and 1,099 graduate students. The main variables under study are: age of access, number of course units approved, number of attempts until succeed, and the mean of the classifications obtained in the course units approved.

This paper is organized into the following main topics: Theoretical Framework, Methodology, Results, Final Considerations, and References. Hereinafter is the development of these topics.

2. Theoretical framework

It is known that education is responsible for a large part of social development, that is, it offers sustainability for a society that wishes to evolve in an intellectual, economic, human and structural way (Prim & Fávero, 2013). The access of different publics to higher education has placed higher education institutions in the face of new challenges and responsibilities, in particular guaranteeing equal conditions of access and academic success.

The term school dropout, besides allowing different interpretations, can be applied in several contexts with slightly different meanings. In certain cases, it is considered as dropout the simple suspension of the relation between the student and the institution before the end of the process for the conclusion of the course (Rigo et al, 2014).

According to Quinn (2013), there are six key factors that lead students to drop out: sociocultural, structural, political, institutional, personal, and learning. The same author states that all these factors are interrelated, for example, personal factors, such as working during the studies, are determined by structural factors, such as poverty.

In the view of Benavente et al (1994), the profile of the student at risk of dropout usually shows a significant school delay, lack of school ambitions, lack of interest in school, subjects and classes. The student at risk of dropout is generally older than others in the same educational level, does not feel supported by the family, lives in an intellectually disadvantaged family environment and has, of course, an insufficient school performance.

As higher education institutions collect more and more data about their students, we enter in a new age of data use to improve student success, streamline processes, and utilize resources more efficiently. Once the data is analyzed, it is possible to obtain better student placement processes, more accurate enrollment forecasts and early warning systems that identify and help students at risk of failure or dropout (Matsebula & Mnkandla, 2017).

Academic analytics makes use of methods of statistical analysis, data mining, and predictive modeling to reveal and recognize hidden patterns in large educational databases. These standards allow us to better understand various educational aspects, such as student behavior and learning outcomes with better accuracy (Joshi et al, 2016). In other words, academic analytics is the application of business intelligence tools and strategies to guide decision-making practices in educational institutions. The purpose of an academic analytics program is to assist those in charge of strategic planning in a learning environment to effectively measure, collect, decipher, report and share data so that operational and student strengths and weaknesses can be identified.

Early identification of students at risk of dropout using data mining algorithms, have a very significant value in terms of preventive measures that the institutions can adopt to reduce dropout. That said, two of the key algorithms used in this task are k-Means and decision trees.

3. Methodology

This study of quantitative nature which aims to explore the academic data of students of engineering courses of Civil Engineering (CE), Renewable Energy Engineering (REE), Electrical and Computer Engineering (ECE), Informatics Engineering (IE), Mechanical Engineering (ME) and Chemical Engineering (CHE), from a public higher education institution in Portugal. From this, a model was created that allows applying academic analytics methodologies to identify the profile of students at risk of dropout.

The proposed analysis was reported for the period 2007 to 2015, taking into consideration the students already graduated and the students who dropped out. A dropout situation is characterized by a student who did not renew his/her enrollment in the current school year and therefore did not complete the course. On the other hand, a graduate student is a student that got his degree diploma.

The data was treated anonymously and in accordance with the General Data Protection Regulation. Data Mining was performed using the k-Means and C5.0 (decision tree) algorithms.

From the data provided, it is possible to observe that between the years of 2007 and 2015, about 745 students dropped out, where 610 are male and 135 females. On the other hand, 1,099 students have completed the studies, of which 822 are male and 277 are female. Table 1 contains the information for each course.

Table 1: Characterisation of the courses according to sex and age of access

Course	Graduates			Dropouts		
	Male	Female	Age of Access (Mean)	Male	Female	Age of Access (Mean)
CE	183	91	23.14	154	52	24.5
REE	106	35	19.42	68	20	22.7
ECE	146	9	23.41	110	4	25.1
IE	160	34	20.89	143	21	21
ME	203	22	21.91	117	8	22.6
CHE	24	86	23.12	18	30	20.9

The data in Table 1 reveals that the age of access of students who dropped out tend to be higher than the age of access of the graduates, indicating this is a factor that is strictly related to dropout. In our data set, the age at which the student starts to study is highly variable and it has a strong influence in several performance indicators. In this way, it is possible to obtain answers to the following objective: identify possible characteristics that can show that the age of access to the studies is a factor that can influence the dropout.

4. Results

In order to characterize the courses regarding their dropout rate, Figure 1 was generated based on the total number of graduates and dropouts of each course. It is possible to notice that, in general, all courses have more than 50% of graduate students, however, they also have a high dropout rate, especially the Civil Engineering, Electrical and Computer Engineering, and Informatics Engineering courses which have more than 40% of dropouts over the nine years. Therefore, it is concluded that the courses with the largest and smallest number of dropouts are Informatics Engineering and Chemical Engineering, respectively.

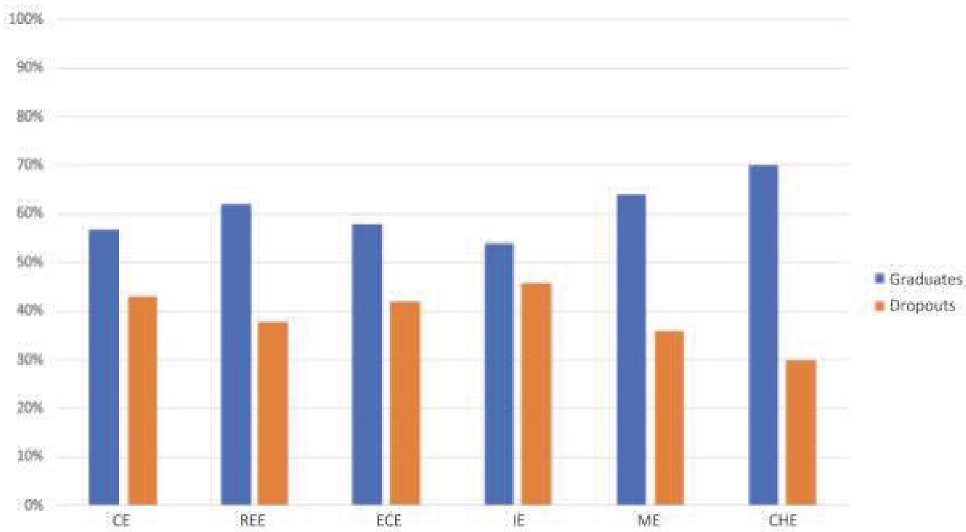

Figure 1: Percentage of graduates and dropouts per course

Figure 2 shows a more detailed analysis, based on the number of years registered of the dropout students over the nine years and per year, which shows that a high percentage of dropouts occurs before the students are enrolled for a year in their respective courses. On the other hand, it can be noted that a large number of dropout students even after they are registered at a much longer time than necessary for the conclusion of the course.

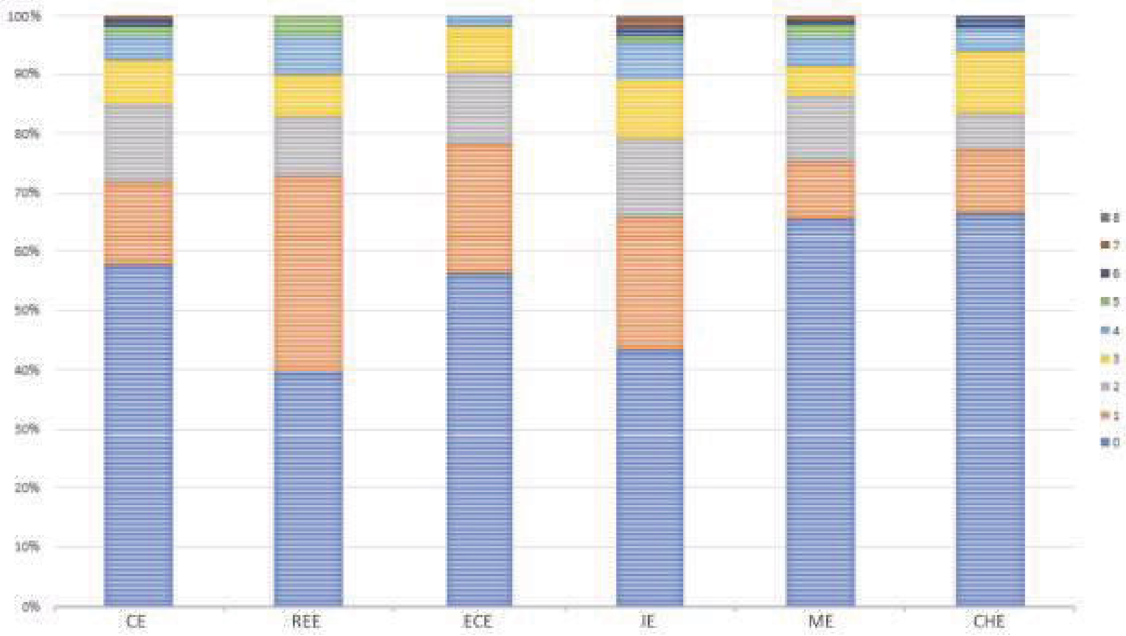

Figure 2: Percentage of dropouts per years registered

In order to make a comparative analysis between the dropouts of all courses and taking into consideration the mean of the number of attempts for approval in the subjects, the graphic of Figure 3 was created.

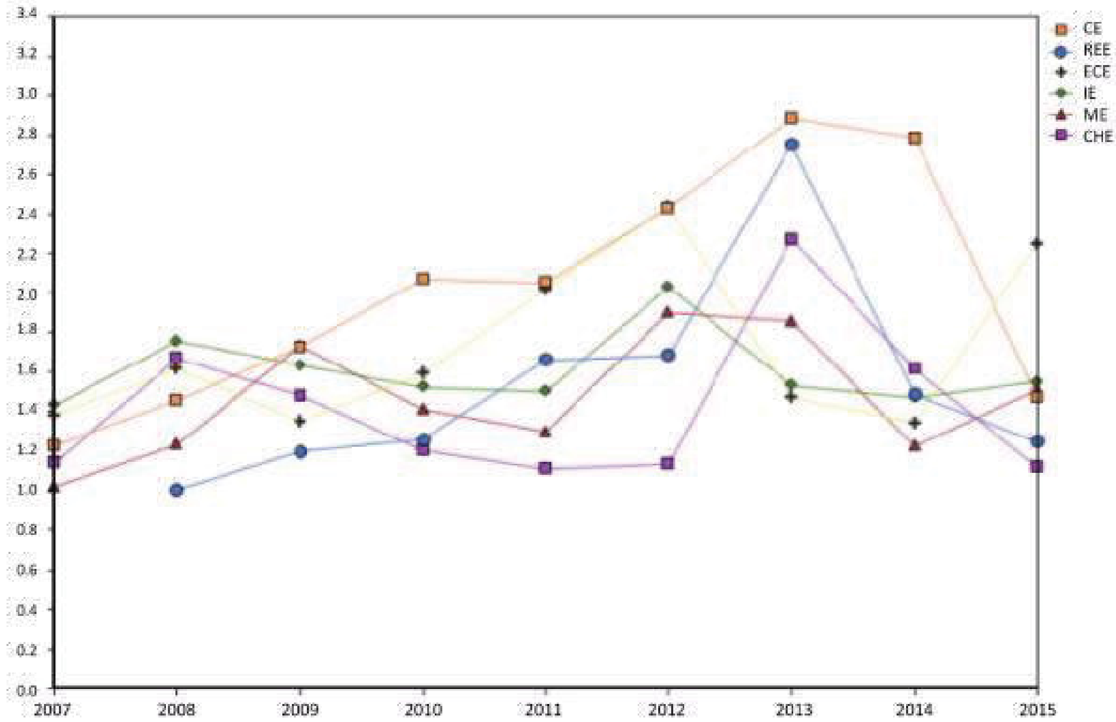

Figure 3: Comparative analysis of the mean of attempts for approval in the subjects of the dropouts

Figure 3 allows us to observe many variations in all courses, however, it is worth mentioning the Civil Engineering course where, in most years, the mean of attempts has been higher than the mean of all other courses. It should also be highlighted the years 2011 and 2012, where the mean of attempts has grown significantly. Likewise, the mean of attempts of many courses started to suffer a great fall between the years of 2012 and 2013.

As a consequence of previous analyzes, it can be concluded that the main characteristics that can help to distinguish between a student with tendencies to complete the course and a student who may be at risk of dropout are: the age of access, the number of approved subjects, the number of attempts for approval, and the mean of grades. It should be noted that no relevant gender difference was identified, however, it is a factor that should be taken into account.

Based on these characteristics, the k-Means algorithm was used in order to identify the groups of students and the characteristics inherent to each one of them. By applying the Elbow Method, we determined that the ideal number of clusters for our data set is equal to 4. Thus, as a result of grouping according to the age of access, Table 2 presents the values of the centroids obtained.

Table 2: Centroids resulting from the k-Means algorithm

Cluster	Age of Access	Number of Subjects	Number of Attempts
1	36.61	7.25	7.68
2	20.27	3.61	4.21
3	25.62	23.46	35.97
4	21.34	10.15	15.55

The data in the Table 2 reveal that: students who start studying late try to attend a few subjects (most likely are student workers); the 25-year-old students have been studying longer and therefore have a greater number of attempts; most students between the age of 20 years old drop out before even starting to study; students between these last two profiles tried less.
Based on this, for the implementation of a classification model of school dropout, we used the decision tree C5.0. The construction of decision tree was based on the age of access, the mean of grades and the mean of number of attempts for approval in the subjects. It is possible to identify if a student has the characteristics of a graduate student or a dropout student and, from this, it verifies if the student is at risk of dropout.

After some tests, it was noted that the ideal division for the training and testing phase was 70% and 30%, respectively. The Figure 4 show the result of the training phase of the algorithm. It is observed that the size of the tree is 12 and, of the 1,159 cases, the algorithm correctly classified 1,009, having a margin of error of 12.9%. It is possible to notice that of the 335 cases of dropout, the algorithm correctly classified 203, whereas of the 824 cases of graduates were accurately classified 806.

```
Evaluation on training data (1159 cases):

        Decision Tree
      ----------------
      Size      Errors

        12  150(12.9%)   <<

       (a)   (b)    <-classified as
      ----  ----
       203   132    (a): class Dropout
        18   806    (b): class Graduate

    Attribute usage:

    100.00% MeanGrades
    100.00% MeanAttempts
     31.06% AccessAge
```

Figure 4: Result of the training phase

At the conclusion of the training, the other 30% of the data set was applied in the testing phase of the algorithm. The results of the classification show that of the 223 cases of dropout, 150 were correctly classified, and of the 275 cases of graduates, were precisely classified 256. Therefore, it is concluded that the proposed model has an accuracy of 67.3% to identify characteristics related to dropout, while 93.1% for graduates.

5. Final considerations

School dropout and low performance are problems faced by many higher education institutions. The concern on how to identify students with learning difficulties and at risk of dropout represents a challenge for teachers, researchers and educational and training institutions. Therefore, a research work was carried out, by using academic analytics with the aim of analyzing the data from a sample of 1,844 undergraduate students regarding their age of access, number of course units approved, number of attempts for approval, and the means of the marks obtained in the course units approved.

In light of the results obtained from the exploration of the referred data and the implementation of the model for prediction of dropout, we concluded that:

- Most dropouts occur before students are enrolled for 1 year in their courses;
- Graduates usually have more attempts than dropouts;
- In most years the number of graduates was higher than the number of dropouts, however, the total number of dropouts is significantly high;
- The model identifies more easily the profile of students with tendencies to complete the course.

In this study, just academic information was used because it is considered that only this kind of data is related with factors that can somehow be controlled by pedagogical strategies. This study aimed to confirm existing suspicions, and the numbers will be confirmed after updating the data set to the current date.

The development of a model based on decision tree allows, after being trained, to identify a student who has a profile that is at risk dropout more quickly, contributing significantly to higher education institutions in the decision-making process.

As far as the future works are concerned, we suggest adding qualitative data to data mining process and using learning analytics techniques to analyze the student's learning path using other sources of information such as classroom attendance and use of the virtual learning environment.

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Game Based Learning in Laboratory Practice

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Abstract: This paper describes a tool that it used in pedagogy nowadays, Gamification, which is based in the use the psychology of the game, its mechanics, and dynamics in non-ludic environments such as a classroom or a laboratory. This paper presents the experience within a teaching innovation project of the University of Alcalá in Spain, mainly the gamification of several laboratory practices. The main objective of the project is to eliminate the negative prejudices, fear or rejection generated by students when studying science subjects, thus turning the learning process into a game, combining challenges and fun and which seeks the motivation of the students at the same time that acquires study habits and reaches a goal within the academic environment, causing significant improvement and less rejection of science within the learning process. The gamification has been applied in one subject which belongs to the curriculum of the Bachelor in Education of Primary Education: Didactics of Natural Science (DNS) of 3rd year, and it has been developed within more than 5 different groups of practices, with a participation of 150 students approximately. The objective of the practices has been to acquire the knowledge the methodology of gamification applied to education, and how to develop different practices in Geology and Biology through this technique. The gamification elements included are: the presentation of assumptions, use of avatars, division in levels, assign missions, design of badges, and define the scoring criteria, timeline and immediate feedback. From the beginning, the students will know what their objectives are in each of the levels and missions that are proposed. In addition, they will be motivated and committed to what they are learning through the use of badges (elements that will make the achievement achieved visually), scoring and the evolution of the assigned avatar.

Keywords: motivation, gamification, biological practices, geological practices, teaching training

1. Introduction

“Gamify” is a booming concept that has been in development during last years (the last decade) and whose main purpose is to motivate the "user" through some specific characteristics of the game, including prizes or rewards, to achieve the proposed objectives. Therefore, this technique promotes that students become the protagonists of their own learning, which generates in them a motivation to obtain prizes or rewards that include a specific objective (which in this case would be the acquisition of scientific skills and abilities to be able to develop a series of laboratory practices in different areas of science such as Biology).

Motivation is an essential element in the teaching-learning process. In this sense, a well-designed game is a guided missile to the motivational heart of the human psyche (Werbach and Hunter, 2012). Based on the age of the university students and their social environment, we want to evaluate the well-designed gamification as an effective technique to work in a laboratory or in the classroom. This communication describes how to strengthen the motivation of students to acquire a commitment to their teaching-learning process. One of the objectives of teaching innovation is to find out alternatives to traditional teaching methods actually are not working, where students are usually playing a passive role. In this line, the gamification technique is proposed as a methodological alternative. In the experience carried out with the 3rd year of Teaching training Degree in Primary Education, it has been tried out, on the one hand, to carry out a study on the effectiveness of motivation through gamification in the laboratory, and on the other hand to establish whether the way of learning to through this technique, it improves or is the same as any other non-gamified laboratory practice.

Up to now it has been successfully developed mainly in business field, in new technologies and in mobile applications; however, there are more and more cases in which this technique is applied in education. The present work focuses on a pilot gamification experience in science laboratory practices, corresponding to the subject of Didactics of Natural Sciences (DNS) of 3rd year, of the Degree in Teaching training in Primary Education of the University of Alcalá (Spain). One of the eight practices of Biology and Geology of the aforementioned subject has been selected to show the gamification technique applied to education, and teach the bases and elements necessary to design a project, in this case, a project based on palynology contents through this technique. This is achieved on the one hand the objective of studying motivation through technique and on the other the validity of it for meaningful learning.

2. Gamification in education, motivate to learn science

As aforementioned, gamify in education means applying techniques based on games and videogames to motivate students and encourage positive progress in them. The fact of applying these ideas in the Degree of Teaching, to turn the teaching task into something attractive and dynamic, makes the student have fun and learn in a meaningful scientific content. In this line, Morris et al (2012) also suggest that scientific education can be improved by incorporating the key characteristics of games that influence motivation, cognition and metacognition. Therefore, it is a very effective tool that helps to get the student's attention, to motivate them, commits them to a mission and can even influence their behavior (Kim, 2015). If this technique helps people to save energy, take care of the environment or improve road safety, why not use it to help learning in a more dynamic and attractive way?

The term gamification was used for the first time in 2002 by Nick Pelling, but it did not begin to gain popularity until 2010 (Rodríguez and Santiago, 2015). Rodríguez and Santiago (2015) define gamification in the following way: "... Gamification is understood as the process by which mechanics and game design techniques are extended, to seduce and motivate the audience in the attainment of certain objectives ... "(p.5) or," ... gamification is to bring the different mechanics and techniques found in games to contexts that have nothing to do with them to try to solve real problems ... "(p.5).

In this definition, Sánchez (2015) endorses that gamification is directly associated with the technologies of the ludic field such as video games. Another point in which they agree Rodríguez and Santiago (2015), Zichermann and Cunningham (2011), and Dicheva et al. (2015) is the goal of motivating and engaging through gamification. Although gamification had its heyday due to the rise of new technologies and mobile applications it does not mean that it should be restricted to these fields. In fact, it can be approached from the use of such basic resources, as a sheet of paper, or the use of an application or a screen to carry it out (Kim, 2015). Morris et al., in 2012, analyzed the idea of gamification applied to science education, based on the results of cognitive psychology research and development, and educational research to provide guidance in the use of existing games and develop new games to facilitate scientific thinking ascribed to the science curriculum.

3. Steps to gambling laboratory practices

Based on the work of Morris et al. (2012) and Werbach and Hunter (2012), who not only argue the possibility of being able to provide a significant scientific learning through this technique but also provide the basis to be able to organize and structure it so that it can be applied in non-ludic environments, and taking into account that the term gamification has been addressed theoretically up to now. Next, we are going to establish which features are indispensable to gamify contents and how we can gamify a practical content.

In order to gamify, the game or dynamics that is intended to be developed must be properly designed in order to achieve the objectives and educational-training competences. Werbach and Hunter, (2012) propose a series of categories of relevant game elements in order to be able to gamify any situation, not related to the game. These categories are the dynamics, the mechanics and the gamification components.

According to these authors, the highest level of abstraction would be the dynamics that will facilitate the progress of the student as well as the achievement of the proposed objectives. These dynamics integrate elements that allow to justify and design the structure and development of the game, in this case, that of a laboratory practice. Within this category the argumentative line, the progress and the relations between the student-players are established. For Werbach and Hunter (2012) the mechanics refer to the basic processes that will allow the development of the action (practice). Therefore, it can be stated that it is the way to develop one or more dynamics. Within the mechanics of the game we talk about competition, challenges, cooperation, rewards, chance ... Finally, the components are probably the most visible elements of gamification because they are more specific and motivating. But we must not forget that they will not work if they are not included in an adequate and well managed dynamic by their mechanics. Thus within these components there is great diversity: achievements-goals, avatars, emblems, missions, collections, combats, levels, points, progress charts...

Nah et al. (2014) conducted a literature review on what are the essential components and what different gamification proposals in education have in common. After identifying the characteristic elements that are needed to gamify, different visions must be established between these elements. Thus, Dicheva et al. (2015) compare the gamification components and their vision from the different perspectives proposed. For example, one of the most popular elements that has already been cited are the "badges". According to Dicheva et al. (2015), badges are considered by Detering et al. (2011) as a pattern of game interfaces, such as game mechanics by Zichermann and Cunningham (2011) and Iosup and Epema (2014) or as a motivational element by Hamari, Koivisto and Sarsa (2014). Therefore, it is clear that within the terminology, depending on the author, their classification and use may vary.

Once the necessary elements to implement the technique have been established, it is necessary to establish how to do so. Werbach and Hunter, (2012) propose up to six steps to implement gamification properly:

- 1. Define the objectives. What do you want to achieve?
- 2. Outline the objective behaviors. How are you going to get it?
- 3. Describe the players. Who should get it?
- 4. Develop activity cycles. How are you going to work to get it?
- 5. Do not forget to enjoy
- 6. Implement the appropriate tools.

We only talk about the components of gamification in the final step. Steps 1 to 4 are defined in the practice script since they are the essential elements of any educational program and will be discussed later in more detail.

Figure 1: Gamify steps (based on Werbach and Hunter, 2012).

4. Practices in the laboratory of sciences in teaching training degree and development of competences

In the curriculum of the Teaching Training Degree in Primary Education at University of Alcalá, here are two subjects of pure scientific content and one of didactic treatment of these scientific contents. The aim is not only to broaden and develop the conceptual, procedural and attitudinal competences of students in this area, but also to complement them by providing the necessary training to carry out their teaching task in the future, allowing a comprehensive education of their future students in the scientific field as well.

In order to achieve this objective~~,~~ and to highlight the importance of the teaching-learning processes in science, teachers must acquire and develop a series of competences that are:

- Generic competences established in scientific subjects:

All these competences are developed in laboratory practices. But, in particular, competences 1, 3 and 6 have been developed more profoundly thanks to gamified practices and to the distribution of students in cooperative groups with assigned roles.

- 1. To develop professional abilities such as teamwork communication ability and oral skills.
- 2. To strengthen the capacity for analysis and synthesis.
- 3. To acquire organizational and planning skills.
- 4. To Encourage critical reasoning and autonomous learning.
- 5. To develop habits and skills for autonomous and cooperative learning.
- Specific competences of DNS:

Among the different competences of the subject, those specifically developed in laboratory practices are indicated below. Competencies 4 and 6 have been developed thanks to gamification since we think that they would not have been easy to achieve with another methodology. In addition, we believe those competences are essential for future teachers in order to know different ways of approaching the teaching and learning process, and the best way to do so is to live these processes themselves.

- DNS1. To know the curricular contents of the experimental sciences in Primary Education.
- DNS2. To know the difficulties inherent in the teaching-learning of science.
- DNS3. To assess the pedagogical potential of the teaching of Science and its contribution to the integral formation of the students.
- DNS4. To know and to put into practice the main teaching methodologies and strategies of teaching-learning of Sciences in the different Primary Education courses.
- DNS5. To know and to know how to use the basic techniques of scientific work: observation, description, classification and experimentation.
- DNS6. To know and to know how to plan the different scientific activities as well as select and elaborate didactic materials for the primary education classroom.

5. Design and development of the experience, and results

Once it has been established the possibility of using the gamification technique and having checked through the consulted literature its benefit and effectiveness for motivation, we started the design of the game for practice. Table 1 shows the steps followed from 1 to 3 proposed by Werbach and Hunter (2012), as well as the dynamics (the SUPPOSED OR CHALLENGING starting as the initial motivating element) and the components for the whole gamification process (LEVELS AND MISSIONS; AVATARES INSIGNIA, SCORE and PROGRESS BAR or STORY-BOARD). During the previous classes, it has been explained the implementation process and the script of this practice.

Table 1: Description of the steps, dynamics and components included in the experience.

Subject	Didactic of Natural Sciences (DNS): PRACTICE OF PALINOLOGY
1. Define objectives. "What do you want to achieve?"	**General objectives:** - Learn to gamify a practical content for students of Primary Education - Study by instrumental and laboratory material of plant specimens, pollen, insects, and the pollination process (developed later) - Develop a project through gamification. **Specific objectives of the practice of palynology:** • Remember how to manipulate a microscope and a stereo microscope. • Establish the importance of reading news and articles of scientific content. Critically analyze the information and know how to use it. • Know how to use dichotomous keys to identify unknown elements.
2. Outline objective behaviors.	- Reading scientific and scientific-informative documents - Handling of laboratory instruments (microscopes and stereo microscope) - Development of skills with the manipulation of mobile apps, i.e. Kahoot!®

Subject	Didactic of Natural Sciences (DNS): PRACTICE OF PALINOLOGY
"How are you going to get it?"	
3. Describe the players. "Who should get it?"	150 students of 3rd year of Primary Education Teaching Degree in 5 laboratory groups with cooperative teams of maximum 4 students with different skill-rols
GAMIFY COMPONENTS	
CHALLENGE	*"The bees are disappearing and the few that remain are disoriented and do not remember their work inside the hive. Therefore, we must help them remembering how they must work and thus save the planet Earth ..."* With the explanation of the assumption they are introduced to the dynamics and they received the instructions how they should work in the laboratory and how they should relateto classmates. For all practices, the same already established laboratory workgroups are kept, in order to work work in a group, cooperative and assigned roles (in this case)... "You are bees and a beekeeper / scientist, the news does not give good data... Throughout the practice, information will be given about how the investigations are progressing".
ROLE OF EACH STUDENT WITHIN THE COOPERATIVE TEAM	- ***Queen bee (honey bee queen):*** will be responsible for coordinating of the group, marking the times and reviewing the work done. You can delegate work to the drone bee. - ***Drone (male honey bee):*** will be responsible for helping the queen bee and supervising the position of the team in the progress schedule bar. Theycan develop some of the roles of the queen bee, only those that are assigned to them - ***Worker (worker honey bee):*** will fulfill the script of practices and perform the manipulative work, and cleaning the workplace - ***Beekeeper/scientist***: will write the content of the work that will be part of thethe script to be presented as results, and will look for the clues and tests that have to be overcome
LEVELS and MISSIONS	3 levels are proposed, with a total of 5 missions, to be carried out in a single laboratory session (time schedule:2 hours duration) **Level 1:** Who or what is killing the bee population? ***Mission 1****:* Alert, bees are disappearing!!!! (Reading of articles and news of scientific content about the problem of the disappearance of bees). ***Mission 2****:* Treasure hunt (Game of clues and, analysis and implementation of the information consulted in the articles and scientific content news.) Students shall answer questions about what they have read in order togo ahead and find the next clue. **Level 2**: Importance of bees for the Earth. ***Mission 3:*** Pollination and Pollen (Use of the microscope, observation of pollen preparations and use of pollen identification keys). ***Mission 4:*** Honey plants and honey (Determination of honey plants using dichotomous keys). **Level 3: The** honey. Overcoming this level and therefore the completion of the single mission involves the satisfactory resolution of a series of questions about what has been done. ***Mission 5****:* Mini-Trivial Kahoot! (Self-evaluation of the practice and end of it).
AVATAR	Each team is assigned with an avatar that will go ahead in the process of research and search for bees.
BADGES	A badge is awarded to each team when each level is completed, so that at the end of the process each team can have achieved a total of three badges.
SCORE	It is intended that all teams exceed the established levels, but depending on the swiftness and dexterity, as well as the attitude demonstrated in each mission, they will receive more or less points (represented as pollen grains). The maximum score to receive has been established in 5 points per level, and the minimum of 1 point. The scoring withing each level, allows to each team to know their progress in their missions, and also notice if they are working properly or not.
STORY-BOARD	A progress line has been designed, where each team can notice: the level where they are and the remaining missions to be completed, having an immediate feedback.

Finally, the students had to show their results in a final report. They must be able to mark the levels and missions achieved in the report. The students had to deliver the results sheet of the practice by teams with the improvement and elaboration of each one of the established missions.

In addition, to assess and analyze the impressions of the students, a Google forms questionnaire was also created. It was created in order to check the type of student (player) that had participated in the gamified practice and check if the dynamics had passed as expected. This questionnaire has been completed by 41 of 150 students.The data included refer to the 41 students surveyed. Regarding the student-player type, 80% had played table games or video games, and 15% approximately had played role-playing games, so that they were mostly familiar with the dynamics and elements of the game. In this way, we must say of all the students who answered the survey, only 15% played every week, while 67% did so sporadically.

Even being knowledgeable students of the games, more than 80% did not know the technique applied to education, so it has been quite a discovery for them, and everyone believes that it can be an alternative that allows to learn the student in an appropriate way, and all would apply the technique in their future classes. In the question about the type of player they like to be, the answers have been balanced although there is a 35% that surpasses the rest that they like to be Achiever or pickers of points as motivation after resolve the challenge (Bartle, 1996) (so when assigning roles we had successful, since in each group there could be between 1 and 2 players of this type).

When students have been asked about the part of the practice or mission that they liked the most, by far it has been the most dynamic part or Game of clues, although the resolution of scientific tests (such as use of a microscope, or use of dichotomous keys) is the second best valued (Figure 2).

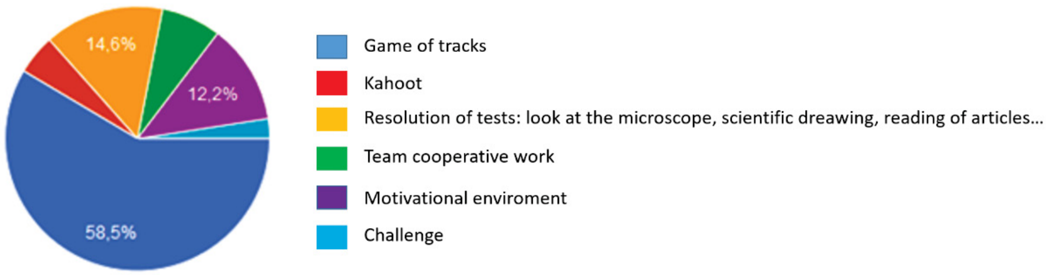

Figure 2 : Graph of Google forms that shows the results to the question: What are the dynamics or mechanisms of the gamify practice that you had like more?

Some other results can be summarized in the following epigraphs:

- The motivation has worked, since of 150 students there has been an attendance to the class of 96%, knowing that the practice did not worth for the total qualification of the subject. In total, has participated 41 collaborative working groups of 3 or 4 components with specific work roles to each. In fact, when we asked what is the most important part of the gamification, 56% have answered that motivation, above the team work and the necesity to feel integrated into a team.
- When we review the reports of delivered practices, they prove that 100% of students have passed the proposed missions, but the most complete mission has been the mission that involved the use of a microscope without the teacher´s help, identification of pollen and scientific drawing (they should remember the procedures for each action studied previously).
- The easiest mission was mission 5, this being the most competitive mission.
- The most worked scientific skills have been observation, detailed description and information analysis.
- From all the competences proposed in the subject, in an evident and optimal way, it have developed the generic competences associated with autonomous work and cooperative teamwork, in addition to working the planning and the organization of the teamwork to achieve the objectives of the game.

6. Conclusions

The latest researchs on games in education have borne the same conclusion: at this time, there is no conclusive and sufficient evidence to make reliable assertions about the effectiveness of video games (games in general) (Morris et al., 2012). We can conclude although gamification allows motivation through the proposed elements to carry out practice, if the game design is not adequate, learning becomes a sense of manipulation and competitiveness, and the significant learning is not doing. The motivation exists, but the objective is lost. So we think that we must to continue in this line of work that has already advanced in the realization of laboratory practices, which did not clarify that the learning has been significant.

The reports presented by the laboratory groups show the achievement of the objectives and therefore the overcoming of the proposed missions. But it has been shown that the quality of work presented is not excellent, in general, especially in instrumental manipulation (microscopes) and identification of pollen and plants through dichotomous keys. Although the main objective (learn the technique) has been met, we think that the technique is important for motivation but it does not make the student learn better, althougt it allows to work mores competences than in a normal practice.

All of groups must participated in the last mission of the game. The last mission is not an event that can be done without the participation of all the groups at the same time because the knowledge acquired during the practice is important to pass it, but in this case the quick response and therefore competitiveness is promoted (the fastest group, the smartest group, the one that has done the best...). Overcoming this mission was excellent and adequate competence, because the students are familiar with the *Kahoot* application.

After all, we conclude that an only pilot practice (in the case of DNS) is not suitable for motivation and learning if it is done in isolation. The technique should be considered in more than one practice so that the student is used to the technique and feel motivated for a long period, and not just for the novelty of a single practice. So it is proposed to work with the technique as usual way in more practices, in this way allowing students to master the procedures of the game. Thus we agree with Morris et al. (2012) when they state that the time devoted to educational gamification is different. While the users of commercial video games use a week long to master the game, in the science class is shorter, so it is necessary to estimate the time to do it. It is also likely that scientifically rigorous games are more likely to mimic typical instruction in the classroom, rather than taking advantage of the attractive elements that are incorporated into commercial games.

Finally, the students of the subject DNS had to present didactic programmings like final work. In this case, at least three of groups of laboratory presented their programs of Biology or Geology based on the technique of gamification. Then the objective of knowing the technique and learning to design projects based on it was fulfilled.

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Completion of Programming MOOC or Dropping out: Are There any Differences in Motivation?

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Abstract: Teaching programming and Massive Open Online Courses (MOOCs) have become a popular topic in recent years. Motivation for participating in such courses can be very different. Results of previous studies indicate that motivation is associated with persistence in university programs and in online environments. Therefore, is important to understand for which purpose(s) learners use MOOCs and to compare determinants, including motivation, of completion and non-completion. Still, there is shortage of evidence about the motives that are associated with MOOC completion in the light of different motivational theories. The aim of this paper is to compare enrolment motivations of completers and non-completers in programming MOOC. Studying motivation in MOOC, we rely on the expectancy-value theory, because task value as a main component of this theory is especially relevant for research aiming to explain people's voluntary engagement in learning and for understanding what causes a person to initially choose to take part in a MOOC we need to understand value and worth of this MOOC for the participant. Two research questions were posed: (1) What are the main motivating factors for completers and non-completers of a programming MOOC? (2) What are the differences in motivation factors between completers and non-completers? Validated FIEM (Factors Influencing Enrolment in MOOCs) scale was used collecting data from 1,302 participants. The data on completion or non-completion of the MOOC was taken from the learning environment. Evaluation of the participants has been analyzed using seven factors discovered in previous research. Using multivariate analyses of variance with the Bonferroni adjustment statistically significant differences were found in four factors: 'interest and expectancies for course', 'personal suitability of distance learning', 'usefulness related to certification', and 'social influence'. All these factors were rated higher by completers than by non-completers. Recommendation could be made for taking account these motivational factors to decrease dropout in MOOCs.

Keywords*:* massive open online courses, MOOCs, motivation, completion, programming

1. Introduction

Over the past five years, many Massive Open Online Courses (MOOCs) have been provided by academic institutions and tens of millions of students from all over the world have enrolled in these courses (Ebben and Murphy, 2014). MOOCs offer a wider range of opportunities for access and participation in education. These courses are seen as a rapidly growing trend in education (Spector, 2013), which might be a paradigm shift in the way that education services are delivered and consumed (Howarth et al, 2016). Massive number of users participate in these courses which, typically, require little or even no prerequisite knowledge (Pursel et al, 2016). Despite the high enrolment rates, one of the biggest problems of MOOCs is high dropout (e.g., Jordan, 2015; Kizilcec, Piech and Schneider, 2013; White et al, 2014), which might be as high as 90% in many cases (Hew and Cheung, 2014; McDonald and Ahern, 2015). Completion rate is considered to be an important indicator of learner success (e.g. Breslow et al, 2013; Daniel, 2012). Results of previous studies indicate that motivation is associated with persistence in university programs (Vanthournout et al, 2012) and in online environments (Hart, 2012). Therefore, it is important to understand for which purpose(s) learners use MOOCs and to compare determinants, including motivation, of completion and non-completion (Littlejohn et al, 2016; Terras and Ramsay, 2015). In the current paper, we try to understand how is motivation to enroll in a programming MOOC related to course completion.

2. Theoretical background

2.1 Motivation

There is no generally established definition of motivation. In Oxford's Dictionary of Psychology motivation is defined as "a driving force or forces responsible for the initiation, persistence, direction, and vigor of goal-directed behavior" (Colman, 2015). Motivation is a complex concept consisting of different constructs. The constructs most often related to motivation are interest, achievement goals, value beliefs, self-efficacy and control beliefs (Pintrich, 2003). Motivation can be derived either intrinsically or extrinsically (Ryan and Deci, 2000). Motivation as an important factor in education affects the achievement of learning goals as has been pointed out by several researchers (e.g. Colquitt, LePine and Noe, 2000; Elliot and McGregor, 2001). Like in all learning situations, motivation also influences engagement in online courses including MOOCs (e.g. Liyanagunawardena, Adams and Williams, 2013; Sun and Rueda, 2012).

Studying motivation in MOOC, we rely on the expectancy-value theory, because task value as a main component of this theory is especially relevant for research aiming to explain people's voluntary engagement in learning (Wigfield and Eccles, 2000) and for understanding what causes a person to initially choose to take part in a MOOC we need to understand value and worth of this MOOC for the participant (McDonald and Ahern, 2015). The expectancy-value theory is one of the predominant theories used in motivational studies (Plante, O'Keefe and Théorét, 2013). This theory states that motivation predicts academic choices and behaviors as reasons when students believe an academic task is important to them (Eccles and Wigfield, 2002). According to this theory values, i.e. reasons for engaging in a specific task, and ability beliefs, i.e. expectancies for future success, directly influence performance, persistence, and task choice (Eccles and Wigfield, 2002; Wigfield and Eccles, 2000). Values and expectancies are influenced by perceptions of competence, perceptions of the difficulty of different tasks, and individuals' goals (Eccles and Wigfield, 2002). Value beliefs as one of the key concepts of this theory have four components: attainment value or importance, intrinsic value or interest, utility value or usefulness, and cost (Wigfield and Eccles, 2000).

2.2 MOOCs

The acronym MOOC (Massive Open Online Course) highlights its key components: online course, the potential for learning on a large-scale, distributed community of peers, and open practices (Conole, 2013). These courses are usually free for learners or at a low cost (Chen, Barnett and Stephens, 2013); unlike traditional web-courses, these are open to everyone and accessible for learners from anywhere in the world, including for people with different backgrounds (Barak et al, 2016; Zheng et al, 2015; Xu and Yang, 2016). There are no obligations or demands for participating in MOOCs (Barak et al, 2016) and MOOC learners should be more able to self-regulate their learning compared to traditional courses and decide when and how they deal with their work (Littlejohn et al, 2016; Terras and Ramsay, 2015). Learners' expectations about MOOCs are often framed within the traditional instructor-driven model, despite the fact that MOOCs are less instructor-driven and, therefore, wrong expectations may lead to drop-out (Terras and Ramsay, 2015).

A systematic review of MOOCs has established that MOOCs have to deal with specific challenges (Veletsianos and Shepherdson, 2016). One of the most noticeable challenges is related to the dropout rate (Siemens, 2013). The reasons for low levels of completion in MOOCs are still unclear (Ebben and Murphy, 2014). In order to explain the dropout rates of up to 90%, it has been suggested that a lack of incentive, insufficient prior knowledge about the topic and having no one to turn to for help can be possible reasons for non-completion (Hew and Cheung, 2014). In studies of student dropout behavior, it has been suggested that social factors affect dropout during participation in MOOCs and MOOC designers should deal with social engagement that promotes commitment and therefore lower attrition (Yang et al, 2013; Ventura and Martin-Monje, 2016). Completion rates are found to be negatively correlated with course length, but consistent across time, university rank, and total enrolment (Jordan, 2014). Completion rates should not be ignored and should be investigated to gain a better understanding of the reasons behind them (Jordan, 2014).

2.3 Motivation for completing MOOC

Intrinsic motivation seems to be positively correlated to persisting in a MOOC as found in the studies mentioned below. Magen-Nagar and Cohen (2016) report that motivation, such as intrinsic orientation, beliefs about the course's value, and self-efficacy, has a strong effect on the use of learning strategies influencing the sense of

MOOC students' achievement and therefore might be related to MOOC completion. Similarly, Kizilcec et al. (2013) claim that the reasons for participation in MOOC for completing learners were mostly intrinsic because they thought it was fun and challenging. de Barba, Kennedy and Ainley (2016) have found that intrinsic motivation, including interest, mastery-approach goals and value beliefs, is related to learners' performance in a MOOC.

However, for some learners, MOOC completion is based on extrinsic motivation. Hew and Cheung (2014) claim that learners would be more likely to complete if MOOCs offered completion certificates. Even though MOOC certification has less value than a traditional course certificate (Kizilcec et al, 2013), it can be motivating for some learners (Magen-Nagar and Cohen, 2016; Milligan and Littlejohn, 2016). Littlejohn et al. (2016) claim that learners whose goal was gaining a certificate of completion were more focused on completing all the activities and assessments of MOOC. Learners believe that attainment of course certificates influences positively their future options (Zheng et al, 2015). Learners, whose main motivation factor to enroll in MOOC is to take a course from a prestigious university, may be motivated to complete the course to put a certification from the university on their resume because it would help them in the labor market (Evans, Baker and Dee, 2016).

Interestingly, motivators related to professional development seem to lead to dropout from MOOCs. The same authors claim that MOOC learners, who were motivated by their curiosity for online courses and who pursued MOOCs for professional reasons, tended not to persist. Littlejohn et al. (2016) explain that learners, whose primary motivators were development of knowledge and expertise related to their work, independently determined activities and material they would engage with and they determined by themselves when maximum learning outcomes for them were attained. Finishing the MOOC is not a priority for most MOOC enrollees, they stay in the MOOC only as long as they believe it is worth their while (Alario-Hoyos et al, 2017). More than ten percent of learners, instead of completing the entire course, selected tasks and themes they were more interested in (Chang, Hung and Lin, 2015). On the contrary, Lin and Wan (2016) found that learners with the purpose of self-development and with more previous learning experience are more likely to complete the course than those who enroll just for certification.

Several other factors besides getting a certificate and intrinsic motivators can also influence completing a MOOC. Dropout could be influenced by interest, expectations, ability mediated by motivation (Terras and Ramsay, 2015) or insufficient prior knowledge of the topic (Hew and Cheung, 2014). Challenging course content and lack of available time might be some reasons for early course attrition (Hew and Cheung, 2014; Zheng et al, 2015). Alraimi, Zo and Ciganek (2015) identified factors that enhance an individual's intention to continue participating in MOOCs. They reported that perceived usefulness and perceived enjoyment as part of motivation predicted intention to continue using MOOCs. Still, there was no significant correlation between perceived usefulness and satisfaction from participating in a MOOC. MOOC aligning with a learner's personal learning preferences and initial expectations may have influence on perceptions of the MOOC's overall value and may influence completion of the MOOC (Howarth et al, 2016).

Wang and Baker (2015) compared motivation of completers and non-completers and found only one item from mastery-goal orientation ('I'm certain I can master the skills taught in class this year') was more highly evaluated by completers; no statistically significant differences were observed in any of the other items.

Still, there is shortage of evidence about the motives that are associated with MOOC completion in the light of different motivational theories. The aim of this paper is to compare enrolment motivations of completers and non-completers in programming MOOC. Our study was based on the expectancy-value theory (Eccles and Wigfield, 2002). Two research questions were posed: (1) What are the main motivating factors for completers and non-completers of a programming MOOC? (2) What are the differences in motivation factors between completers and non-completers?

3. Method

3.1 Context of the study

The Estonian-language programming MOOC "Introduction to Programming" (in Estonian "*Programmeerimise alused")*, lasts for 8 weeks and includes 78 hours of expected work. The course is offered to learners who have little or no experience with programming. The MOOC gives an overview of some programming techniques and teaches the basics of algorithmic thinking. So far, this MOOC has been organized three times since the winter of 2016 and completion rate of it is over 50% (Lepp et al, 2017).

3.2 Sample and procedure

In spring 2016 1,770 participants registered for the MOOC "Introduction to Programming". After registration, the participants of the MOOC received a link to the questionnaire. Answering the questionnaire was voluntary and was not a requirement for passing the MOOC. All respondents were 18 or older. The descriptive statistics of the sample are given in Table 1.

Table 1: Descriptive statistics of the sample

Total number of respondents	**1,302**
Male	637 (48.9%)
Female	665 (51.1%)
Age	
Range	18-76
Average	34.3
Standard deviation	10.01
Educational level	
Unfinished basic education	2 (0.2%)
Basic education	50 (4.6%)
Secondary education	381 (29.3%)
Higher education	396 (30.4%)
Master's degree	430 (33.0%)
Doctoral degree	32 (2.5%)
Employment status	
Employed	1028 (79.0%)
Students	141 (10.8%)
Retired	15 (1.2%)
Did not work or study	118 (9.1%)
Previous experience with programming	
No experience	132 (10.1%)
Only self-taught	138 (10.6%)
Experiences in formal education (school, university, courses or MOOC)	1,014 (77.9%)
Other	18 (1.4%)

In the case of the MOOC "Introduction to programming" 836 (64.2%) respondents completed the MOOC and 466 (35.8%) dropped out.

3.3 Instrument

The data was collected with an online questionnaire. The motivation scale (FIEM) was based on the expectancy-value theory (Eccles and Wigfield, 2002; Wigfield and Eccles, 2000) and was composed and validated by the authors (Luik et al, in press). The FIEM scale showed sufficient fit indices in CFA; the standardized factor loadings and item reliabilities of FIEM scale were moderate or high (Luik et al, in press). This scale of the model consists of 28 items, divided into seven factors (Table 2).

Table 2: Description of the instrument

Factor	Number of items	Examples	Cronbach's alpha
Interest and expectancies for course	8	*'I am interested in that topic'* *'I can participate in a course with excellent instructors'*	.819
Personal suitability of distance learning	4	*'I can choose the time, when I study'*	.817
Suitability for family and work	2	*'I can combine learning with work'*	.762
Importance and perceived ability	6	*'I need that knowledge in real life'* *'I know that I do well in this topic'*	.771
Usefulness related to certification	4	*'I get a certificate from the university'*	.789
Social influence	2	*'My friends think that I would be successful at this course'*	.857
Usefulness related to own children	2	*'I would like to help my children in their programming studies'*	.800

The prefacing statement to all motivational items was 'What did motivate you to enroll in the MOOC?' and all motivational items were on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). Five items with demographic data (gender, age, education, employment status, previous experience with programming) and name were added. The data on completion or non-completion of the MOOC was taken from the learning environment.

3.4 Data analysis

The analyses were carried out using SPSS version 24.0. Factor means for each participants according to the items were computed. Linear mixed models were used. Multivariate analyses of variance with the Bonferroni adjustment for multiple comparisons were used to identify the differences between the factors for completers and non-completers. Multivariate test of between-subjects effects with Bonferroni adjustment was used to identify the differences in motivation factors between completers and non-completers. Bonferroni correction was used on p-values to counteract the problem of multiple comparisons.

4. Results

Four statistically significant differences between completers and non-completers in motivational factors emerged (Table 3). Factors 'interest and expectancies for course', 'personal suitability for distance learning', 'usefulness related to certification', and 'social influence' were rated higher by completers than by non-completers.

There was a minor difference in the ranking order between completers and non-completers. The highest-rated factors (ratings over 5) 'interest and expectancies for course', 'personal suitability of distance learning' and 'suitability for family and work' were same for both groups. Similarly, both groups gave the lowest ratings (less than 3) to 'usefulness related to own children'. All factors were statistically significantly different from each other in the case of non-completers (F (1, 465) = 11229.585, p < .001; multiply comparison with Bonferroni adjustment all p < .001). However, in the case of completers, there were statistically significant differences between the motivational factors (F (1, 835) = 20539.313, p < .001), but there was no statistically significant difference between the factors 'social influence' and 'usefulness related to certification' (mean difference .124; std. error .059; p =.767). Statistical significance was detected in all other pairwise comparisons with Bonferroni adjustment (all p < .001).

Table 3: Comparison of motivational factors between completers and non-completers (in ranking order)

Factor	Completers (n=836)		Non-completers (n=466)		F-statistic	p
	M	Std. error	M	Std. error		
Interest and expectancies for course	6.13	.027	6.04	.036	3.913	**.048**
Personal suitability for distance learning	5.70	.037	5.53	.050	7.539	**.006**
Suitability for family and work	5.34	.059	5.18	.080	2.676	.102
Importance and perceived ability	4.72	.038	4.607	.051	3.136	.077
Usefulness related to certification	4.01	.052	3.80	.069	5.913	**.015**
Social influence	3.89	.065	3.52	.087	11.537	**.001**
Usefulness related to own children	2.76	.064	2.67	.086	.768	.381

Note. In bold are p values above .05

5. Discussion and conclusion

This paper aimed to compare motivations of completers and non-completers for enrolment in programming MOOC. Firstly, it was found that 'interest and expectancies for course', 'personal suitability of distance learning' and 'suitability for family and work' were the main motivating factors for completers as well as for non-completers of the programming MOOC. The same ranking was found out in a previous study in the case of all learners (Luik et al, in press).

Secondly, the motivational factors between completers and non-completers were compared. Four statistically significant differences were found. All these four factors 'interest and expectancies for course', 'personal suitability of distance learning', 'usefulness related to certification', and 'social influence' were highly rated by completers of MOOC.

Intrinsic factors like interest have been found to be related to learners' performance (de Barba et al, 2016) and learning strategies (Magen-Nagar and Cohen, 2016) and therefore may be linked to MOOC completion. The role of initial expectancies in MOOC completion was also found in a previous study (Howarth et al, 2016), and Wang and Baker (2015) claim that curiosity and prestigious university can affect dropping out. However this result is on contradictory to Evans et al. (2016) findings that MOOC learners, who were motivated by their curiosity tended not to persist on MOOC. In our case although, it was one of the highest rated factors for both groups, completers evaluated interest together with expectances higher than non-completers.

The factor 'personal suitability of distance learning' was also rated higher by completers comparing with non-completers, which is in accordance with previous studies. Terras and Ramsay (2015), who claim that learners should cope with increased freedom and autonomy in MOOCs and MOOCs need higher e-learning skills. Zhou (2016), who have found out that the decision to enrol in a MOOC depends, to a large extent, on how learners evaluate their time and resources. The influence of learners' learning preferences matching with MOOC design was also found by Howarth et al. (2016). Learners, who prefer distance learning, might be able to cope with the difficulties of the MOOC and also overcome situations where motivation tends to disappear and therefore complete the MOOC more likely.

Zhou (2016) has claimed that significant others play a critical role in determining one's motivation in MOOCs and our results indicate that it may be one of the critical factors influencing MOOC completion. Some other authors (Yang et al, 2013; Ventura and Martin-Monje, 2016) assert that social factors too affect dropout from MOOCs. Our results also supported the findings of the studies that emphasized the importance of certification for completers (Evans et al, 2016; Hew and Cheung, 2014; Littlejohn et al, 2016; Milligan and Littlejohn, 2016).

However we cannot state that completers and non-completers differ in their internal and external motivation as has been claimed in several papers (Evans et al, 2016; Howarth et al, 2016; Kizilcec et al, 2013: Littlejohn et al, 2016; Zheng et al, 2015). In our study, among the four factors that completers rated higher than non-completers, there were both factors describing both internal and external motivation. Although Evans et al. (2016) claim that motivators related to professional development seem to lead to dropout from MOOCs and Alrami et al. (2015) also reported that perceived usefulness predicted intention to continue using MOOCs, our study did not support that. There was not statistically significant difference in factor 'importance and perceived ability'.

In conclusion, the evidence from this research indicates that motivation to enroll in a MOOC plays a significant role in completion. Creating different support systems and organizing MOOCs according to their motivation enable learners with different motivation to complete the MOOC.

The study has some limitations that have to be taken into account when generalizing the findings. First, the number of participants was low compared to the common number of participants in MOOCs, but the participation rate was still considerable in the Estonian context. Second, we did not study in-depth the differences between participants according to their background data and because we studied only programming MOOC in the Estonian context, the results are not generalizable to other MOOCs and countries.

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Towards a Model for Research-Based Exhibition Learning Design

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Abstract: This paper argues that a higher level of research activity is necessary at all levels in the creation of science centre exhibitions. Science centres focus greatly on their role as an informal learning space but rarely integrate learning theories or develop documented knowledge in their exhibition practices. A research-based approach can expand understanding of exhibitions as a media, encouraging a more systematised, theory-based and documented practice. We argue that if an exhibition is to be research-based, initial ideas regarding the form of the exhibition, and the elements designed to support learning, have to include the use of theory and a systematic and documented design processes. This approach involves the inclusion of one or more researchers to guide the initial definition of the learning goals and how to reach them, creating a base for testing not only if these goals are reached, but also how. This premise forms the basis for creating a model for collaboration between research and exhibition development in a science centre context that facilitates an iterative research-based development process and emphasises focusing on learning elements. We present a new model for developing research-based exhibitions developed from an analysis based on a five-year exhibition project at a Danish science centre. The model illustrates the levels of collaboration between research and exhibition development in a DBR framework. The current papers analysis of data from the five-year exhibition development is structured around the three phases of collaboration illustrated in the model: 1. high level collaboration, 2. Medium level of collaboration, and 3. Low level of collaboration. The conclusion A result from the analysis suggests that the model can guide the collaboration process by creating awareness of the phases in the collaboration, what point in process the project is, and who the central participants at collaboration level are. A focus on the level of collaboration can help to navigate in the development process and a focus on the divergent goals and rationals in practice and research will help ease potential collaboration conflicts.

Keywords: science exhibitions, learning design, research-based exhibition design

1. Introduction

In recent decades conditions for museums and science centres in the West have evolved from primarily focusing inward on the care and display of items to today's increased outward focus on visitors and surrounding communities (Weil, 2006). Various studies examine the transition phase science centres are undergoing (Pedretti, 2002; Toon, 2005). Their main critique is of visitors being viewed as passive and they call for a broader, context-dependent dissemination of science (Quistgaard & Kahr-Højland, 2010). Research points out the importance of museums developing intellectually by engaging in research as a key way of remaining relevant, stating that research enhances organizational learning that involves: "embracing change and using it in innovative ways – learning from past actions and present situations in order to grow, develop and remain sustainable for the future" (Kelly, 2009, p. 67). Laherto (2013) argues for the use of educational research in exhibition development to ensure that exhibition practices are well rooted in theory and research. Science centres could benefit from expanding and integrating educational research in the development of exhibitions instead of relying predominantly on the skills and experience (however extensive) of the science centre staff (Laherto, 2013). Match-making between research and practice, however, is not without challenges. Studies show that various fields, operate with their own terminology, that time frames for research and development differ and that research results are not always directly applicable in development projects (McLean, 2006).

In this paper we present results from the study of a collaboration project between research and exhibition development in the PULSE project – a health promotion exhibition at a Danish science centre. The goal in the study has been is to understand what processes are specific for research-based exhibition development at science centers. We have used a framework of Design-Based Research (DBR) to analyse the process and from this we suggest a new model for research-based exhibition design.

2. Background: DBR in research-based exhibition development

Collaboration between research and exhibition developers is an established practice at science centre's internationally. The research goals of museum exhibition studies vary, covering a range of topics stretching from learning outcomes, to visitor behaviour along the exhibition route to interpreting the experience of a museum space (Falk & Storksdieck, 2005). The majority of the background literature used in this article does not make a sharp distinction between museums and science centres, the latter of which is the focus of this article. As a result, we subsequently use the term museums collectively to refer to both in the exploration of respectively research and exhibition development, and DBR in a science centre context.

2.1 Research and exhibition development

In response to the need for a greater understanding of visitors, there is now a growing, albeit slowly expanding, foothold in the museum community of practice to focus on and practice evaluation and user research (Kelly, 2009; Miles, 2007). Kelly (2009) argues that the evaluation and visitor study activities of museums need to evolve and be more research-based, stating that: (...) research can demonstrate that museums make a difference, help them improve their performance and, ultimately, contribute to organisational sustainability. (p. 66). Shared knowledge-building and theory-based exhibition development can qualify exhibition practices, ultimately leading to the creation of better exhibitions and learning opportunities for the public and visitors (Kelly 2009). In the museum world new exhibition projects do not necessarily begin with a research question or learning hypothesis concerning the theme the exhibition conveys (Laherto, 2013; Wells et al., 2013). Laherto (2013) argues that even though the educational function of museums and science centres is articulated as its main purpose, the production of exhibitions is rarely based on educational research:

> *"During the past few decades, museums and science centres throughout the world have placed increasing emphasis on their educational function. Although exhibitions are the primary means of promoting visitors' learning, educational research is not often utilised when designing these learning environments. Rather, the development of exhibitions in museums and science centres tends to rely on the know-how of the staff." (p. 121)*

This implies that the initiation of an exhibition development process does not necessarily include a research issue, often leaving the decision making in the development process undocumented and non-systemized in the conceptual phase. The process of developing an exhibition thus becomes as important as studying the final product to identify the conditions behind the product and the scientific knowledge the exhibition comprises (Achiam & Marandino, 2014). Creators of exhibitions are well aware that an exhibition is a complex learning and communication tool. In comparison to, for instance, movie genres, those of exhibitions are not as well understood, developed or defined (Macdonald, 2007), which underlines the complexity of layers involved when operating an exhibition, especially considering that it is to be placed alongside other exhibitions in its own unique museum space (Achiam & Marandino, 2014).

In the above, it is argued that museums should increase (or initiate) their focus on research (Kelly, 2009), but also incorporate theorization and systematization into development practices to aid research on museums and their practices (Achiam & Marandino, 2014).

2.2 DBR in a science centre context

Originally referred to as design experiments, the DBR approach was created to capture, describe and develop learning designs in a naturalistic environment (Brown, 1992). The aim of DBR is to understand the intended learning processes in the design and to rigorously test the design for these learning hypotheses. Consequently there is a dual focus on creating a design and refining and adjusting soft hypotheses and on knowledge gained.

DBR is a broad methodological framework that (ideally) seeks to implement various methods in the pursuit of a design for a given context while simultaneously generating or improving learning theories on what elements of the design support different kinds of actions. Cobb et al. (2003) identify five features that combined describe key aspects of a DBR project. First, the purpose of the project is to develop theories about both the learning process and the elements designed to support or achieve this learning. Second the methodology is interventionist, with initiation of the design beginning with the use of prior knowledge of other research relevant to the context, the learning theories and the design type. Third, a DBR project employs an iterative design process that involves making adjustments based on new discoveries, but, fourth, also testing new hypotheses.

Finally, the approach is pragmatic and the theories developed are humble and domain specific (Cobb et al., 2003).

Most science centres focus on designing exhibitions that to some degree or to a great extent support learning (Falk et al., 2007). Given the focus on designing for exhibitions with an educational aim and the call for research to support the exhibition design process, DBR is a well-suited methodology in the endeavour to merge research and exhibition design. Hauser et al. (2009) describe their experience with developing exhibitions within the DBR framework. Some of the challenges mentioned are that research and development for exhibitions can take place at varying rates and that researchers have difficulty producing conclusive answers that practitioners find applicable. Ejersbo et al., (2008) points out that balancing theory generation and design production are described as a general challenge when working with DBR. Working with diverse goals can be a serious challenge to the success of projects integrating research and development, but must also be acknowledged as a premise for the entire collaboration and requires being approached with forethought and sufficient resources. Figure 1 presents Ejersbo et al.'s (2008) osmotic model of a DBR process that illustrates the challenges involved in focusing simultaneously on two aims: producing a product and knowledge generation.

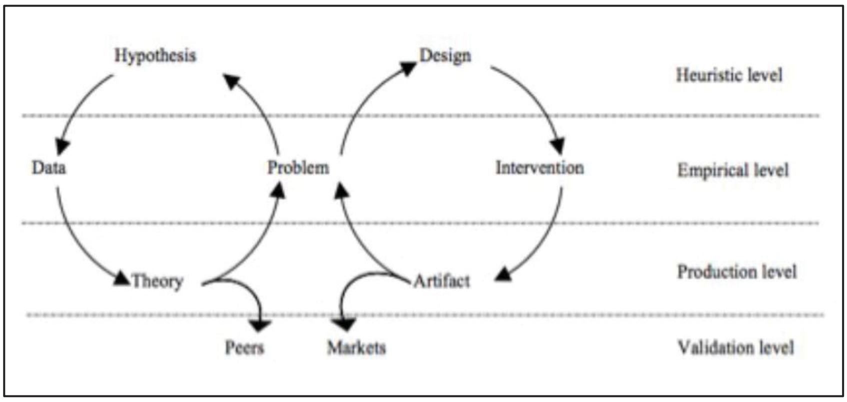

Figure 1: Osmotic model showing the balance between artefacts and theory generation in the design research paradigm. From (Ejersbo et al., 2008)

The circle on the left represents the traditional way of conducting educational research, which comprises problem definition, creating hypotheses, data collection and analysis. The circle on the right, which describes a production cycle with an emphasis on user feedback, consists of iterations that involve definition of the project or problem in question in the development process, developing artefact prototypes or designs, tests involving target groups and final development of the artefact or exhibition. In the cycle in the circle to the right, the market or visitors validate the artefact developed. Ejersbo et al.'s model indicates that an ideal DBR project should begin in the middle (with a problem) and then move in synchronous circular movements. Developed within the field of educational research, this osmotic model requires further development to accommodate the specifics of an exhibition development process, which differs from that of education.

The main research goal in this paper is through the analysis of a case – the PULSE-project – to understand the various levels of processes in collaboration between research and exhibition design at science centres and potentials in applying design-based research in development of a process model for strengthening collaboration.

3. The PULSE exhibition and data collection methods

The PULSE project is a large-scale project that was created in collaboration between the Danish science centre Experimentarium and the health research institute Steno Diabetes Centre. The project began in 2012 and the core outcome is an exhibition, with the goal of communicating health promotion. The core target group of the exhibition is the family unit defined as an intergenerational group of minimum two persons living together one being 6-12 years old. The project builds on health promotion theories and action competencies that include a number of subcomponents such as knowledge, commitment, visions and action competences (Jensen, 2000). In short the exhibition consists of eight different multi-user exhibits in which participants are active as a team consisting of two to five members and a mid-point with various screen-based activities on health. The exhibition resemble places in the home, for example, a kitchen, where balancing skills are put to use, a bathroom, where cleaning it involves dancing. PULSE explores how a science centre exhibition and connected outreach activities, can influence how families perceive the issue of health.

3.1 Methods and data collection

The PULSE-project has the ambition to move the research field of health promotion with a broad and positive approach to health (WHO, 2005b) into a museum setting. This is a relatively new venue for health promotion (Christensen, et.al., 2015), underpinning the relevance of involving research in the development process. The overarching research question was: 'What kind of educational and structural elements should be integrated in health exhibitions and associated community activities to encourage families to take action that improves and sustains their health?' (Magnussen et. al, 2017).

PULSE was based on a formal collaboration between research and development at Experimentarium and between the two institutions Steno and Experimentarium. The collaboration has had phases of intense collaboration and phases of division. PULSE data has been logged for four years by PULSE researchers and the current study is part of this longer series of studies (Magnussen et al. 2016; 2017). The research process has been inspired by design-based research with focus both on developing new innovative learning designs as well as generating theoretical insights into context dependent learning (Cobb et al., 2003). The project has developed through iterations of problem-definition, design, interventions, analysis and redesign applying different theoretical frameworks as well as methodological approaches such as ethnographic field-study, video observation, eye tracking technology, surveys and qualitative interviews. The phases described are not static and linear, which means that some of the elements described separately here may overlap, oscillating between design and testing (Cobb et al., 2003).

This study focuses specifically on collaboration processes between researchers and developers developing science exhibitions and our ambition is to formulate a model on such collaborative ventures. The authors are a senior researcher with vast experience in working with DBR-projects, a PhD-fellow who has been an active part of the PULSE-project from the beginning and a research assistant responsible for executing a summative evaluation of the PULSE-project. The empirical data consists of 2 interview studies done before and after the phases of collaboration. The first study was a documentation of the experiences made in the PULSE working group in the first phases of collaboration where concepts and narrative for the exhibition was formulated (Kahr Hällman & Thiel Sandholdt, 2014), giving voice to both researchers and developers. Eight semi-structured qualitative interviews were conducted with key developers and researchers involved in the project (Kvale & Brinkman, 2008). The interviews lasted 30-60 min. and were audiotaped. The interviews were conducted in spring 2014 by one of the PULSE researchers (and co-author of present article). An additional videotaped interview was done in connection to a half-day seminar with researchers and developers by the end of the collaboration process. The main focus in this interview was to understand the developers and researchers perception of the collaboration process after the final phase of the project. All data is originally in Danish, but translated here by the authors. Participants are anonymized and are only referred to as "developer" or "researcher" in the following sections.

4. Formulating a model for collaboration

With the osmotic model as a tool we have looked at what happened in the PULSE project. Our main finding in this article is a reformulation of the osmotic model made specific for such collaborative ventures in exhibition development processes. We start our analysis by presenting the model, since this is the turning point for the following paragraphs. We do not claim that this is a one-size-fits-all model, or that all exhibition projects should be research-based in the manner presented here, but contend, however, that there is a need for a higher level of research and the application of theories when creating an exhibition (Kelly, 2009; Laherto, 2013) and that DBR methodology is a well-suited framework to build on (Hauser et al., 2009; Reisman, 2008).

The analysis is therefore structured around phases of: 1. high level collaboration, 2. Medium level of collaboration, and 3. Low level of collaboration. This is referred to in the bar in the left side of the model.

4.1 High level of collaboration

In the first two years of the project researchers and developers worked closely together. The main goal was to formulate early design concepts and detailed hypotheses to support the creation of the specific design concepts for the PULSE exhibition development and research. Put in a DBR frame this relates to what Cobb and Gravemeijer (2008, p. 69) describe as the envisioned learning trajectory. In other words, the project is put in a broader theoretical context and describes the classes of phenomena that, in this case, the exhibition will comprise.

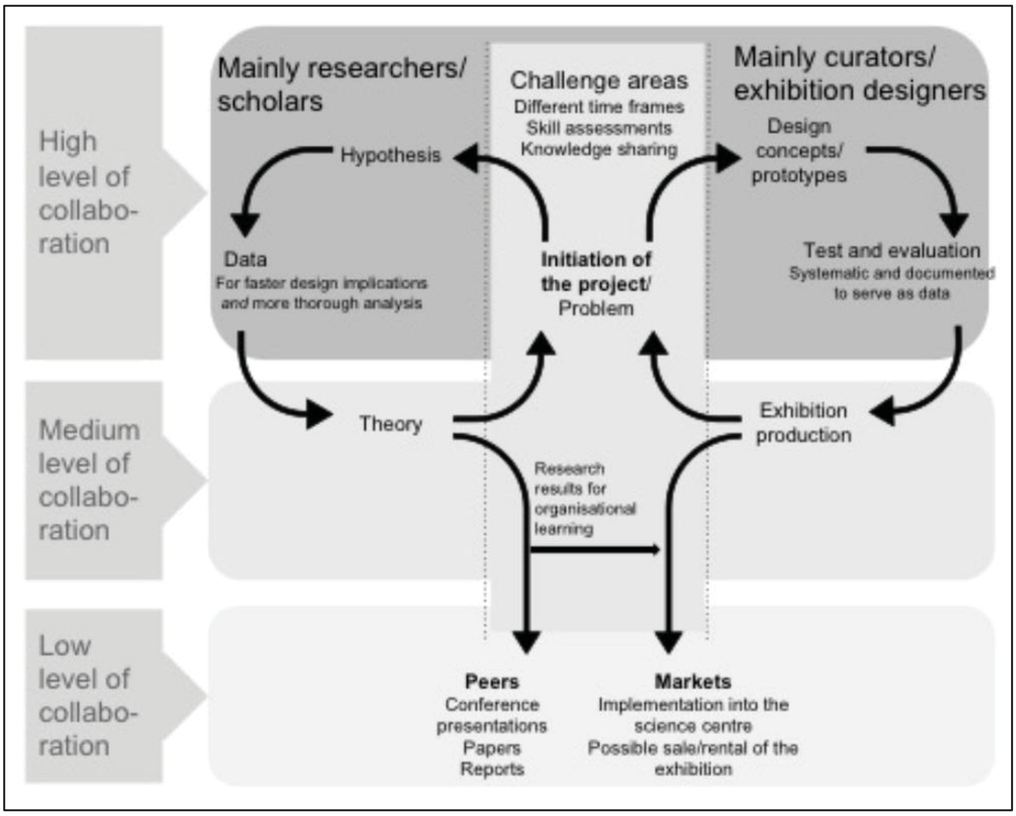

Figure 2: Model of research-based exhibition development that illustrates the collaboration and challenges that arise between research and exhibition development in a DBR framework

The team was physically located in the same office and met for a weekly informal breakfast to update each-other on bits and bops to create a formal space for sharing informalities. The team also arranged a monthly social or seminarial event related to the exhibition subject health set in working hours, to get to know each other better and broaden the various health perceptions or 'provide a common language' as described by developer 1. This facilitation of the collaboration also created a more clear understanding between researchers and developers of eachother's competences and professional terms:

> *"I'm so surprised that you're real people, I thought researchers were like someone who walked around in lab coats and wrote 1000 words (...) but the whole way to talk and sort the world is new to me (…) So you can become more specific in your language and when describing things."*
>
> *(PULSE exhibition developer 1.*

These findings indicate that in the phase with a high level of collaboration, it's important to prioritize and facilitate a space for participants to find a common language through exploring the meanings of each other's professional terms and reaching an understanding of meaning of common concepts in the project. This is also evident in the next quote, where one of the researchers express what she saw as initial challenges in the collaboration between researchers and developers:

> *"Uncertainty can quickly arise concerning what they [developers] can do and what we do [researchers]. And about which skills we share and do we complement each other well? The process can be really, really uncomfortable for all parties. (...) facilitation is needed throughout and much more than you think. Otherwise, a lot of work is wasted" PULSE exhibition Researcher 1.*

In the phase of high collaboration the front-end study and two user-involving workshops were carried out with families. This also relates to the identified challenge of time: The extensive focus on user-involvement in the early project phase where the concept of the exhibition was open for discussion was new to the developers and took much more time than in more traditional exhibition development projects. It was also new to the researchers to adjust to a development process where findings from data had to be quickly derived and presented to practice and only later be used in more traditional academic writing processes. The bonuses of this clash of traditions was however also evident. One of the developers said that the expanded process and user involvement allowed ideas to be implemented during the conceptual stage of the design:

> *'We have user tested before, but not in this manner or at that stage. So it's not unique that we're doing testing, but doing it at such an early stage and being receptive to it is new' (…). Having families at Experimentarium [involved in developing the exhibition] has truly been a plus. They could tell us what they wanted. But they could also tell us what they just didn't want at all (...) So some really good filters for sorting (...) and what to spend energy on." (PULSE exhibition developer 2).*

These findings indicate that integration of research and development in the design processes can inspire the development process by involving new types of methodological approaches. The user-involvement processes with families is an example of processes that can contribute with new knowledge to both the research and design process in the project: Researchers are able to generate data and develop theories on how families understands health in connection to designing exhibitions in a science centre context, and exhibition developers gain specific knowledge and ideas for their target audiences preferences in the future exhibition design. Extensive facilitation of the collaboration is however necessary in order for cross-pollination to happen and divergent time-frames and competences to meet.

4.2 Medium level of collaboration

The later phase of the PULSE project involved a medium level of collaboration between the researches and developers. The intense process of involving users and formulating a hypothesis and design concept for the exhibition was over. The task at this point for the developers was exhibition production and the researchers focused on generating and organize findings. The research part of the project team focused, amongst other studies, on studying the types of health skills visitors gain knowledge about when they participate in the exhibition's various activities (Magnussen et al., 2016). This was with a two-sided focus on developing theoretical knowledge on what types of skills families develop in health promotion exhibitions, and with focus on providing the developers with knowledge on how to improve the exhibits. Besides providing opportunities for organizational learning (Kelly, 2007), these different types of focus have the possibility of developing knowledge for the specific context – the improvement of the specific exhibition – and for the overall understanding of developing different types of exhibitions.

During the phase with medium collaboration between researchers and developers the main focus was on production. Creating an exhibition is a complex affair involving, e.g. a variety of craftspeople and safety issues, introducing a range of new professions to the development group. Experimentarium has a whole team of people comprising, for example, carpenters, software developers and welders skilled at crafting the physical elements of exhibitions and have responsibility for the production of the physical and/or digital product(s). It is thus also central to define what processes the collaboration contribute to and in what phases of the project the two sides of the team work on separate processes (Ejersbo et.al., 2008)

When the exhibition opened it was possible to do a research-driven summative evaluation with ideas for design improvements (Zachariassen & Magnussen, 2016), which is an example of research results used for organisational learning.

4.3 Low level of collaboration

In the last phase of the project the collaboration between research and practise was low. The exhibition was open to visitors and in this phase the craftspeople focus on set up of displays/activities or to solve technical problems. Conversely the researchers focus on analysing results and finishing papers or attending conferences to present their results, which can, but not always, be aimed at a different audience (peers) than the exhibition developers. It is important to create strategies during this period of reduced collaboration to ensure that the knowledge researchers generate is shared with the organization via avenues other than formal papers. Broader dissemination will furnish the organization with learning opportunities to build on and deliver insights into the researchers' work that is perhaps more opaque than the physical manifestation of a grand exhibition. As a means of supporting knowledge sharing in the PULSE project, an informal half-day seminar was conducted. An important voice raised in the half-day seminar is the need for knowledge sharing going from practise to research:

> *"The presentations were absolutely fantastic. In fact, I'd like to sit down with each of your presentations and then ask questions about what you presented. Wow, have we ever learned a lot in a short time (...) a unique aspect of this project is that I find it necessary to discuss your feedback as every little detail in this project has been considered and to a far greater extent than usual (...) You've come up with some pretty darn amazing specific design proposals, but it would be wonderful if we could put some of our development skills into play (PULSE exhibition developer 1, half-day seminar at the end of the project)*

The developer describes a desire for the facilitation of a higher degree of dialogue on design impacts. This is a valid point and is a reminder that an effort needs to be made to create a balance between and awareness of the different skills and qualifications present in a project, but also that it is important to discover when they complement each other. Providing adequate space and resources to actively do this is thus essential.

At this point in the model, it would be possible to open a new phase of high collaboration by entering into a new project building on the attained experiences and knowledge. This could be the development of a new exhibition or school material based on the finished exhibition. In such a process the obtained experiences and knowledge would serve as fruitful kick-off resources, making the participating researchers and developers well prepared for the forthcoming collaboration.

5. Discussion and conclusion: Model for research-based exhibition practice at science centres

In the discussion we will touch on issues to be aware of when working with DBR in exhibition development projects and we will elaborate on the model for collaboration (figure 2).

An educational program, learning game or lesson plan can be characterized as having: (1) a specific object of learning, (2) a narrow target group, e.g. second graders, (3) a facilitator taking responsibility over the process, e.g. a teacher, and (4) should be adaptable in many different contexts. The features of an informal learning environment open to visitors, such as an exhibition in a science centre, are that it: (1) is open to interpretation by many different types of visitors, (2) contains easily understood and manageable tasks that do not require a facilitator, (3) is confined to a specific space, i.e. a science centre, and (4) is a very physical product in comparison to an educational program. Using a DBR framework in the designing of exhibitions can be a beneficial method for enhancing knowledge sharing on exhibition development and also for increasing know-how on creating learning outcomes for visitors in the museum environment (Hauser et. al., 2009; Reisman, 2008), in part due to the shared focus on both developing a functional design in a specific context and on the development and refinement of theory (Cobb & diSessa, 2004). The DBR framework can thus help make ends meet when designing educational exhibitions in informal learning environments. It can, however, be difficult to focus simultaneously on theory generation and developing a product (Ejersbo et al. 2008).

To accommodate this we adapted the osmotic DBR model to a science centre exhibition design context (figure 2). The developed model highlights how researchers/scholars focus on generating theory, while curators/exhibition designers specialize in the production of exhibits. An exhibition is typically created based on the expertise of the museum staff (Laherto, 2013), indicating that the circle to the left could be abandoned entirely in a non-research-based development process. The left circle visualizes the added effort of research goals to a process involving one or more researchers. As the PULSE project highlights, the relationship between different skills and fields of specialization becomes evident. The sample list of challenges written between the two circles represents the challenges that can occur when the two circles meet. The challenges listed are examples taken from the PULSE project. The inclusion of these challenges in the model is an effort to provide exhibition projects working with DBR an explication of what to remember to facilitate and plan for. For instance, strategic planning and facilitation is central to support integration between research and development in order to avoid wasted work.

The analyses in this paper suggest that it is important to be aware of the phases in the collaboration process and at what point in process the project is. And in relation hereto: who should be part of the collaboration and why. A focus on the level of collaboration can help to navigate in the development process and a focus on the divergent goals and rationals in practice and research will help ease potential collaboration conflicts. It is central that the collaboration is strategically supported through the entire research and development phases and that integration processes is supported both in the application for funds, the facilitation of design collaboration and in the later knowledge sharing phases where sharing of knowledge can strengthen improvements of the exhibition design. Producing a research-based exhibition will ideally result in not only an actual exhibition but also academic work, enabling peers to refer to and build on knowledge outcomes of the project. The in-depth analyses, academic arguments concerning the hypotheses and the framing of questions that the project will be based on provide more generalizable knowledge for the understanding of exhibition design and educational theory.

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Potentials and Barriers for Implementation of Learning Technologies to Support Problem-Based Learning Inspired Methods in Higher Education in Jordan

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Abstract: This paper presents results from a case study of ICT integration in higher education at universities in Jordan and Palestine. The study was conducted as part of the Erasmus+ project, Modernization of Teaching Methodologies in Higher Education: EU Experience for Jordan And Palestinian Territory (METHODS). The main purpose of the project is to modernize teaching forms at universities in Jordan and Palestine to raise the competencies of individual learners to become active members of the knowledge society by enhancing the learning process of students acquiring 21st century competencies to become autonomous and active learners. Traditional instructive methods are still widely applied in higher education in many Arab countries. The approach has been criticised for being teacher-centred rather than student-centred, and faces problems with the integration of learning technologies in educational programs. Teaching methods need to be improved at universities in Jordan and Palestine, so some universities have been experimenting with problem-based learning (PBL) methods in their courses for creating student-centred, ICT-supported higher education. This paper presents results from a background study conducted to understand possibilities of and barriers to developing and implementing new types of teaching forms with elements of problem-based learning. The current interview studies were conducted with a class of 30 engineering students and one faculty member at a university in Jordan. The interviews specifically focused on understanding how participants perceived the existing educational practice and system, what problems they identified in their classrooms, and what teaching methods they hoped to see developed further in their classrooms. The results show that participants experience problems with group work, teaching that has little focus on applying theory to practice, open problem solving, and implementation of technology in courses. The results indicate that it is central to both look at pedagogical approaches such as application of theory on practice and support of group work as well facilities for group work and ICT infra structure, when establishing new ICT efforts at Middle Eastern universities.

Keywords: higher education in Middle Eastern countries, ICT and learning

1. Introduction

Developing new educational approaches and practices has been a central focus at universities in Middle Eastern countries in recent years. Middle Eastern education has been criticized for rewarding passive consumption of knowledge and failing to engage students in applying skills and knowledge to situations outside the educational institution (Mahrous & Ahmed, 2010; Britz & Richard, 1992). In the majority of Arabic-speaking countries, traditional instructive educational methods are still influencing higher education, and teaching methods in higher education are teacher-centred rather than student-centred (Saleh, Al-Tawil & Hadithi, 2012).

Problem-based learning (PBL) is an educational method that could be used to change traditional educational approaches in higher education in Middle Eastern countries (Sungur & Tekkaya, 2006). Problem-based learning has been defined as both an educational strategy or philosophy and a teaching form (Baden & Major, 2004). As a result, there are various PBL guidelines and models developed for specific disciplinary, cultural or instructional contexts. These varied guidelines include principles such as perception of knowledge building, learning, teacher roles, student roles and problems that must be considered when implementing PBL (Graff & Cosmos, 2003). It is central to understand what possibilities and barriers exist for implementing new teaching forms in higher education in a Middle Eastern context. This paper presents results from the project Modernization of Teaching Methodologies in Higher Education: EU Experience for Jordan And Palestinian Territory (METHODS). The study is an interview study involving students and a faculty member at a Jordanian university. The central goal of the study is to understand what possibilities or barriers exist for implementing new PBL-inspired, ICT teaching forms in higher education in a Middle Eastern context.

2. Background

Pedagogy in educational institutions in many Middle Eastern countries has been criticised for depending solely on lectures, rote learning and dictation through teaching that consists of illustrating concepts and reading from textbooks (Mahrous & Ahmed, 2010; Chadraba & O'Keefe, 2007; Tubaishat, Bhatti, & El-Qawasmeh, 2006). The Middle Eastern education system has been criticised for being an examination-oriented system dependent on memorizing facts rather than applying theoretical concepts to situations outside the classroom (Mahrous, 2010; Britz & Richard, 1992; Russell, 2004). Instead of continuing to follow a system focussed on rote learning, new educational tools and models are needed in Middle Eastern higher education.

Alkoudmani and Elkalmi (2015) reported on pharmacy schools in several Arabic-speaking countries experimenting with blended learning methods and e-learning. In contrast to traditional educational approaches in Middle Eastern countries, new methods of instruction have been introduced in these pharmacy schools to provide interactive, problem-based learning, as well as computer-assisted learning in several countries such as Kuwait, Jordan, Saudi Arabia, Egypt, UAE and Qatar (Alkoudmani & Elkalmi, 2015). Implementing these new educational approaches can be difficult because of major barriers, including ICT problems, higher connectivity, cost, unequal income distribution and low public esteem of online learning as a credible way to learn (Alkoudmani & Elkalmi, 2015).

Implementing PBL has shown to have several positive effects on students' motivation and learning. Sungur and Tekkaya (2006) reported a study that focussed on investigating the effectiveness of PBL and traditional self-regulated learning on tenth-grade students' motivation and learning strategies. Results showed that PBL students had high levels of intrinsic goal orientation, critical thinking and peer learning compared to students following classes with traditional instructional approaches (Sungur & Tekkaya, 2006).

It is important to understand the differences in applying educational models and tools in both a Middle Eastern and Western educational context. In a cross-cultural study of business students' perceptions of the effectiveness of pedagogical tools, Mahrous & Ahmed (2010) show that students in Middle Eastern countries, the U.S. and Great Britain all perceive lectures, group projects, multiple choice questions and essay questions as pedagogically effective tools. Contrary to this, methods that simulate authentic work life situations were rated significantly lower as an effective pedagogical tool by Middle Eastern students than by American and British students. Case studies that introduce students to the conditions of decision-making in an authentic professional context is a widely used tool in business studies and has been shown to provide students with a more practical experience than other pedagogical tools (Burns, 1992). Mahrous and Ahmed suggest that above the results stem from students being accustomed to passive learning systems, so students lack the practical experience to analyse a problem with open-ended multiple answers and experience confusion on what is expected of them (Mahrous & Ahmed, 2010).

The current study presents data from a qualitative interview study with students and a faculty member at a Jordanian university. The focus of the study is to understand possibilities and barriers in the existing educational culture to develop PBL-inspired educational models and tools for higher education in a Middle Eastern context.

3. The METHODS

Project Modernization of Teaching Methodologies in Higher Education: EU Experience for Jordan and Palestinian Territory (METHODS) is a three-year project, which began in 2016. The main purpose for this project is to modernize teaching forms in higher education at two Middle Eastern universities. The establishment of the international technology learning centre is to utilize ICT's best practices at the level of higher education. The project was created in collaboration with EU-partners and partners from the Middle East from universities in the Palestinian and Jordanian territory. The project activities includes pre-studies of the challenges of integrating new types of ICT learning forms at Middle Eastern universities, development of ICT learning centres and teaching forms to develop a design course prototype and development of new ICT learning pilot courses. The current study is specifically aimed at uncovering possibilities for and barriers to integrating teaching forms with a PBL approach in existing courses in the engineering program in Jordan.

3.1 Data collection and analyses

To understand the potential of and barriers to the development and implementation of PBL at the Jordanian university, qualitative research methods have been conducted. The data consists of qualitative unstructured interviews (Kvale & Brinkmann, 2009). In total, eight interviews have been conducted before and after students experienced courses with elements of PBL. Students and one faculty member were interviewed about teaching methods used, and how traditional methods differ from PBL, their experiences with PBL, which ICT tools are used in a teaching context and the challenges that accompany ICT.

The collection of the qualitative data took place at University of Jordan and via Skype in October and December 2017, and a total of 17 students and one faculty member participated in eight focus group interviews. The qualitative unstructured interview method allowed an in-depth understanding of the participants' perceptions and meaning creation (Kvale & Brinkmann, 2009). The interviews were conducted with a focus on PBL elements such as group work, standard education and use of ITC in education. These topics contribute to understanding any issues that could arise when implementing elements of problem-based learning.

The data analysis of the interviews with the faculty member and the students has been analysed with an inductive thematic analysis (Braun & Clark, 2006). The purpose of this method is to discover patterns and themes across the data sets. This method allows the researcher to review every statement in the data set and to organize and describe the data set in rich detail (Braun & Clark, 2006). The data set was analysed with a semantic approach. This means that the process involves progression from description, where the patterns and themes are identified though the statements from the students and faculty member and their explicit meanings then summarized to interpretation (Braun & Clark, 2006). In the thematic analysis process, the thematic analysis phases were followed, step-by-step, from viewing statements to coding to patterns and themes, which resulted in the following findings below (Braun & Clark, 2006).

4. Findings

In this section the findings of the interview study are presented. The following table lists the themes and sub-themes identified through the thematic analysis.

Table 1: Themes generated in thematic analysis of interview data from interviews with students (S) and a faculty member (FM) at Jordan University. Data collected September–December 2017.

THEMES AND SUB-THEMES	EXAMPLES OF FROM DATA
Conventional way/standard teaching method Students passive Not reaching own results Theoretical not practical	S1: '... the method doesn't allow you to **search for information [author emphasis added**] on your own, you get **explained/described** and **displayed everything** in advance, which means that you have **not really reached a result yourself…**'
Group work, relations and facilities Group-work facilities, do not know where to sit Mixed-gender group work at home are not socially acceptable	S2: 'The problem is when we work in a group of projects, we do not know where to sit. Sometimes it can be **difficult to work together** at the university library.' FM: '…it's not popular that a group of **mixed-gender work together at home**. To go home to a group member's home and work together there, it's **socially not acceptable**.'
University and skills for labour market University learning not useful on the labour market Relations and network, not skills	S3: '…when you graduate, you meet **challenges** in terms of **society l**ooking at your **relations/networks, rather than your skills**.'
Limiting infrastructure Slow internet connection, web sites blocked Outdated laboratories	FM: '…the **infrastructure can either help or prevent**, it can make things easier or worse…the **infrastructure is unfortunately what limits us**.'

4.1 The conventional way/standard teaching method and skills for labour market

The interviewed students expressed that the existing teaching method – what they define as 'the conventional way' – is characterized by passivity and the storage of information that is quickly forgotten at the end of the semester. They criticised traditional methods for not teaching them to be critical thinkers and for not giving them the opportunity to develop communication skills, as the learning situation is characterised by the teacher-centred teaching method (Hmelo-Silver & Barrows, 2006). One student commented:

> *If you are asked about detailed information in the later semesters in specific subjects that you have learned through the conventional method, you…forget about these things and you will not develop real life skills. There are also things that do not focus on communication, interaction skills. They focus only on the material, the academic building skills. Other skills like communication…you teach them outside of the curriculum, but not at university.*

It appears that the students' active involvement in their education is relatively limited. Furthermore, they state that the teaching method does not encourage them to do further research on their own and that they lack experience in taking responsibility for their own learning. The students also expressed that they felt teaching should focus on building competencies such as Critical thinking, communication and interaction, which are some of the basic principles of PBL (Graff & Kolmos, 2003). How this relates to exams and teaching materials was expressed by a student during an interview:

> *It is the same conventional method you study; you are taking an exam and then you will be done. In many subjects, you do not get the important things because you have not experienced or gained experience of something yourself; you have only studied the content and materials you have received.*

Through PBL, students can acquire knowledge based on their own experiences with the content, as well as through research, problem solving and discussion. The faculty member from the university expressed that the existing teaching form also proves to be challenging from the teacher's perspective:

> *The main problem with standard teaching methods is that the students are passive, [and] they do not do much in class unless the teacher asks them. They do not study regularly; they only study just before the exam, so that's a problem. So, it's a conventional way to study: they read and solve tasks. They do not do research; this is the problem of the conventional way of studying.*

The data from interviews with both students and teacher indicates that the existing course assessment forms pose a challenge when implementing PBL processes, as exams focuses solely on course content from the syllabus. Within the teacher-centred paradigm, students' focus is on learning strictly the course curricula, motivated by exam results and the teacher's delivery of the subject-specific "true knowledge" (Hmelo-Silver & Barrows, 2006). Several students also expressed doubt of whether the skills they acquire at university are sufficient for their careers after graduation. One student said,

> *We have heard from other students, who have graduated and come to work, that what is working here at university has nothing [to do] with what we will work with when we get a job. Therefore, the university is not useful when entering the labour market.*

Part of the goal of PBL is to prepare students for the labour market, including through work on real-life issues from the surrounding community. In the case of student-centred learning environments, it is important for teachers to clarify the educational objectives behind activities the students are involved in, such as why they would need to complete problem-solving activities (Hmelo-Silver & Barrows, 2006).

4.2 Group work, student relations and limiting facilities

The finding in this section includes several aspects related to group work in a Middle Eastern context, such as gender issues, facility issues and new types of e-learning platforms.

One of the major challenges of group work is that there are very limited physical facilities available at the Jordanian university. The vast majority of students mentioned that they do not have spaces for group work at the university. One student explains:

> *We do not have rooms available where we can sit in groups and work. The engineering library closes at 16:00 and it can therefore be difficult to find a suitable place to sit and work. They [the university] have not secured us facilities for group work.*

Students do not have meeting rooms or group rooms to do group and project work, making group work nearly impossible. Because of this, students are not able to learn negotiation, planning or co-work in solving of tasks.

Another challenge that arises from a lack of group work is related to gender issues and elements of gender-mixed groups. This central aspect is highlighted by the faculty member:

> *If we have a group of three students, and the max must be three in one group, and there is one female student, I usually allow her to join the group [of other female students] as it will not work if she is to be alone. The reason is that they sometimes have to work from home, and…if they go it's no good that the mixed groups work together at home, they go home to one of the group members' homes and work together there, socially it's not acceptable.*

Here, there are also personal and interpersonal aspects that arise. Students expressed that they do not have the opportunity to work at home together if they work in mixed groups. As the teacher has pointed out, home work in mixed groups, is in general, not culturally accepted. This is a factor that may influence the negotiation process and can eventually challenge the mutual responsibility in the form of the negotiation process among the group members and hence the community of practice (Wenger, et al., 2009). Lack of facilities can thus be challenging for group work processes in general and specifically for group work in gender mixed groups.

E-learning technologies have been tested by the participating faculty member, who sees these technologies as a way to change the classroom from traditional teacher-centred activities to activities characterized by PBL's student-centred paradigm (Garett, 2008; Plush, 2014). Technology-based environments help promote the active involvement of students in the form of discussion, group work and responsibility for self-learning. In the interview, the faculty member mentions how he has applied e-learning as a teaching tool for several years as a supplement:

> *I've been trying online for the past 2–3 years, [to use] YouTube videos. So, I make videos and upload them on YouTube, and the students find it very useful. They can actually go to YouTube and see the teaching; even if they have not been to the classroom, they can see [the videos]…They have the opportunity to see and understand them and refresh their memory. The YouTube videos help the students a lot; they help them understand the concept and read up to the exam, etc.*

The YouTube videos allow students to follow up on some of his classes. It also helps the students to clarify some of the things they may not understand from the reading material. As one student notes, "We really like XX's videos on YouTube. [They] are excellent and we do not experience any problems with his teaching."

The faculty member has experimented with other types of online forums to support PBL elements in his courses to allow students to exchange ideas and support the anchoring of the habitat in the specific requirements of the student community (Wenger et al., 2009):

> *We have to use e-learning as a testing tool, as a forum, [and] I have planned to do more…[to use] a forum where students can exchange ideas with each other and ask questions to be answered there. We created a Facebook page for this, where students can post questions to the teaching content. I can answer it, or another student can answer. Other students may also have the same question.*

Activities like knowledge exchange between the students and the teacher will create learning environments that are characterized by dialogue that supports knowledge building of a specific subject. The aim is that the students will be able to negotiate digitally. Students are able to utilize their own competencies and have the opportunity to foster new skills with their own by drawing on the other fellow students and the teacher. The forum can complement the community of learning in the form of group and project work, especially with the lack of facilities for group work at the Jordanian university (Wenger et al., 2009). It can help strengthen the negotiation process in group work and the course itself. The use of the forum will, however, need to be supplemented by the other aspects of PBL, such as real-world problem-solving.

However, many students in the study note that their access to technology is limited. The university has limited computers, software and labs, and the internet connection is poor. It is difficult to make best use of technology in the classroom when students and teachers cannot use it as they intend to. One of the students complained:

> *For example, when you need to work with something specific here at university, the computers are very old; we cannot use them. And, the internet network is very bad. Sometimes you can spend one and a half hours accessing the internet…to search for something that [should] not take that long.*

The limitations of technology in Middle Eastern universities will limit the acquisition of new tools and the use of existing ones, such as Facebook forums and YouTube videos, as old technology is too frustrating for students and teachers to use. The unstable internet connection will affect whether IT-based workflows will reduce complexity and increase group and project work from a PBL perspective. This will also complicate student practices by not allowing them to make use of online resources. To technically secure and a solid ICT infrastructure is thus an extremely central element when building new ICT learning centres at Middle Eastern universities.

5. Conclusion

Teaching in Middle Eastern universities is characterised by passive learning and storage of information that is quickly lost at the end of the semester, which does not encourage independent learning processes. This can pose challenges to implementing the PBL method. In the study it became evident that there are challenges with both group work and facilities but also exciting possibilities in applying new online teaching forums. The lack of facilities for group and project work at the university can prevent students – especially in mixed-gender groups – from negotiating, delegating and planning jointly. The responding faculty member in this study, however, is experimenting with using a variety of platforms for e-learning as teaching tools. He attempts to actively engage the students by establishing a Facebook forum where the students can exchange knowledge. The online forum can complement the community of practice in the form of group and project work, thus opening online facilities as students meet challenges with physical facilities. In addition, there are some challenges with access to equipment and infrastructure, including an unstable network connection. This can immediately lead to challenges associated with the inclusion of digital habitats that must be considered if the IT-based working methods will optimize group and project work, which is part of PBL's goals.

The above study indicate that it is central to both look at pedagogical approaches such as application of theory on practice and support of group work as well facilities for group work and ICT infra structure, when establishing new ICT efforts at Middle Eastern universities.

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Theoretical and Methodological Basis of Assessment of Pedagogical Digital Competences

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Abstract: Pedagogical Digital Competences (PDC) or also known as ICT competences of teachers are a significant subject matter as they are a prerequisite for efficient digital technology applications in the teaching and the learning process. In many countries of the world, the PDC are integrated into the educational framework of the educator. There are also a number of specific frames for PDC (eg. UNESCO, ISTE, DigCompTeach, DigCompEdu, ECDL). The theoretical base of assessment of PDC is represented by evaluating of teacher competences as a whole. Measures are important because they: can raise teacher's awareness of the need to develop her or his competences; can support a transformation in teaching culture and practice; permit the recognition of the (new) competences acquired or developed; play a part in the quality assurance and control of training and development, thereby leading to its improvement and helping to achieve excellence; can help to develop trust in the teaching workforce; and can facilitate timely intervention to improve teaching. This output also defines the three basic functions of this rating that can serve for supporting teachers' development (formative assesment), monitoring their progress (summative assessment) or for establishing their competence level, for decisions on salaries. For purpose of the formative assessment these tools are: regular meetings with principal or other staff – reviews of competences, self-assessment, critical friends groups, peer review, individual development plans, classroom observations by peers, video analysis, written reflections/narratives, reports, portfolio (inputs/outputs), action research, student/parent feedback. Summative assessment tools include: examinations, classroom observations, micro teaching, video, essays, testing. Evaluating of PDC prefer methods of solving authentic tasks (didactic or performance test, scring rubrics) and combine internal and external evaluations. This would give a more objective picture of the level of teachers PDC than just using a questionnaire with items subjectively evaluated by the teacher himself.The article may be interesting for educator lecturers in the area of PDC and for the educators themselves. It analyzes the available resources and offers conceptual starting points for creating tools for PDC deepening.

Keywords: assessment of digital competences, assessment culture, authentic tasks, assessment methods, digital competence, professional qualification, self-assessment

1. Introduction

The 2030 Agenda for Sustainable Development is an universal agenda to wipe out poverty through sustainable development by 2030. In May 2015 UNESCO was entrusted to coordinate the Education 2030 agenda with its partners. The targets for education are essentialy captured in Sustainable Goal 4 (SDG4) and aim to „ensure inclusive and equitable quality education and promote lifelong learning opportunities for all". By 2030, member states have to substantially increase the supply of qualified teachers and ensure that teachers and educators are adequately recruited, well-trained, professionally qualified, motivated and supported within well-resourced and effectively governed systems (Incheon Declaration, 2016).

Current ICT skills or digital competences are usually included in the current competences models of the teacher's profession (Australian Professional Standards for Teachers, 2011). Malach and Kostolányová (2017) used model analysis to define specific ICT content requirements for individual categories of pedagogical staff, including their principals.

The concept of Digital Competence is much debated and multifaceted worldwide, but the definitions can be summarised as follows: „Digital Competence is the set of knowledge, skills, attitudes, abilities, strategies, and awareness that are required when using ICT and digital media…" (Ferrari, 2012).

Digital competence of teachers/teachers´ digital competence is an up-to-date version of the recently used ICT Competency for Teachers (used by UNESCO in 2011) or Teachers' ICT Competency. Krumsvick (2011, p. 45) defined teacher's digital competence as a "teacher's competence in using ICT in a professional context with a good pedagogical-didactic judgment and his/her awareness of its implications for learning strategies and the digital building of pupils and students ". More recently, From (2017) proposed using the Pedagogical Digital Competence (PDC), which he defined as follows: "The concept of pedagogical digital competence refers to theability to consistently apply the attitudes, knowledge and skills required to plan and conduct, and to evaluate and review on a continuous basis, ICT-based teaching, based on theory, current research and proven experience with a view to supporting student learning in the best possible way (p. 48)."

One of the possibilities to effectively support the ICT competence of teachers is to build on national and international frameworks.

Using the North Carolina Professional Teaching Standards, the **ISTE Standard, 2017** (International Society for Technology in Education) and other sources, a set of 20 skills has been developed in four focus areas, more closely characterized by their respective competencies: 1) Leadership in Digital Learning, 2) Digital Citizenship, 3) Digital Content and Instruction and 4) Data and Assessment.

The European Framework for the Digital Competence of Educators sets out the dominant areas and essential ICT competencies important for future teachers (educators) (DigCompEdu, 2017). The objective of DigCompEdu is to identify and describe the key components of educators' digital competence and to provide an instrument for (self-)assessment, based on research and stakeholder consultations. The framework works with six different areas of competence, with a total of 23 competences.

ICT Competence Framework for Teachers includes six aspects of teacher´s work: 1) understanding ICT in education, 2) curriculum and assessment, 3) pedagogy, 4) ICT, 5) organization and administration and 6) teachers professional learning (UNESCO, 2011).

European Digital Competence Framework for Teachers (DigCompTeach, 2017) describes the key components of teachers' digital competence and provides an instrument for (self -) assessment, based on research and stakeholder's consultations. The model consists of five areas: 1) information and data literacy, 2) communication and collaboration, 3) digital content creation, 4) safety and 5) problem solving.

ECDL module ICT in education enables candidates to start engaging in the pedagogically effective use of ICT to support and enhance teaching, learning and assessment in the classroom. The candidate will be able to: understand the key concepts and benefits of using ICT to support and enhance teaching, learning and assessment in the classroom, outline considerations for planning an ICT enhanced lesson, understand safety, security and well-being considerations when using ICT in education, outline ICT resources that can be used to support and enhance teaching, learning and assessment, understand how to source and evaluate ICT resources to support and enhance teaching, learning and assessment, outline key features of classroom technologies and use key features of a learning platform.

PDC translated into national curricula of teacher training

The required PDC for teachers helping to achieve education development goals are established in national PDC standards if they exist. In August 2014 UNESCO Bangkok published Case study: National ICT Competency Standars for Teachers aimed at ICT competency standards to guide pre-service and in-service teacher education. Except for Australia, all countries have stand-alone competency standards. Australia's ICT competency standard is embedded into the Australian Professional Standards for Teachers (APST). The table below explains briefly each country's ICT competency standards (UNESCO, 2014). (Table 1)

Australia: The case study carried out that the Australia is most advanced of other countries of study - the ICT standards are already embedded into the APST. One teacher must meet certain standards to be able to obtain provisional registration as a Graduate Teacher; to obtain provisional license as a Proficient Teacher; and formal national certification as Accomplished and Lead Teacher.

Korea: Korea's implementation for use of standards is still at the first - planning stage. There is a need arised from case study - a diagnosis instrument construction for assessing teachers' current competencies and discerning competencies for development and enhancement.

China. The country undertook an extensive pilot to implement and review the training mechanism, examination and certification.

Table 1: ICT commpetency standards in UNESCO Bangkok case study

	Title	Areas
Australia	Australian Professional Standards for Teachers (APST)	Professional knowledge Professional practice Professional engagement
China	ICT Competence Standards for National Primary and Secondary School Teachers	Awareness and Attitude Knowledge and skills Implementation and Innovation Social Responsibility
Kenya and Tanzania	ICT Competency Framework for Teachers for SIPSE Curriculum Pathways (SIPSE is modification from original STEM)	Policy Awareness Curriculum & Assessment Pedagogy ICT - Internet Organization & Administration – Classroom Management Teacher Development
Korea	ICT Skills Standards for Teachers	Information gathering Information analysis and processing Information transfer and exchange Information ethics and security

Kenya and Tanzania. Upon completion of the SIPSE courses comprising Technology Literacy and Knowledge Deepening, successful teachers will be awarded with certificates of completion. The certificates will be credited within the national Teacher Service Commission (Kenya) and Teacher Education Department (Tanzania).

The outlined standards constitute a snapshot of how ICT Competence can be translated into curricula, courses or how it can be conceptualised in academic papers. Although there is a common tendency towards formal instruction and certification, the selected standards vary in scope and target groups.

The outlined iniciatives in supporting of ICT competency of student teachers show various tendencies of initiatives. The countries participating in the study walk towards connectivity in classrooms and technological integration of resources. But also we can recognize a lack of constant, though-out and structured approach of ICT competencies support for student teachers.

The table below explains briefly initiatives of some countries in Europe in supporting PDC of student teachers - results of comparative investigation from Poland, Portugal, Slovakia, Spain and Russia (Gutiéerez-Esteban et al, 2015)

Table 2: Supporting ICT competencies of student teachers in selected countries

Poland	increasing the number of e-learning courses; increasing activity in distance teaching; using and developing modern computer and information technologies for more individualized education; supporting international projects aimed at ICT utilization; popularization of e-learning in academic environment; development of e-learning postgraduate programmes for teachers; provision of access to educational materials to students and all those interested.
Portugal	gaining a permanent access to the internet for students; easy access to the materials; spread of eduroam; using multimedia (smartphones, netbooks, tablets); ICT technicians participation on discussion how to set the best practice in order to make a better use of the network resources.
Slovakia	implementation ICT into the educational proces; supporting the national projects aimed at ICT implementation (Infovek, DVUI).
Spain	an active policy to promote the training of student teachers in ICT utilization;

	enhancing connectivity and the technological infrastructure of classrooms; ensuring Internet access; emphasizing the use of ICT in teacher training.
Russia	national iniciatives concerning digital competence in education generally; use of e-learning and distance learning technologies; use of digital libraries, electronic evaluation, institutional repositories, streaming technology, online modelling, online communities support.

Assessment of Pedagogical Digital Competence

The starting point for solving the question of assesment or self-assessment is the approach to evaluating of teacher competences as a whole. Measures to assess the development of teachers' competences are important because they: can raise teacher's awareness of the need to develop her or his competences; can support a transformation in teaching culture and practice; permit the recognition of the (new) competences acquired or developed; play a part in the quality assurance and control of training and development, thereby leading to its improvement and helping to achieve excellence; can help to develop trust in the teaching workforce; and can facilitate timely intervention to improve teaching (Supporting teacher competence development for better learning outcomes, 2013). This output also defines the three basic functions of this rating that can serve for supporting teachers' development (formative assesment), monitoring their progress (summative assessment) or for establishing their level (competence level), for decisions on salaries/new roles. For purpose of the formative assessment these tools and techniques are available (low stakes for the teacher): regular meetings with principal or other staff – reviews of competences, self-assessment, critical friends groups, peer review, individual development plans, classroom observations by peers, video analysis, written reflections/narratives, reports, portfolio (inputs/outputs), action research, student/parent feedback. Summative assessment tools and techniques (high stakes for the teacher) include: examinations, classroom observations, micro teaching, video, essays, testing. Instruments for (self) evaluation of teacher's digital competence have recently become the focus of educators of in-service teachers and teachers, as well as all other stakeholders, to provide feedback and background material for updating relevant learning needs. Evaluating the level of PDC of (future) teachers, similarly to other research of learning outcomes, should prefer methods of solving authentic tasks (didactic or performance test, scring rubrics) and combine internal and external evaluations. This would give a more objective picture of the level of teachers PDC than just using a questionnaire with items subjectively evaluated by the teacher himself.

Perla and Vinci (2015) described three main approaches of evaluation, focused differently on one or more dimensions of those described. In the *positivist-experimental* approach, evaluation is understood as the analysis and verification of the attainment of preestablished objectives. In practice, this approach coincides with the logic of examinations and tests. The *pragmatist of quality* approach stresses the dimension of the comparison and definition of standards and criteria, conceiving of educational evaluation as management of the organizational procedures to guarantee attaining the training standards defined inside or outside the system. Particular significance in this evaluation models is given to the opinion. The *constructivist* approach values the subjectivity of the players involved in the evaluation process and aims at interpreting and understanding. The model sees evaluation almost as an *act of communication*, which can be interpreted and negotiated. When deciding how to evaluate teachers' digital competences, it would be useful to use a combination of all evaluation approaches with regard to the purpose (formative or summative) and whether the evaluation is heteronomic or autonomous (self-evaluation).

There are not many specific sources yet dedicated to PDC assessment issues. However, the MENTEP project, which aims to create a Technology Enhanced Teaching Self-Assessment Tool (Abbiati et al, 2018), looks very promising. The online tool assesses four dimensions of digital pedagogical competence: digital pedagogy, digital content use and production, digital communication and collaboration, digital citizenship, divided into 15 sub-areas and 30 competences. In each of the four areas a set of descriptive items is presented to users illustrating different TET-competencies in the relevant subareas. Each competence is illustrated by five statements describing relevant practical pedagogical situations at five competence levels. Users read the five statements, reflect on their actual teaching practice and select the one that most closely matches their own pedagogical behaviour. „After using the TET-SAT, teachers tended to have a more critical perception of their level of TET competences, their self-assessed ICT ability decreased, and their views on ICT in teaching and learning became more critical (especially those who started with a very high self-assessed TET competence)"(Abbiati et al, 2018, p.5-6).

2. Research of expert opinion on evaluation of PDC

2.1 Research goal and questions

The main goal of the presented survey was to identify and articulate the knowledge of ICT experts about existed frameworks of digital competence of teacher and its effective utilization for PDC development. In accordance with the theoretical framing presented earlier, this survey sought for these answers:

- Do you know a tool that is currently exploring and evaluating the level of PDC?
- Do you use some of your own way of assessing the level of PDC development?
- How do you think the level of ICT teacher development should be assessed?
- What should be evaluated?
- Who should initiate the development of ICT competences of teachers?
- Should teachers be financially assessed directly in line with his/her development of PDC?

2.2 Respondents of the survey

The presented survey involved a fixed group of experts of University of Ostrava who are related with ICT and pedagogy education. Experts on our final list (*n* = 13) were invited personally and by email to participate in the survey. Of these, 5 participants agreed and participated in this survey.

2.3 Procedures

This survey was bulit on two-stage process. In first round the participants met together in a bulk discussion and discussed the main areas of the survey .The second round of the survey contained an open-ended questionnaire.

Table 3: Procedures of survey

	Focus	**Data sources**
Stage 1	Existed frameworks and standards of PDC, current status of PDC development, national policy etc.	Bulk discussion
Stage 2	Knowledge of current tool for PDC evaluation, institutions evaluating PDC, the content of assessment, initiators of PDC development.	Open-ended questionnaire

2.4 Results

Based on the results of the first stage, where the main areas of PDC assessment were discussed, the open-ended questionnaire was developed. The items of the questionnaire were kept quite broad to invite a wide range of responses.

The first questionnaire items showed the expert group doesn't use any of current tool for PDC evaluation, although one of experts is familiar with some tool for PDC assessment. None of the experts knew that any such tool would ever be used.

Table 3 presents a paraphrased overview of the question: *How do you think the level of PDC development should be assessed?*

Table 4: Assessment of PDC development

	Answer
Expert 1	E-portfolio.
Expert 2	The most meaningful tasks that would verify the reality, not just the subjectively assumed competence. Both general digital competence and the ability to use ICT in the subject matter the teacher teaches should be identified.
Expert 3	Questionnaire.
Expert 4	Rubrics scoring seems to be an ideal tool.
Expert 5	Questionnaire, a verified tool (a set of practical exercises verifying knowledge, skills and competencies in managing and using ICT in the learning process).

Some of the experts pointed out that is important to assess and verify the real state of PDC development – not the subjectively assumed competence. This comment opened an interesting area for contemplation and showed possible way how to solve the problem of PDC development assessment in the future.

The findings of the question *What should be evaluated?* are considered to be the most important for future research in the area of the PDC level assessment.

Table 5: Evaluated PDCs

	Answer
Expert 1	Whether and how the teacher uses technology in teaching or in teaching planning, whether teachers use online materials, if they use e-learning.
Expert 2	Real skills, but also the ability to solve (find solution) on - for teachers - unknown issues.
Expert 3	Searching and processing information, organizing data, sharing ideas.
Expert 4	Work with software, hardware control, ability to deal with basic troubles of the user, ability to transform general interpretation into interactive environment.
Expert 5	Controlling the basic functions of the computer, using computer in preparation for teaching (use of didactic resources), use in own instruction, use in (adaptive) testing or self-testing of pupils, in evaluation of teaching and in fulfillment of administrative tasks of the teacher.

The experts pointed out the importance of real skills in software and hardware control. All of them highlighted the importance of PDCs used for teacher planning and preparation, fulfillment of administrative tasks and also for evaluating of teaching.

According to question *Who should initiate the development of ICT competences of teachers?* all the experts agreed that the teacher himself should initiate his/her own development of PDC. 4 experts also answered that the principal of school could be also important as an initiator.

All experts thought that the Ministry of Education should be *responsible for the implementation and progress of the assessment* of the level of PDC development. Even though two ot them pointed out that also universities should receive a mandate from the Ministry of Education for a qualified assessment of PDCs.

According to question *Do you think that teachers should be compulsorily certified in PDC development?* only one expert answered negatively. The most of respondents believed that there should be an obligation to become certified in PDC development, although none of them has ever been subjected to any certification of PDC.

Consistent with the findings in previous question only one expert answered negatively the question *Should teachers be financially assessed directly in line with his/her development of PDC?* The most experts believed that teacher should be financially valued according to the level of his/her PDC development.

The last item of questionnaire was aimed at frameworks or standarts which experts use in their practice.

Table 6: Frameworks and standards utilization

	Answer
Expert 1	Digital Education Strategy for 2020: 1. Digital literacy, 2. Informative thinking, 3. Digital technology in education.
Expert 2	I do not use any of them.
Expert 3	I do not use any of them.
Expert 4	DigCompEdu, ISTE, ICT competency framework for teacher (UNESCO).
Expert 5	ISTE standards for educators, DigCompTeach, UNESCO ICT Competency Framework for Teachers.

Two experts have never used any standard or framework of PDC. The other two experts work most with ICT Competency Framework for Teachers (UNESCO, 2011).

3. Discussion

The results of the survey show the expert group doesn't use any of current tool for PDC evaluation, also that some of experts have never used any standard or framework of ICT competences for teachers. Some of the experts mentioned that there is importance in assessment and verifying the real state of PDC development – not the subjectively assumed competence, which pointed out the possible way how to solve the problem of PDC development assessment in the future.

All of the experts highlighted the importance of PDCs used for teacher planning and preparation, fulfillment of administrative tasks and also for evaluating of teaching as main PDCs that teachers should have. The most of respondents believed that there should be an obligation to become certified in PDC development and that teacher should be financially valued according to the level of his/her PDC development. Experts agreed that the principal of the school and the teacher himself should initiate his/her own development of PDC. Although all experts also thought that the Ministry of Education should be responsible for the implementation and progress of the assessment of the level of ICT development of teachers' competencies.

In survey one remarkable note appeared - that also universities should play a role in assessment of PDCs. This opinion could indicate the path of further research in the area of PDC assessment. Because the Faculties of Education could play the most essential part of acquiring PDC in future. How are student teachers prepared to integrate technology in their future teaching? Which PDCs are essential for (future) teachers? To what extent and in what ways is technology used in teacher training institutions? In what ways are student teachers prepared to integrate technology in teaching in teacher training institutions? What are initiatives in supporting ICT competences?

4. Conclusion

The acquisition of pedagogical digital competence and it's use by the teacher for an increase in the quality and importance of the process of teaching and learning can be considered a significant subject of common interest in educational policy, theory and practice itself. The presented survey shows modest but clear contribution toward articulating PDC assessment. The findings stressed the importance of considering the essential role of universities in PDC acquisition and assessment. The survey will continue as a response to the current findings. The next intention will be aimed at pre-service teachers and students of faculties of education - specifically on the content of education in the field of their PDC development. The experts of presented survey will investigate knowledge, skills and competences, which pre-service teachers and students of faculties of education used to gain during their studies.

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Obstacles to Games-Based Learning in Early Childhood Education: Cyprus Teachers' Perceptions

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Abstract: Digital games are an innovation in early childhood education that can enhance preschoolers learning and acquiring skills. The role of the teacher in the successful implementation of games-based learning in pre-school settings is crucial. Nevertheless, there are certain factors that restrain teachers in accepting and using games-based learning in their teaching activities. The main aim of this quantitative research is to investigate how teachers perceive the obstacles that prevent the adoption and integration of games-based learning in Cyprus early childhood education. Results show that early childhood teachers in Cyprus are young in age, having a few years of teaching experience. Teachers in the specific country are also high experienced in using computer in any environment but less experienced in using digital games. The majority of the sample has increased levels of self-efficacy in the ability of implementing games-based learning in classroom. Moreover, teachers have very positive attitudes toward the use of digital games. A 19-item questionnaire was administered to 84 early childhood teachers in Cyprus. Factor analysis reveals three types of obstacles to the use of games-based learning in early childhood classroom: "lack of confidence", "lack of support" and "lack of equipment". The higher the teachers' self-efficacy in using digital games is, the lower the level of teachers' perception regarding the obstacle "lack of confidence" becomes. Similarly, the positive teachers' attitudes toward games based learning are link to less perceived obstacles to using digital games. Teachers with no frequent use of computer and digital games in the classroom perceive "lack of confidence" as major obstacle. The other two obstacle factors ("lack of support", and "lack of equipment") are not significantly correlated to any individual characteristics. According to the findings of this study useful conclusions are drawn concerning teachers, and educational authorities. Future research with greater samples from other populations in different countries should be conducted in order to identify possible differences and similarities across pedagogical practices and cultures.

Keywords: games-based learning, Cyprus, early childhood education, obstacles to games-based learning in early childhood education

1. Introduction

Even though, digital games consist a distinct form of informal Information and Communication Technologies (ICT), for the younger generation (Kankaanranta et al, 2017), Games-Based Learning (GBL) has become an integral part of pedagogical use of ICT in education. Literature on Early Childhood Education (ECE) and GBL (Allshop et al, 2013; Clements and Samara, 2003; Divjac and Tomic, 2011; Doliopoulou and Rizou, 2012; Edwards, 2013; Fessakis et al, 2013; Hatherly et al, 2010; Koivisto et al, 2011; Lieberman et al, 2009; Lonigan et al, 2003; Manessis, 2011; Manessis, 2013; Stephen and Plowman, 2014; Verenikina et al, 2010; Yien et al, 2011; Zevenbergen and Logan, 2008) has emphasized that digital educational games, when properly designed and utilized, can enhance young children's learning, cognitive development, healthy behaviors, social interactions, higher order thinking, problem solving, critical ability, memory, and eye-hand coordination skills. Early childhood teachers can play an essential role in the successful implementation of GBL in pre-school settings, as well as in helping preschoolers to gain appropriate skills. The last two decades, governments all over the world have recognized that the success of educational systems rises on the backs of educators (Davis, 2001). Hence, this fact alone emphasizes even more the role of the early childhood teacher. Moreover, teachers' role is as much important as creative, given that he is expected to plan and implement by himself, a set of GBL activities in his teaching methods, because the curriculum for preschool education does not include specific guidelines for instructors concerning GBL. Review of the literature states that the adoption and use of ICT and digital games in teaching and learning is usually affected by teachers' competency and skills in using ICT, teachers' confidence in integrating GBL in the classroom, teachers' beliefs and perceptions about GBL, and teachers' perceived obstacles to the use of GBL in early childhood settings (Blackwell et al, 2013; Hew and Brush, 2007; Ihmeideh, 2009; Nikolopoulou and Gialamas, 2015). Despite the potential benefits of GBL in pre-school education, and although teachers have positive views about the usefulness of GBL in early childhood settings (Manessis, 2014), many educators are still feeling constrained to using ICT in their teaching practices (Blackwell et al, 2013; Ihmeideh 2009; Nikolopoulou and Gialamas, 2015). Therefore, it is important to investigate teachers' perceived obstacles to GBL in early childhood education, as some barriers may lead in excluding GBL from pre-school settings. The main aim of this research is to investigate teachers' perceptions of obstacles to adopting and integrating games-based learning in Cyprus early childhood education.

2. Theoretical framework

2.1 Obstacles to adopting ICT – GBL in pre-school education

Literature refers to two types of obstacles/barriers that may prevent the successful implementation of technology and GBL integration into classrooms. One type of obstacles is external barriers such as lack of time, training, support, and limited resources. Another type is internal barriers that include personal beliefs such as negative attitudes and lack of confidence (Ertmer, 1999; Snoeyink and Ertmer, 2001). According to several research studies there are a number of obstacles that early childhood teachers encounter while integrating ICT and GBL methods in their classrooms. Such obstacles are lack of equipment/resources, lack of training, lack of time, lack of technical/administrative support, lack of funding, poor and unclear fit with the curriculum, lack of confidence in using technology, and lack of knowledge/skills (Blackwell et al, 2013; Fenty and McKendry Anderson, 2014; Ihmeideh 2009, 2010; Joshi et al, 2010; Liu and Pange, 2014; Nikolopoulou and Gialamas, 2015; Parette et al, 2013; Prestridge 2012; Wood et al, 2008). The identification and understanding of how obstacles relate to teachers' intention to adopt and use GBL in the classroom is of major importance, because it is likely to help early childhood education policies and teachers themselves to find effective ways to overcome these barriers. For example, the study of Ihmeideh (2009) examined ECE principals' and teachers' perceptions of barriers to the use of technology in Jordanian pre-school education. The results of this research revealed that even though most of the early childhood teachers were aware of the value of using technology for learning and teaching, they were restricted by a number of barriers which made the integration of ICT in the classroom very difficult. It is noted that principals were not certain about ICT benefits for preschoolers. These main obstacles were the lack of appropriate software, lack of funding, lack of time, and lack of teachers' technology skills. Useful practical recommendations were suggested (e.g., attention should be paid to in-service teacher training for both teachers and principals to acquaint them with the key role of ICT in early childhood settings, and to train them on how to sufficiently prepare and use digital games in the classroom).

Self-efficacy refers to one's belief of one's ability to succeed in specific situations (Bandura, 1997). The term self-efficacy in the ability of using digital games concerns the ECE teachers' beliefs in their own capabilities with regard to the instructional use of computer and computer games in the classroom. Early childhood teachers with a strong sense of computer games efficacy are more likely to embrace innovation arising from ICT and utilise the potential of learning with GBL in their methods. High levels of self-efficacy will help teachers to challenge themselves with a variety of demands upon their role and be intrinsically motivated (Jessel, 2012). Self-efficacious teachers will put forth a higher degree of effort so as to correspond to the new needs of pre-school education. ECE teachers with low self-esteem and lack of computer skills, on the other hand, cannot successfully make use of GBL in the classroom (Manessis, 2014). Hence, low self-efficacy is perceived as a barrier to the use of ICT and computer games in education (Bingimlas, 2009; Gialamas & Nikolopoulou, 2010; Paraskeva et al, 2008).

2.2 ICT/GBL in pre-school education in Cyprus

The Cyprus educational system is centrally organized and the main bodies of educational policy and planning are the Ministry of Education (YPEPTH) and the Pedagogical Institute (PI). During the last decade, early childhood (3-6 years of age) settings, both public and private, acquired computers but very few of them participated in small-scale research or pilot projects. Until recently, there was a lack of a central plan for the introduction of ICT. In 2016 the pedagogical institute published a framework for the introduction of ICT in teaching and learning in ECE, called "Cross-Thematic Curriculum Framework for ICT". This curriculum defines that ICT is an essential part of education and a powerful tool for both children and the educator. It is important that children always come into contact with technology in an organized framework that aims at their all-round development. However, there is no specific reference to the use of digital games in the educational process. Although, many early childhood settings have been lately equipped with computers available to the children, those computers are not sufficient enough to cover the needs (predominantly one computer). Unfortunately, there are no computer labs in early childhood settings. The teachers are responsible for decoding the expectations of curricula planners and embodying them into their teaching practices.

3. Methodology

3.1 Participants

The perceived barriers are examined using a sample of 84 ECE teachers. They are all female (worldwide predominance of females in the population of early childhood teachers). Demographic and individual characteristics of the participants (years of teaching experience, years of computer experience, access to computer at home, frequency of using computer, digital games experience, in-service teacher training in ICT), as well as class conditions (use of digital games in the classroom by teachers and children, number of computers in the classroom, and classroom internet access) are shown in Table 1. Early childhood teachers in Cyprus are young in age, having few years of teaching experience. Teachers in the specific country are also high experienced in using computer in any environment but less experienced in using digital games. 67,9% of early childhood settings in Cyprus had only one computer in class whereas almost one third of the specific classes (27,4%) have no computer at all.

Table 1: Characteristics of the sample (84 pre-school teachers) and class conditions

Teachers' characteristics			
Years of teaching experience		Years of computer experience	
1-5	33,3%	<1	1,2%
6-10	26,3%	1-2	3,6%
11-15	19,0%	3-5	15,5%
16-20	8,3%	5+	79,7%
20+	13,1%		
Access to computer at home		Frequency of using computer per day	
Yes	100,0%	<1 hour	46,4%
		1-3 hours	39,3%
		>3 hours	14,3%
Digital games experience		Teacher training in ICT	
Yes	61,7%	Yes	35,7%
No	38,3%	No	64,3%
Class conditions			
Digital games use in class by teachers		Number of computers in class	
Yes	47,6%	None	27,4%
No	52,4%	One	67,8%
		Two	2,4%
		Over three	2,4%
Digital games use in class by preschoolers		Classroom internet access	
Yes	46,4%	Yes	61,2%
No	53,6%	No	38,8%

3.2 The instrument

Data was collected by the use of a questionnaire which consisted of two sections. The first section included statements regarding teachers' demographic and individual characteristics such as years of teaching experience, years of experience with computers, access to computer at home, frequency of using computer per day, experience in playing computer games, teacher post-education training in ICT, as well as information on class conditions (number of computers in class, digital games use in class by teachers and preschoolers, and classroom internet access). The self-efficacy in the ability of using computer games for instructional use was measured by using the four items of "confidence with technology" subscale (Pierce et al. 2007), adapted for digital games. Teachers' views and intentions about the usefulness of GBL in early childhood education were assessed by using four statements. Respondents were invited to rate their agreement with a statement in each item on a 4-point Likert scale, ranging from 1 – "Strongly disagree" – to 4 – "Strongly agree".

The second section contained 19 statements addressing early childhood teachers' perceived barriers to the implementation of digital games in pre-school settings. Statements were taken and slightly adapted to account for the specific context of digital games from the relevant literature, and specifically from the studies of Al-Senaidi et al. (2009) and Nikolopoulou & Gialamas (2015). Teachers were asked to rate their views on a four-point Likert type scale: 1 (not a barrier), 2 (minor barrier), 3 (moderate barrier) and 4 (major barrier).

4. Results

4.1 Self-efficacy and views-intensions

The majority of the sample has increased levels of self-efficacy in the ability of implement GBL in classroom (Figure 1). Moreover, teachers have positive attitudes toward using GBL in their methods (Figure 2).

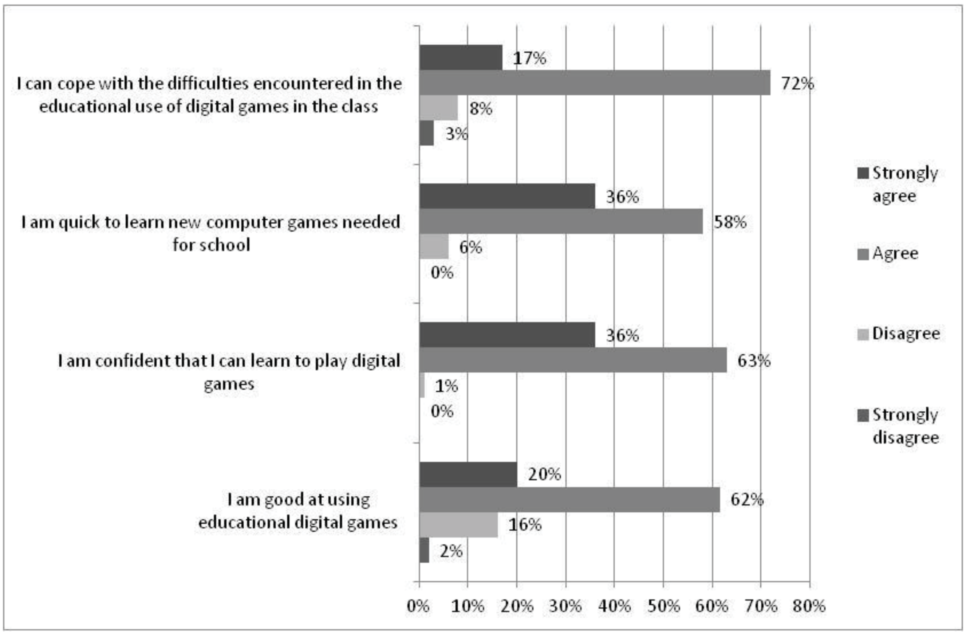

Figure 1: Self-efficacy in the ability of using games-based learning in early childhood classroom

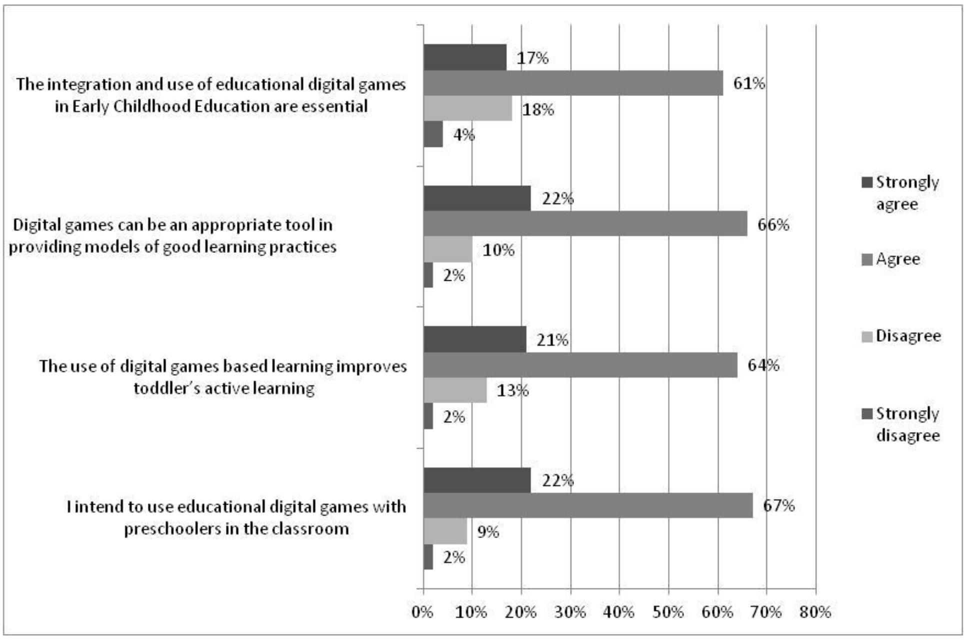

Figure 2: Attitudes toward using digital games in early childhood classroom

4.2 Descriptive statistics for barriers and factorial structure of the questionnaire

To assess teachers' perception of barriers to implementing digital games in early childhood classroom, mean values and standard deviation are calculated and are shown in Table 2.

Table 2: Factor loadings, means and standard deviation per item

Items	Factors			Mean	SD
	F1	F2	F3		
Fear of using digital games in classroom	.840			2.64	1.05
Negative parents' attitudes	.766			2.76	1.04
Inadequate knowledge about the usability of digital games	.764			2.89	.92
The educational objectives of early childhood education cannot be achieved by using digital games	.758			2.52	1.04
Lack of interest of the teachers about digital games	.723			2.81	.97
Uncertainty about usefulness of digital games in preschool education	.656			2.76	.93
Digital games do not improve preschoolers' learning process	.638			2.29	1.07
Complexity of digital games	.585			2.72	0.93
Difficulty of managing a gaming class	.580			2.49	1.02
Lack of teachers games based learning skills	.574			2.80	1.01
Lack of confidence in using digital games as educational tools	.539			2.70	.98
Danger of addiction	.505			3.05	.91
Many demands of the curriculum	.489			2.86	1.00
Lack of funding		.900		3.39	.90
Lack of technical support		.850		3.24	.86
Lack of appropriate digital games for meeting preschoolers' needs		.503		3.27	.87
Outdated, incompatible, or unreliable computers			.749	2.95	.99
Not enough computers			.647	2.89	1.02
Lack of internet access			.597	3.07	1.08
Chronbach-a	.89	.74	.71		
All responses range from 1 (not a barrier) to 4 (major barrier) Factor 1 (F1): "lack of confidence", Factor 2 (F2): "lack of support", Factor 3 (F3):" lack of equipment"					

Figure 3 shows top five teachers' perceived obstacles, as far as the mean value concerns. Lack of funding is in the top of the obstacles' list.

In order to investigate the structure of the 19 items regarding the teachers' obstacles, a PCA (Principal Component Analysis) is performed using OKN (Oblimin with Kaiser Normalization) as the rotation method. PCA reveals a three factor structure of the administrated questionnaire (see Table 2), based on the inspection of the scree plot of factor variances. A parallel analysis is performed 10 times for determining the number of factors to retain from PCA. The comparisons of eigenvalues between the OKN method and the parallel analysis technique also suggest a three-factor structure, explaining 51.78% of the total variance. Each item has a factor loading over the threshold of 0.45 (Hair et al., 2006) on only one factor.

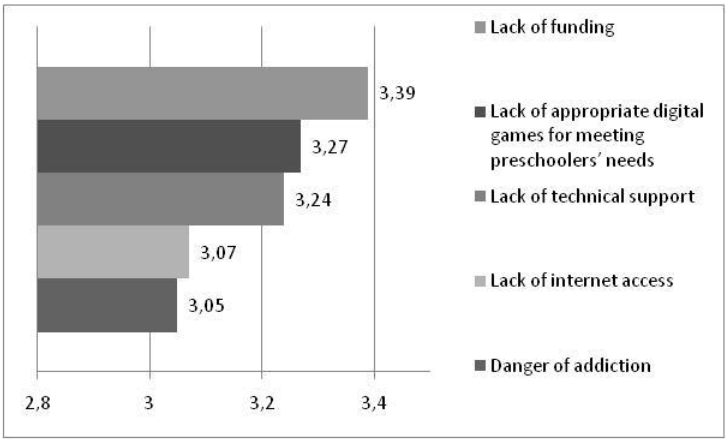

Figure 3: Mean scores of the top five teachers' perceived obstacles to using digital games in pre-school settings

The first factor (F1), labeled "lack of confidence", contains thirteen items: fear of using digital games in classroom, negative parents' attitudes, inadequate knowledge about the usability of digital games, the educational objectives of early childhood education cannot be achieved by using digital games, lack of interest of the teachers about digital games, uncertainty about usefulness of digital games in preschool education, digital games do not improve preschoolers' learning process, complexity of digital games, difficulty of managing a gaming class, lack of teachers games based learning skills, lack of confidence in using digital games as educational tools, danger of addiction, many demands of the curriculum. The second factor (F2), labeled "lack of support", is associated with three items: lack of funding, lack of technical support, lack of appropriate digital games for meeting preschoolers' needs. The third factor (F3), "lack of equipment", contains three items: outdated, incompatible, or unreliable computers, not enough computers, lack of internet access. The three barrier factors show satisfactory internal consistency: Cronbach's α coefficient ranges from .71 to .89 (Table 2). Inter-factor correlations are small to mediocre with a positive sign (Table 3).

Reliability analyses are also performed for the other two scales used in this study ("computer games self-efficacy" scale and "teachers' views-intensions" scale). The Cronbach's alpha coefficient shows satisfactory internal consistency: .83 for teachers' self-efficacy in the ability of using digital games in their teaching, and .89 for teachers' views and intensions about the usefulness of GBL in early childhood education.

Table 3: Factor intercorrelations, factor means, standard deviations and reliability indices

Component	(F1)	(F2)	Mean	Std. Deviation	Cronbach-a
Lack of confidence (F1)			2.74	.63	.89
Lack of support (F2)	.100		3.33	.67	.74
Lack of equipment (F3)	.136	.265	3.03	.76	.71

4.3 Impact of individual characteristics on barriers

In order to investigate the impact of specific individual characteristics ("teachers' training in ICT use", "experience in playing computer games", "self-efficacy in the ability of using computer games for instructional use", "frequency of computer usage", and "digital games usage by the teachers in the classroom") on the barrier factors extracted by the previous factor analysis (F1, F2, and F3), an estimation of correlation coefficients is conducted (Table 4). The "lack of confidence" factor is significantly correlated with "teachers' training in ICT use" ($r = -.23$, $p <.01$), "self-efficacy in the ability of using computer games for instructional use" ($r = -.26$, $p <.01$), "frequency of computer usage per day" ($r = -.25$, $p <.05$), and "digital games usage by the teachers in the classroom" ($r = -.22$, $p <.05$). The teachers who have not been trained in ICT use, with low self-efficacy in their ability of using computer games for instructional use, with no frequent use of computer per day, and with no use of digital games in the classroom are the ones who have the tendency to believe that lack of confidence is a basic barrier on the implementation of digital games in classroom. No significant coefficients are found between the other two factors and the individual characteristics of the teachers.

Table 4: Correlations among factors and individual characteristics

Component	Training in ICT use	Experience in playing digital games	Self-efficacy in using digital games	Frequency of computer usage per day	Digital games usage by the teachers in the classroom
Lack of confidence (F1)	-.234a	-.198	-.261a	-.249b	-.223b
Lack of support (F2)	.021	-.032	-.039	.068	.034
Lack of equipment (F3)	-.057	-.134	-.131	.045	-.094

a Correlation is significant at the 0.01 level (2-tailed)

b Correlation is significant at the 0.05 level (2-tailed)

5. In conclusion

Early childhood education teachers, despite their positive views about the usefulness of GBL, are restrained to a limited use, or no use of digital games in their teaching methods due to specific obstacles. Taking this into account, it is important to investigate the obstacles to using and integrating GBL in pre-school settings, as perceived by Cypriot early childhood teachers. This research aims not only to identify these obstacles but also to contribute to the limited body of the literature by adding evidence of the current status of these teachers' perceived GBL barriers.

The results show that overall the participants are highly experienced with computer usage. All of them have access to a computer, which are using relatively frequently. However, Cypriot early childhood teachers of the sample are less experienced in playing digital games (almost 40% of them have never played in the computer) whilst 53% of the teachers have not used digital games in the classroom at all. Moreover, early childhood teachers in Cyprus perceive themselves as competent computer games users with increased levels of self-efficacy in the ability of implementing games-based learning in classroom, when needed. The majority of the sample has also positive attitudes toward integrating GBL applications in pre-school settings. This finding is in agreement with other studies (Allshop et al, 2013; Can & Cagiltay, 2006; Gerkushenko & Sokolova, 2013; Manessis 2011, 2014).

Regarding the teachers' perceptions of obstacles to using GBL methods into their classrooms, top perceived major barrier is "lack of funding" (M=3.39, SD=0.90). Generally, lack of support and lack of confidence are the main obstacle factors that limit GBL adoption by the teacher. In Cyprus early childhood settings, there is as much inadequate funding, concerning both hardware and software, as insufficient support for teachers. Hence, the lack of financial, technical, and administrative support, and the lack of funding are all perceived by teachers as inhibitors to their use of ICT and digital games. This result is in agreement with earlier research in early childhood settings (Ihmeideh, 2009; Nikolopoulou and Gialamas, 2015).

Concerning the impact of individual characteristics on teachers' perceived obstacles, these characteristics are significantly correlated to the obstacle factor "lack of confidence". The characteristics mentioned above are: "teachers' training in ICT use", "self-efficacy in the ability of using computer games for instructional use", "frequency of computer usage per day", and "digital games usage by the teachers in the classroom". Thus, these characteristics could be used to predict how pre-school teachers will be constrained to using GBL in their teaching, if they perceive that lack of confidence is a major obstacle. This finding has implications for in-service teacher training for both early childhood teachers and educational authorities. Teachers' self-efficacy for example, could be increased via attending appropriate in-service teacher training programs, which should be carefully designed, as these are expected to help teachers to overcome the obstacles to the successful integration of GBL in pre-school settings.

A limitation of this study is the small sample of teachers. Teachers' perceived barriers can be further explored with larger and more diverse samples. Future research with other target populations in different countries should be conducted in order to identify possible similarities and differences across pedagogical practices and cultures.

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Teachers´ Attitude Towards Educational Video Games: The Role of Educational Level

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Abstract: Educational video games offer a variety of genres and complexity levels wide enough to make them suitable to be used across all educational levels. In fact, literature review provides examples of educational video games used to teach a broad number of subjects which range from mathematics to entrepreneurship. However, teachers´ needs and goals when using educational video games might vary based on the educational level (Kindergarten, Vocational Education, Higher Education...). Previous research also suggests that the subject being taught might affect the use of educational video games as some subjects might be more suitable than others to applying educational video games. Therefore, despite the great potential of using video games in different educational settings, teachers´ positive attitude towards educational video games cannot be taken for granted. It is the main goal of this research to explore factors affecting teachers´ attitude towards educational video games. To achieve this goal, an exploratory research using a convenience sample of 108 teachers serving in different educational levels was conducted to analyse the effect of two contextual variables (the educational level and the subject being taught) and two personal variables (age and gender) on teachers´ attitude towards educational video games. Main results suggest that one of the analysed variables affect teachers´ attitude (educational level) while the other three (subject, age, and gender) show no statistically significant differences. Implications of these findings, limitations of the study, and future research lines are addressed.

Keywords: educational video games, attitude, educational level, age, gender, gamification

1. Introduction

Educational video games can be used across a wide variety of subjects and educational levels. For example, Sung, Hwang, and Yen (2015) developed an educational video game for improving 4th graders' learning performance in a health education course. Another educational video game, *Newton´s playground*, was developed to teach physics to 8th and 9th graders (Shute, Ventura, Kim, 2013). *StartUp_EU*, was developed to teach entrepreneurship to Secondary Education students (Protopsaltis et al., 2013). Regarding Higher Education, the lab of technology education in Accounting of University of Sao Paulo developed DEBORAH Game (http://deborahahg.wixsite.com/deborah) to teach Accounting History to undergraduate students. Despite the potential of using educational video games across multiple disciplines and educational levels, literature review suggest that differences exist in the use of educational video games based on the educational level. For example, Proctor and Marks (2013) report that only 25.2% of teachers in Secondary Education use computer-based games in the classroom, compared to a 60.6% of teachers using games in Primary Education, with game use bifurcation occurring on K–5 and 6–12 population groupings. Ince and Demirbilek (2013) findings also suggest that Secondary Education teachers use educational video games more than High school teachers (30.12% versus 11.19%). Different variables might help explaining use differences across educational levels. Attitude is one such variable as attitude is considered a good predictor of behavioural intention (Davis, 1985). Although attitude explores teachers´ perceptions and not real use, a better understanding of teachers´ perceptions regarding educational video games is important because teachers play a crucial role in selecting, implementing, and evaluating educational games for their students (Hanghøj and Engel Brund, 2011). Moreover, it has been pointed out that insights into teachers' perceptions of the benefits of digital games for student learning provide us with a better understanding of teachers' decisions to use digital games (Huizenga, Ten Dam, Voogt, and Admiraal, 2017). Therefore, the primary goal of this research is to explore teachers´ attitude towards educational video games across five educational levels: Kindergarten, Primary Education, Secondary Education, High School, and VET (Vocational Education Training). To do so, an online questionnaire was designed to survey a convenience sample of 108 teachers. Along with attitude, three other variables (the subject being taught, age, and gender) were analyzed.

This study is structured as follows: Firstly, we review the academic literature to posit our research questions (RQs). Secondly, the method used is explained. Thirdly, the results are discussed. Finally, the conclusions are addressed.

2. Educational video games

Educational video games refer to any educational game which is play online or through digital devices such as computers, tablets, and mobile phones. As pointed out by Van Eck (2006) the use of video games in education include the use of commercial off-the-shelf videogames (COTS) which take advantage of contents in the game that can be used for educational purposes and the use of serious games –a type of video games developed with non-recreational purposes where learning is the primary goal–. Teachers can also make students build their own games as part of their learning process. These three different approaches to the use of video games in education allow for a wide variety of possibilities to integrate video games for educational purposes in the curriculum. For example, a commercial off-the-shelf videogame such as *SimCity* has been used to strengthen leadership decision-making (Lin and Lin, 2014). *ETIOBE Mates* is a serious game which was developed to improve children's nutritional knowledge (Baños et al., 2013). Finally, Yang and Chang (2013) provide an example of making students to design a digital game based on biology course content to increase retention of both course content and critical thinking skills.

3. Attitude towards educational games

Attitude is the result of an individual beliefs concerning a behavior, the results of that behavior, and the importance attached to such beliefs and has two components: affective and cognitive (Bagozzi and Burnkrant, 1985; Chaiken and Stangor, 1987). The affective component in attitude refers to how much a person likes the object of his thoughts (McGuire, 1985) and measures the degree of emotional attraction to the object. The cognitive component refers to an individual's specific beliefs about the object (Bagozzi and Burnkrant, 1985) and consists in a value-based assessment, judgment, reception or perception of the object (Chaiken and Stangor, 1987). The academic literature on teachers' attitude towards educational video games suggest that educational video games might elicit both positive and positive teachers' attitude towards educational video games. For example, Can and Cagiltay (2006) found that teachers believe that using educational video games might increase noise in the classroom during game play making more difficult to manage the students. On the other hand, in the same study, the authors found that other teachers believe that using educational video games will make classroom management easier because students will be silent during game play. However, to the best of our knowledge, no previous research has analysed the effect of two contextual variables (the educational level and the subject being taught) on teachers' attitude towards educational video games.

3.1 Contextual variables

As pointed out in a previous section of this paper, the academic literature suggest that teachers are using educational video games at different ratios based on the educational level (Proctor and Marks, 2013; Ince and Demirbilek, 2013). One possible explanation for the different adoption of educational video games by teachers teaching in different educational level is teachers' attitude towards educational games. Also, the academic literature suggest that the use of educational video games is not limited by the type of subject being taught. Educational video games have been used to teach a wide variety of subjects including health education (Sung, Hwang and Yen, 2015), veterinary education (De Bie and Lipman, 2012), energy education (Yang, Chien and Liu 2012), language teaching (Reinders and Wattana, 2014), citizenship education (Lim and Ong, 2012), Newtonian physics (Shute, Ventura, Kim, 2013), entrepreneurship (Protopsaltis et al., 2013), and nanotechnology (Blonder and Sakhnini, 2012) to name a few. However, qualitative research suggests that the subject being taught might be a barrier for Higher Education teachers to adopting the use of games in their courses (Sánchez-Mena and Martí-Parreño, 2017). In fact, one respondent to Sánchez-Mena and Martí-Parreño´s 2017) study stated that "Gamification can be useful for some subjects but not for all. For me it is difficult to use gamification in subjects in which I must teach complex maths-related elements" (p. 439).

3.2 Personal variables

Age can affect teachers' attitudes because teachers' prior experience has been found to inform teachers' beliefs about practice (Calderhead and Robson 1991). In fact, Hamari and Nousiaien (2015) found that age affects teachers' perceived value of educational video games. Previous research has pointed out gender differences regarding attitude towards video games with male players showing more positive attitudes towards video games than female players (Bonanno and Kommers 2008). Moreover, the academic literature suggest that gender might affect teachers' beliefs of educational games. For example, Ince and Demirbilek (2013) found gender differences among Secondary and High School teachers' attitude towards educational video games. In fact, Ince and Demirbilek (2013) findings suggest that male teachers show more positive attitude towards educational video games than female teachers.

To gain a better knowledge of the effect of the educational level, the subject being taught, age and gender on teachers' attitude towards educational video games, the following research questions (RQs) are posited:

RQ1: Are teachers' attitude towards educational video games different across educational levels?
RQ2: Does the subject being taught affect teachers' attitude towards educational video games?
RQ3: Does age affect teachers' attitude towards educational video games?
RQ4: Does gender affect teachers' attitude towards educational video games?

4. Methodology

4.1 Participants and sampling method

A total of 108 teachers participated in this study. Of the sample, 60.2% are female being the average age 40.9 years old. Table 1 shows sample percentage across educational levels. Snowball sampling (Goodman, 1961; Biernacki, and Waldorf, 1981) was used as the sampling method. Although this type of sampling does not allow a probabilistic sample of the target population, snowball sampling is often used when it is difficult to identify beforehand all those who might fall into the target population (Hall, and Hall 1996).

Table 1: Percentage of participants across educational levels

Educational level	**%**
Kindergarten	8.3%
Primary Education	32.4%
Secondary Education	37.0%
High School	2.9%
VET	19.4%

4.2 Measurement Instrument

The measurement instrument was an online self-administrated questionnaire which included the target variables. Attitude towards educational games was measured with two items adapted from Chattopadhyay and Basu (1990) using a 5-point Likert-type scale where 1= totally disagree and 5= totally agree. Gender was measured as a dichotomous variable (male/female) while age was measured using a ratio scale. Finally, the subject being taught was measured using a nominal scale.

4.3 Procedure

Once the questionnaire was designed, a digital version was created using the forms tool facilitated by Google (https://goo.gl/forms/XhU6gGe5ZoFSrBp02). The researchers personally contacted and invited the teachers to participate in the survey using a personal email in which the link to the questionnaire was provided. For the dissemination of the questionnaire, firstly, the online form was sent to teachers of 8 schools in the Valencian Region in which researchers have personal contacts who helped them to spread it among the target population.

5. Results

As an overall result, and without considering the educational level, results suggest that teachers' attitude towards educational video games is positive, as the mean attitude got a score of 4.32 (being 5 the highest score). Then, a two-way ANOVA was run on teachers' attitude towards educational video games to give answer to RQ1 and RQ2. Our research interest was not just knowing whether teachers' attitude towards educational video games was different across educational levels and different depending on the subject taught, but also knowing whether there was an interaction effect between these two independent variables. Table 2 shows the results. The main effect for level of education is significant (F= 3.81, sig. <.01), but not for the subject being taught (F= 1.30, sig. >.05). Moreover, no significant level of education by subject taught interaction appears. Accordingly, we can say at least for one educational level that teacher's attitude towards educational video games is different in comparison to the others (RQ1); however, the subject being taught exerts no influence (RQ2), neither there is an interaction effect between the educational level and the subject.

Table 2: Two-way ANOVA results for teacher's attitude towards educational games: Influence of level of education and subject taught

	Type III sum of squares	df	Mean Square	F	Sig.
Corrected Model	41.71	43	.97	1.48	.077
Intercept	776.09	1	776.09	1182.06	.000
Level of Education	10.01	4	2.50	3.81	.008
Subject taught	21.39	25	.86	1.30	.197
Level of Education × Subject	10.98	14	.78	1.19	.301
Error	42.02	64	.66		
Total	2098.75	108			
Corrected Total	83.73	107			

Table 3 shows teacher's attitude towards educational video games by educational level. A further post hoc analysis revealed that there was a significant difference between the attitude towards educational video games of primary education teachers and VET teachers (sig.<.01), having the first educational level (primary education) a much better attitude towards educational video games. No other significant differences were revealed among the rest of the educational levels.

Table 3: Teacher's attitude towards educational games across educational level

	Mean
Kindergarten	4.50
Primary Education	4.70
Secondary Education	4.27
High School	4.17
VET	3.71

A Pearson correlation coefficient was performed in order to answer RQ3: data suggest that there is no relationship between the teacher's age and his/her attitude towards educational video games (p=-.181; sig. >.05). The same relationship can be stated regarding attitude and gender (explored in RQ4): whatever the gender of the teacher, the attitude towards educational video games is the same (Table 4). Accordingly, neither age nor gender influence teachers' attitude towards educational video games.

Table 4: Teacher's attitudes towards of educational games across gender

	Mean	Standard deviation	*t* (sig.)
Male	4.29	.99	-2.73 (.785)
Female	4.34	.82	

6. Conclusions, limitations of the study, and future research

One main conclusion of this study is that teachers' attitude towards educational video games is positive although educational level affects this attitude with primary education teachers showing a statistically significant more positive attitude towards educational video games than VET teachers. Why this attitude is different in these two groups of teachers deserves further research. Maybe students´ age or curricula is affecting primary education and VET teachers' attitude regarding the suitability of using educational video games in their courses. It is surprising that it is primary education teachers' attitude the more positive among all analysed educational levels. Primary education teachers' attitude is more positive even than Kindergarten teachers' attitude although it could be expected the contrary. This result also deserves further research. Another remarkable result is that the subject being taught exerts no influence on teachers' attitude. This result suggests that the subject being taught is not a "barrier" in teachers' mind. In fact, although one can believe that some subjects are more suitable than others to using educational video games, the increasing body of academic literature on educational video games provides more and more examples of educational video games being used to teach a wide variety of subjects. Challenging previous research which suggested gender and age differences regarding the use of educational video games might happen, our results suggest that neither age nor gender affect teachers' attitude towards educational video games.#

One main limitation of this study is both sample size and sample type. The convenience sample used to survey teachers prevents to generalize these findings to the target population. More research is needed using representative sample which allows to confirm and generalize these results. Also, more qualitative and quantitative research is needed to delve into the differences portrait in this study. Because culture can affect attitude, more research using sample from different countries is also needed.

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E-Learning in Practice: Problem-Based Learning and the Role of Students' Knowledge in Internships

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Abstract: As part of their master in *ICT, Learning and Organizational Change* (ILOO), students at Aalborg University can participate in a 3-4 month internship in their final semester before writing their thesis. The internship is part of the university's commitment to Problem Based Learning (PBL) which aims to develop students' academic knowledge and skills through the solution of authentic problems in practice in cooperation with others. The paper focuses on a recent investigation into how internships within the ILOO master programme served as sites for the performance and development of students' knowledge and how this knowledge was understood and used by practitioners who work with digitalising learning in public and private sectors. Data have been collected through visits to companies and interviews with hosts as well as individual and focus group interviews with students who have completed their internships. Based on these data the paper discusses how students' knowledge contributes to the development of e-learning in practice, where e-learning serves both as a commercial field of interest for companies and as a site for the internal development of their organisations. Theoretically, the paper builds on approaches that conceptualise knowledge creation in dynamic relationships in practice, i.e. practice theory, sociomaterial approaches, and theories of problem based learning and ICT. The paper contributes with insights into ways in which internships and students' knowledge contribute to the development of e-learning as a both practice-based and academic field. Preliminary results indicate that students' methodological and theoretical insights into e-learning have a significant role to play in companies and that students often are involved in problem solving that aims at innovation and cutting-edge development. Thus, the investigation into the role of students' knowledge in practice can give new insights into how education affects employability and how employability is created within problem based learning environments.

Keywords: employability, internships, problem based learning, e-learning

1. Introduction

Recently, there has been a growing emphasis within research on the role of employability in programmes of higher education (Mardis et al, 2017). The focus on employability rises out of an increasing pressure on universities to offer education that links more clearly with the requirements of a changing labour market as well as creates knowledge and innovation of interest to society (Saad, Robani, Jano & Majid 2013). This changing focus of universities from engaging in knowledge for its own sake to adapting to professional needs may, especially within the humanities and social sciences, be understood within a problematized neoliberal approach to education (Osborne & Grant-Smith, 2017). However, whereas the focus on employability can be understood as an aspect of the marketization of higher education, it also involves significant knowledge about transitions from higher education to work and the ways in which academic knowledge is included, valued and developed in professional practices. Thus, gaining knowledge about the ways in which students in ICT, Learning and Organisational Change (ILOO) use their knowledge in practice through curriculum based internships was the outset of the research project dealt with in this paper. The specific focus of the research project was to understand how internships within the framework of Problem Based Learning (PBL) act as sites for the performance and development of students' knowledge in practice and how this contributes to creating employable ICT graduates. The paper concentrates on data from internship hosts, i.e. from professionals within both public and private organisations and how they understand and value the contribution of interns to the practices of digital learning and organisational change.

2. The role of employability in higher education

Research in the role of employability in higher education has flourished in the last decades following changing conceptions of higher education and its relationship to society (Artess, Hooley & Mellors-Bourne, 2017). McCowan (2015) for instance argues that higher education systems, for example in the UK, are increasingly tied to the logic and functioning of the changing political economy, which highlights the role of employability in the success of universities as educational institutions. Rowe and Zegwaard (2017) similarly report on the growing significance of employability for measuring the value of higher education for instance in Australia and New Zealand, and how this affects expectations associated with the work-readiness of graduates. Others, for instance Tomlinson (2012) stress that relationships between universities and the labour market have to some extent been disrupted by the massification of higher education which has affected employment, and contributed to the precariousness of work. This is specifically true for ICT professionals who are at the center of changing definitions of work, and in fact to some extent contribute to defining "the future of work" (Chillas, Marks & Galloway, 2015).

In spite of the changes affecting the labour market, research in employability has, according to the literature, been dominated by a focus on skills and personal attributes which has served to define the ways in which universities can work with employability, for instance through curricula (Yorke, 2006). Notwithstanding the relevance of skills and behaviours to employability, the problem of a skills- and behaviour based definition is that it may fail to capture the complexity and contextuality of work-readiness. In addition to this Yorke and others underline that employability should not be confounded with graduate employment. Thus employability is "probalistic", and employment is a "socio-economic reality", the latter being outside the scope of what universities can provide.

One of the strategies that can support the aspiration of universities towards enhancing students' employability is internships, where students engage as full participants in professional activities in the workplace. Though research in internships sometimes warns against the risk of employers using interns as cheap labour (Tomlinson, 2012), the significance of internships for gaining work experience and employability is generally underlined by research. Especially internships that are included in study programmes are mentioned by research as enhancing the work-readiness of graduates, thereby shifting the focus from gaining work to that of building a profession (Rowe & Zegwaard, 2017).

3. PBL and employability in practice

As mentioned above Aalborg University (in Denmark) has a long tradition for using PBL (Problem Based Learning) in BA and Master programmes. In fact PBL was central to the founding of Aalborg University in the 1970s, where problem based learning was seen as a way to promote critical thinking and create social equality through education (Dirckinck-Holmfeld, 2009). Problem based learning represents a variety of changing learning models but is generally based on the concept of inquiry into authentic problems in practice, and therefore involves both project orientation and the collaboration between students and students and practitioners (Kolmos, Fink & Krogh, 2004). PBL is in its various forms inspired by a number of learning theories for instance Vygotsky (1978) and Lave and Wenger (1991) and builds on social-constructivist approaches to learning that stress both individual constructions of knowledge and group responsibilities for creating and developing a project (Dirckinck-Holmfeld, 2009). A significant aspect of PBL is the way in which students work with academic knowledge, as lecture formats and decontextualised learning is generally replaced by relating knowledge to inquiry into real world problems. As stated by Marra, Jonassen, Palmer & Luft (2014), "The idea of "basics first" goes out the window in PBL; rather one learns the basics in the context of a meaningful but ill-structured problem solving activity" (2014; 221). In terms of employability, PBL therefore offers students the opportunity of making significant links between their academic knowledge and practice throughout their studies.

4. Internships and employability in ILOO

ICT, Learning and Organizational Change (ILOO) is a two year master programme that builds on both professional BA programmes such as teacher education and on classic university BAs within for instance computer science and management studies. Thus, students enter ILOO with a diversity of educational and professional backgrounds that contribute to the programme's focus on ICT, learning and organisational change. In addition to this a majority of students have some kind of practical experience, ie job experience from employment as teachers, nurses, etc. Practice is therefore significant in the ways in which students interact with and apply their knowledge, and also in many cases significant for their choice of Aalborg University as a PBL university for their master studies.

In the context of the ILOO master programme, PBL provides a continuous opportunity for students to relate their knowledge to practice and to specific contexts of work, as students work on projects with partners outside the university in every semester. Collaboration with practitioners can take the form of both action research, design based learning and implementation, and ethnographic fieldwork. In semester 1-2 (of 4 semesters) PBL is represented in project work corresponding to respectively 15 and 10 ECTS. In the 4th semester students work on their thesis, which corresponds to a 30 ECTS project work which has a strong empirical and collaborative basis. Learning through internships dominate the 3rd semester of ILOO where students choose from either doing a project or participating in an internship in a private or public organisation of their own choice. Around two thirds of the students usually choose the internship option, as internships, according to students, increase their career options after graduation.

The significance of researching employability in the context of internships related to the ILOO master programme is that ILOOs are emerging ICT professionals who are at the forefront of a changing labour market where digitalization is reconceptualising the understanding of work as well as the context and organisation of business. As argued by Chillas, Marks & Galloway (2015) the ICT sector has in many ways become “symbolic of the knowledge economy” and is believed to have a major influence on the productivity and competitiveness of most countries. In addition to this ICT professions are changing with the developments in technology as well as the mainstreaming of technology use in all lines of work. This tendency is specifically relevant for ILOOs who have interdisciplinary profiles that encompass both technical and soft skills. The significance of researching ILOOs’ employability is therefore in tune with Mardis et al (2017) who argue that internships have a role to play in responding to a professional field “that is highly dynamic and places great emphasis on innovation” (23; 2017). E-learning is implicated in this changing professional field, as the digitalisation of learning is of central significance to the knowledge economy, not only for educational institutions, but for the innovation and competence development of most organisations.

5. Data and methodology

As an aspect of developing and qualifying the ILOO master programme, the role of internships for student employability was investigated in the autumn of 2017 through qualitative research, i.e. interviews and visits to companies. Qualitative research can provide knowledge of how organisations use interns, how interns are positioned in companies and how they create value in practice as qualitative approaches can track emerging understandings across multiple sites (Marcus, 1995).

The purpose of the research was to understand how employability can be enhanced by participation and situated learning in internships and how students contribute to qualifying and innovating e-learning in companies through internships. Nine companies where contacted in November-January after the internship period ended and asked how and why they used interns, as well as how they felt interns could contribute to the production of relevant knowledge in the company. Out of nine companies, seven were visited in order to extend the knowledge gained in interviews with insights into company cultures and organisations. Seven students who had been interns in the companies were interviewed to give a more comprehensive understanding of how internships affect students’ learning through practice. Two companies could not be visited for practical reasons. The companies involved represented a diversity of private and public workplaces and can be briefly described as follows:

- Commercial e-learning business, based in Copenhagen
- International games and toys producer, based in Jutland
- Regional organisation, administrates health care within the Copenhagen region
- Privately funded organisation for the training and further education of farmers and agricultural workers, based in Jutland
- Newly established museum of communication in Copenhagen financed by two major tele-companies
- Private company, develops software for hospitals worldwide, based in Jutland
- Governmental, Copenhagen-based organisation with a focus on education and the digitalisation of eg tests in elementary schooling
- Small e-learning company, based in Copenhagen
- Municipal organisation based in Jutland who works with eg implementation of political initiatives related to elementary schooling

6. Investigation of internships and the role of e-learning

Internships involve forms of situated knowledge and engage students in roles that reflect the social practices and the organisational culture of the company. Practice is in the context of this project inspired by insights from practice theory (Nicolini, 2011) and socio-material approaches to organisational knowledge (Orlikowski, 2010). These are theoretical inspirations that understand knowledge and learning as implicated in dynamic social processes which are material and embodied. Following this understanding students’ knowledge and its association with employability for instance gains its significance from being performed and located within specific relationships in practice. These relationships are not one-to-one translations of skills into relevant organisational contexts, but forms of knowledge performed within specific practical challenges, for instance the development of e-learning platforms or the implementation of new technologies. How students become employable is thus deeply contingent on the ways in which their knowledges, skills and behaviours are implicated in practices that shape relevant futures, professions and innovations for the companies involved.

One of the phenomena affected by specific activities, embodiments and understandings in practice is students' roles as interns in companies and the idea that interns should be apprentices to 'old-timers' in the organisation (Lave & Wenger 1991). Thus, being an intern is a legitimate role in most companies, that defines the tasks and status of the student in the workplace, but the ways in which this role is interpreted and performed in companies can vary considerably and influence the ways in which the student can act and learn through practice. With regard to apprenticeship and social learning practices Lave and Wenger (1991) talk about learning as "increasing participation in communities of practice" which emcompasses "the whole person acting in the world" (Lave & Wenger 1991; 49). Following this understanding, learning is "an evolving, continuously renewed set of relations" in which participants often move from peripheral to full participation in the community of practice. Learning, then, is a situated activity that is based on the notion of learners as participants in practices, though Lave and Wenger underline that "peripherality suggests that there are multiple, varied, more- or less-engaged and -inclusive ways of being located in the fields of participation" (1991; 36). Membership is thus a shifting as well as an evolving process of engaging in practice.

7. Students' roles as apprentices and innovators

In the companies studied, students were as interns expected to be initially placed in a position as peripheral learners, and then over time moved into other more legitimate and fully integrated roles in the company. Integration and redefinition of roles would thus follow a process in which the student was engaged in different kinds of tasks and projects where he or she would be observed and tested by senior staff, and then reassigned tasks and roles according to the observations made.

However, in practice, the process of testing the skills and abilities of interns was often not prolonged and thus students would often be asked to act as full members of the community of practice more or less from the outset of the internship, as hosts quickly saw their potential for the workplace. This tendency was reflected in the ways in which interns were talked about by the hosts, for instance as both *a youthful and fresh addition to the workplace* (E), and as providing *new inspiration* (D) or *a new outlook* (B) on existing practices. Some hosts associated the student's age with a different outlook on and experience with ICT, one host for instance mentioned that *It has been wonderful to get some youthful inspiration into our work, and so inspiring to see how quickly she* (ie the student) *has understood the potential of the technology, for her, it's like breathing* (C). Following this, hosts would in some cases define students as significant knowers who from the beginning of the internship were placed in a position as innovators and consultants for staff, in which case the staff would act as apprentices to the students. One example of this was a student who worked with the implementation of ICT in local schools, and who was asked to do research and make recommendations for this process at the municipal level for close to a hundred school principals (I). Other students would be asked to supply content for evolving e-learning platforms or for new learning strategies within the company (A,C,D). As outsiders with experience and knowledge about ICT, learning and organisational change, students could therefore sometimes find themselves in a situation where they were seen as both apprentices and as innovators and disruptors of existing practices. These shifting and to some extent contradictory roles were defined by relationships in practice, such as the ways in which students knowledge and experience with e-learning could contribute to the development and innovation of the organisations involved.

8. The significance of ICT and students as mediators

When talking about ICT the hosts underline that technology is an increasingly significant aspect of their business and professional practice as well as a site for innovation. ICT is both an important tool in their work with creating efficiency, development, and learning, and an agent of change that brings challenges to the organisation of work. Thus, companies work with both extending their knowledge of what ICT can do, and with understanding how they can adapt to the implementation of new technologies. For ILOO interns this means that their interdisciplinary knowledge and experience is highly valued by hosts, who often see them as mediators between technicians and non-technical staff. This understanding of the interns stresses both their knowledge of technology and their ability to use it and teach it to others. For example the host of H mentions that *This is what I find valuable in that Master* (that is: ILOO)*: you are not an ICT expert, but you have a basic understanding of technology that enables you to learn it and to make it understandable to others.* In organisation G the host similarly talks about the value of the student *having an understanding of ICT and how it can be used in an organisation.* Finally, the host from B talks about the challenge with ICT professionals who do not have the teaching and learning skills needed for implementing change. His impression of ICT professions is therefore that *they are introverts and that is not what you need when you talk about learning and training and all that - so you need someone who has empathy, who has good soft skills as well*. Empathy with users and insights into their perspectives on technology therefore becomes central to the use of technology in this organisation, which includes not only internal uses, but also uses of the products sold, in this case games and toys. User experiences and user perspectives are therefore central to the ways in which students' knowledge can act in practice, where their role as mediators moves them from a position as peripheral learners to significant participants in the workplace.

9. The role of e-learning in companies

When students become significant knowers and innovators in the companies, it is because their knowledge - and not least their academic knowledge - can act within and create value in practice for the companies involved. This involves not only an adaptation of students' skills to practice, but students' active participation in practices in which their knowledge becomes viable and creates new possibilities for the workplace. This involves students' roles as interdisciplinary and 'hybrid' professionals, but also their role as learning professionals, i.e. as e-learning designers, developers and (in some cases) teachers.

According to the hosts interviewed, e-learning plays a significant part in the ways in which companies create value, organise themselves and make business within various fields of work. Thus learning is a significant driver of change and business expansion for the companies, and learning is generally digitalized to create flexible learning environments, minimise costs and link companies with new social practices. E-learning, broadly understood as the digitalization of learning and competence development is therefore a highlighted area of development and innovation in the companies involved in the research. The host from organisation C, a public organisation with employs a variety of health professionals in different locations, for instance stresses that e-learning is a central priority to the organisation and that the student's knowledge of e-learning could contribute to an understanding of how competence development can be organised *so that it works*. The host from organisation B, a private company, also underlines the value of the student's knowledge for internal competence development, for instance by transforming *training* into *adaptive learning* practices, ie teaching staff how to adapt ICT to specific needs in practice. In organisation I, a municipal organisation, the central challenge is to implement new learning and communication platforms in all schools, an extensive reorganization of formal learning practices in which the student has contributed with valuable research. In organisation E the focus has been on developing and redefining the physical museum through digitalisation of for instance web based learning, and in organisation D the aim is to reach farmers and agricultural workers who do not ordinarily attend physical courses. The examples show that as learning and e-learning are identified as pervasive fields of interest and innovation for the companies, specific knowledge within these fields enhances students' positions in practice, where they gain an increasingly central role in providing and creating knowledge, including research based knowledge - to processes of innovating learning.

10. The role of academic knowledge in companies

As employers shift between viewing interns as apprentices in peripheral roles and involving them as significant knowers and innovators in practice, they increasingly address the relevance and importance of theory and methodology for ways in which companies can renew themselves and extend their activities. Thus research, and students experiences with for instance field work and literature reviews, participates in generating, conceptualising and qualifying innovation. The host from company E for instance explains that interns' knowledge of theory can contribute to qualifying funding strategies, as theoretical and methodological perspectives are needed in applications, for instance within the museum sector. Students' theoretical knowledge therefore becomes valuable in expanding the role of knowledge in the company and in securing funding for staff that can support innovation and development. In organisation I the student's work with theory and methodology as a 'a study product' (ie as an aspect of writing a project) becomes equally important as a policy instrument, in the sense that the organisation, a municipality, wishes to work with elementary education through *an increased research perspective.* In organisations B and H, which are both private companies, the student's knowledge of learning theory, usability tests and interaction design contribute to the companies' image as experts within their fields, the host from H for instance argues that theory can add to the argument that *we are not only experts in learning, we know what learning is.*

These are examples of how students contribute to the circulation and application of academic and research based knowledge in workplaces that in different ways aim to strengthen and expand their status in the knowledge economy. As a consequence, hosts often come to understand internships as an exchange of knowledge rather than merely as a one way learning process as implied by for instance the concept of apprenticeship. This is for instance underlined by the host from company G who states that internships provide a *win-win situation*, as students through internships get to apply their knowledge in practice, and companies get new insights into knowledge that can be applied in practice. This approach indicates that internships not only cater to the needs of the industry, but that knowledge within the field of e-learning and organisational change has a role in developing significant, emergent practices associated with innovation.

11. Conclusions: Students' employability in a practice perspective

As described above research in internships involving ILOO students can give insights into the value of students' knowledge for companies and how this affects the employability of candidates. E-learning is significantly involved in these considerations, as the digitalisation of learning has become a central issue of development and innovation across the divides of public and private work relationships. Knowledge of and experience with e-learning is therefore an aspect of students' participation in practice that becomes constitutive of their employability, as hosts associate employability with students' ability to engage in real life situations and practices. Thus, a number of the hosts mention that they would like to employ the ILOO candidates or have already offered them a job, reflecting the fact that not all companies have the funding or opportunity for employing additional staff. Following this, the hosts generally understand the interns as potential full participants and future workers in the workplace. The host from A for instance says about the student that *she fitted in well as an instruction designer*, thereby placing the student in a position that will enable her to act as a professional rather than an intern. Thus the data show that students, though they did also have a number of basic functions and tasks in the organisation, were often placed in significant positions in the company where they were engaged in innovating and qualifying learning and development processes in the company. These shifting positions were associated with their role as hybrid ICT professionals who could create new relationships between technicians and staff, with their role as knowers who could produce and strengthen knowledge through research and as learning professionals who could understand the significance of learning for development and innovation. In this way results generated by the research reflect issues of employability related to emerging ICT professionals who contribute to shaping practices of work and innovation in the knowledge economy. These professionals are - through their involvement in work through PBL - not really transitioning from the university to the workplace but are gradually building their relationship with work through practice. In this context students do learn from work, but, it seems, employers and their organisations also learn a lot from students, who reportedly make significant contributions to the work in which they themselves will eventually take part. Employability is thus not a one way relationship between curriculum based knowledge and its application but a dynamic process of creating viable knowledge through engagement in different social practices.

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Playful Social Inclusion: Approaching Inclusive Thinking and Acting Through Game Based Learning

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Abstract: The Erasmus+ Project *eCrisis* deals with the challenge how game-based learning fosters social inclusion in primary and secondary school and even society. By working with teachers to improve the serious games Iconoscope and Villages Voices, we embed the games to be used in school for social inclusion. As one research output 'post game - activities', such as game based dialogues, are central. Students are empowered through the social inclusion approach by becoming aware of inclusive processes while playing the serious game Village Voices. This game boosts the ability of dealing with conflict resolution by generating conflicts. The players are trapped on a flying island and have to solve different tasks to accomplish a greater goal. 14 gaming sessions were held in the first period of the project. This article focuses on the analysis of one session with a small heterogeneous group of four people. The group was made up of people labelled as disabled, non-disabled, with refugee background as well as representing different ages and genders. The aim is to observe how inclusive structures evolve through gaming. We will describe our research on social inclusion, which sits with a critical debate about existing concepts. Also, we will describe the gaming set-up involving computers, the play session, characterize the pedagogical intervention and present the findings by using the Documentary Method following Ralf Bohnsack. The core question of this research is how inclusive processes emerge while people are playing so that we can identify the role of gaming practises as well as parts of the game or processes of game based learning that manifests as inclusive thinking and acting.

Keywords: serious games, game based learning, social inclusion, diversity

1. Introduction

The following paper is an extend research stemming from the Erasmus+ Project *eCrisis* (project number FA 467040) (eCrisis 2018). The project started in 2016 and will end in 2019. The aim of the project is to foster social inclusion through playing (digital) games. Nowadays inclusion plays a vital role at all levels, i.e. in relation to individual issues such as bullying, social systems like classroom management, and even society as a whole. The societal change is remarkable because of multiple crises in Europe, war and flight, economic crisis or authoritarian and anti-secular political swings to mention just a few. The core aim of the project is the use of serious games to enable skills towards social inclusion by teachers at primary and secondary school levels. This project will provide pedagogical scenarios on how to deal with inclusion-related issues like discrimination, bullying, and exclusion through playing games. The first part of the project was geared towards developing a theoretical pedagogical framework. Thus several workshops were held to observe how people were interacting with each other while playing games and how this affects inclusive processes. These assumptions lead to the following research question: How do inclusive processes emerge while people are playing?

To engage in these questions the paper is structured as follows: First of all, selected theories in the context of inclusion and game-based learning are presented including the underlying understanding of inclusive processes, as well as a definition of game-based learning. Furthermore, it is necessary to describe the term *Serious Games* because of the game at hand, *Village Voices*, classifies as such. The game was developed by Greek project partners and will be introduced in a few sentences, so that the reader gets an idea about the game mechanics and goals. In the second chapter the used methodology is mentioned, and it is argued why the Documentary Method has proved useful for observing and analysing inclusive practises. Against this backdrop, the empirical findings are illustrated by significant examples of one gaming session (Situation 1 and Situation 2). Finally, we will discuss our findings including the former compiled theoretical input. In the end we will present the learning outcomes and give a short input about further research steps.

2. Theoretical background

2.1 Inclusive processes

Inclusive processes must be considered against the antonyms of exclusion, segregation and integration. Figure 1 illustrates the relation between these concepts. The concepts can be assigned to societal systems on a macro-level, as well as to school systems in European countries on a micro-level.

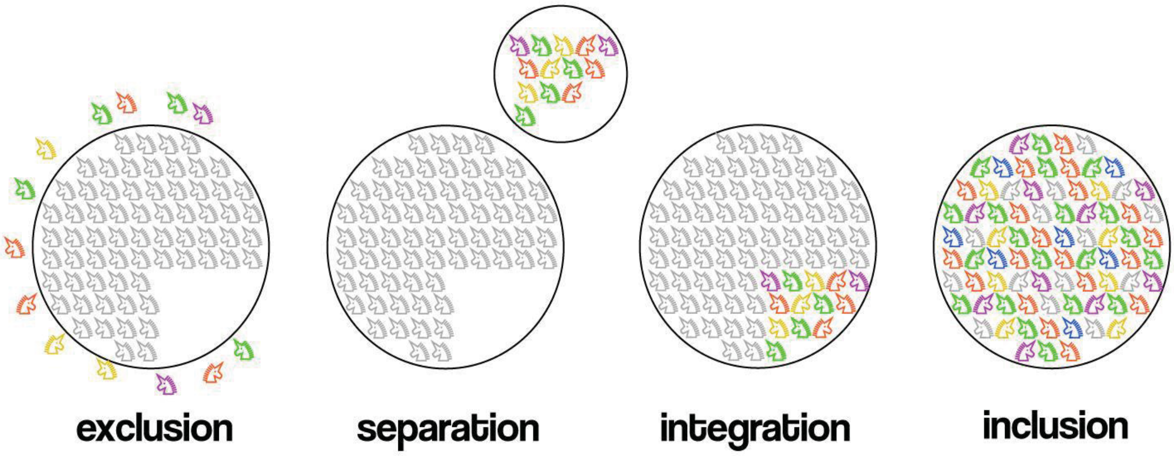

Figure 1: Exclusion - inclusion process

The exclusion model on the left shows that access for specific individuals or groups is denied. In the second model "separation" can be seen that a selected group with categorised characteristics is practically excluded from the majority or what is to be considered as mainstream society. The next concept points at integration. In an integrated setting certain groups of categorised people are involved. Additionally, this integrated group is not part of the original community, because they do not display characteristics of the mainstream society. Thus, integration still contains exclusive moments. Those can be seen in activities geared towards adapting the marginalised people in accordance to the majority. The last concept of inclusion illustrates a totally different approach to participation. There, individuals are anticipated following a holistic approach and considering their full spectrum of potentials and abilities. So, the focus does not lie on the dis-ability any more. In a fully inclusive society every single individual has equal access at all levels in society.

Considering, the the heterogeneous group in the empirical material elaborated in this paper it is necessary to deepen the understanding of the difference between integration and inclusion. Prengel (1995) worked out three categories of marginalized individuals and/or groups. She mentioned that women, people with migration background, and people with disabilities are the biggest groups in society which are disadvantaged and discriminated. With this approach Prengel (1995) addressed societal inequalities and opened a discussion about how pedagogical intervention can be laid out to overcome exclusion and separation. In relation to Figure 1 Prengels approach correlates to the model of integration. A specific group or individuals which does not fulfil societal norms and criteria are integrated in mainstream society. They need to adapt themselves through extra procedures, i.e. therapies or cultural adaption, in order to fit or be made to fit. The model of inclusion deals with a new point of view. It states that the whole community is constituted by everyl individual. There is no marginalised group which has to be integrated in the mainstream. All individuals are seen in accordance to their and appreciated in their abilities. This approach can be underlined by citing O´Brien (2014).

> *"Inclusion is an emergent property of a particular situation in which everybody takes responsibility for claiming the right to be part of a diverse community of equals. It is a social creation for which everyone engaged in a common project holds responsibility. Inclusion benefits and challenges everyone involved. Everyone grows and learns in proportion to their engagement and openness." (O´Brien 2014, p. 9)*

Inclusion comes in all forms and shapes: It is as varied a process as its involved actors and their interactions. Additionally, it is a learning process for everyone involving challenges at different levels. According to this approach, the question can be asked: How do inclusive processes shape pedagogical interventions? Within the eCrisis project pedagogical scenarios were developed to foster inclusive processes in school environment applying the method of game play. In the following chapter, it will be explained, how games and playing are a predestined option to do so.

2.2 Game-based learning and serious games

Prensky (2001) invented and discussed the term (digital) game-based. He stressed that the core aim is to learn through fun and engagement (ebd., p. 5). The interaction between players is primarily about entertainment with a highly exciting medium (ebd.). Additionally, the term *Serious Games* is defined and used by many scholars. It can be seen as a medium which fosters game-based learning. Ebener and Schön (2011) point out that serious games can be seen as a part of game-based learning or even that there is no difference between them. With Micheal and Chen (2011) the focus on the learning process gets clear because the term serious games mainly focuses on the learning goal and not, like popular games, on the entertainment. They both extend and specify Prenskys idea according to game-based learning as fun and entertainment. In the eCrisis project we used the Serious Game 'Village Voices'. The game is described in the following section.

2.3 Game: Village Voices

The game Village Voices is a multiplayer game, which focuses on triggering conflicts. Up to four participants' characters wake up in a village and receive different tasks to fulfill. Every character has specific skills in order to harvest raw materials only he/she has access to and can craft a different good. In total, there are four different persons with different skills: the carpenter, who can chop wood and build furniture, the blacksmith who can carve stone and forge tools, the innkeeper, who can harvest grain and bake bread and the alchemist, who can harvest mushrooms and make a potion. After five tasks (e.g. harvesting grain) the have to collect energy, displayed by fruits. Players can only proceed or win respectively by working together or corrupt the line of events by stealing the stuff of the others. In order to win the game, the players have to finish four different tasks. First, they only need their own goods. In the next tasks the player needs to trade their goods to get goods which are produced by the other players. So, they have to trade and cooperate. One other possibility is to steal goods. This can be the source of conflict, or even escalation. The players can post what they think of their fellow players and one can express feelings. While playing the persons are asked about their perceived level of conflict and their feelings (Cheong, Khaled, Holmgård & Yannakakis, 2015).

2.4 Sample and setting

In the first phase of the project 13 gaming sessions were recorded by video and audio with about 270 participants. We selected one gaming session with four participants. The argumentation is that the interaction is observable quite well and the group has a very heterogeneous character. We called the first participant Ludwig[1]. Ludwig is in his 20th and studying at university. He is born in Austria, but his parents migrated from another country. Mustafa is the second participant and also in his 20th. He is working in his father´s company. As well as Ludwig, he was born in Austria and has a migration background. Helga is the third participant and around 40 years old. She was also born in Austria and lives in a social care organisation because of her disability. The fourth participant is called Yussuf. He was born in Syria and flight to Austria in 2015 because of the civil war. We invited them to play the selected game Village Voices. Before we explained them research ethical issues and they had to fill out a informed consent.

We set up the Village Voices Game on four computers which were located vis-á-vis. Every participant had their own computer with a mouse and a keyboard. They were starting at the same time with the game. Just one researcher was in the room for observations. The other four researcher were sitting in a room next to the gaming session behind a one-way-mirror to observe them incognito.

[1] All names are anonymised because of retaining the participants identity.

2.5 Methodology

For the analysis of the data material the project team decided to use the Documentary Method, an approach developed by Ralf Bohnsack. In the following chapter the motivation behind using the method and in addition the analysis process and its three steps will be described.

The Documentary Method (Bohnsack, 2003) is widely used to interpret classroom activities (Baltruschat, 2015; Sturm, 2015) and videos (Bohnsack, 2009; Hampl, 2015). It has been further developed to interpret how students interact in classrooms based on video material generated in these settings (Wagner-Willi, 2005; Fritzsche & Wagner-Willi, 2015; Richter, 2015). Contrary to other methods that are used to reconstruct interactions based on video material, such as objective hermeneutics and conversation analysis as well as ethnographic and praxis-theoretical approaches (Dinkelaker & Herrle, 2009, p. 12), the Documentary Method "allows us to differentiate between theories, norms and intentions on one and the non-intentional or habitualized activities or practices on the other hand" (Bohnsack, 2010, p.109). This differentiation is crucial as research on gaming interaction is to engage at the intersection of individual (theories, norms, and intentions), cooperative and communal thinking, and action. The action may involve non-intentional or habitualized activities or practices that point to conjunctive experiential spaces (Mannheim, 1982). The concept of conjunctive experiential spaces widens the understanding of community to "structural identical experience, (…) experience that is also shared by those who do not even know each other" (Bohnsack & Schäffer, 2002, p. 254). Therefore, the Documentary Method was chosen in this study to engage of the research questions that focus on inclusion in classroom activities. Moreover, the Documentary Method is widely used in research on inclusion. The aim of inclusive schooling is to provide access for every single individual in class. The analysis of inclusive classroom activities shows the interaction between all participants. Habitualized practices, norms, values, and intentions can be visualized by using the Documentary Method. Those visualizations are important to understand and reflect on classroom activities and the underlying dynamics of interaction conditioning inclusive settings (Sturm 2012).

Finally, the concrete research process will be explained. Initially, we gained an overview of the collected data. According to Bohnsack the first research step called "Formulating Interpretation" (Bohnsack, 2007, p. 134f.). We reflected and filtered the data to the aspect what happens what can we see. This step helps to structure the material and select important aspects. Out of the game session, we chose two different scenes. We have chosen two different situations due to two main reasons. Firstly, we saw an aggregation of interaction schema between the participants while scanning the material. Secondly, we can see beside the communication also a representative section of physical interaction. These two lasted about three minutes in total and were repeatedly watched and thoroughly analysed. We transcripted the two sessions to work directly with the concrete material. The gaming session was held in German language, so for the paper we translated the relevant passage in English language. Out of this material we extracted the following two situations:

Situation 1: The first situation deals with the discovery which character is played by whom. Ludwig took an active part figuring out who is who. The conversation is hold between Ludwig and Helga. Yussuf was not participating in the first situation. Neither Mustafa, later he started directly with fulfilling his first request. Therefore, he addressed the whole group and not the person he wanted to help him. Ludwig gave him support in form of addressing Helga directly. She did not show any reaction. Thus, Ludwig stood up, went to Helga´s PC and decided to take over her mouse to do her tasks.

Situation 2: The second selected scene shows how Ludwig wanted to address Yussuf but he could not remember his name. Therefore, Ludwig asked the present Researcher 1 about Yussufs name. Researcher 1 told Ludwig Yussuf´s name. Thus, Ludwig addressed Yussuf directly and asked him a question. Yussuf responded with a quick one-word answer. Ludwig told him what he needs and underlines his request with a denomination. Neither Helga nor Mustafa participate in this scene. Instead Researcher 1 was involved in the gaming session although she was no part of the community.

The second analysis step according to Bohnsack is called the "Reflective Interpretation" (ebd., p. 135f.). Thereby, the habitualised and implicitly orientations and interactions are scanned. Additionally, the focus lies on the way and manner how interaction and communication take place (ebd.). In the next chapter the empirical findings and their interpretations are presented and linked with existing theoretical approaches.

3. Empirical findings

We recognized that there are two aspects which appear repeatedly at different stages in the interviews. These two aspects are related to (1) gender and (2) culture.

3.1 Gender

In the selected sequence the four participants started the game and got to know each other's characters. The game offers the possibility to choose a female or a male character. But his setting is not every clearly pointed out in the game design. So, in the beginning four male character started the game play. In our analysed session, Ludwig started with inquiring who was the blacksmith. Helga answered, that she believed it was her. Ludwig answered that he anticipated her being the female carpenter instead. Interestingly, he used the masculine term in German (Tischler) as the game character shows. Additionally, carpenter is a job that is often associated with physical strength and therefore a male-dominated job. Helga was correcting him with the German feminine version (Tischlerin) although her character was male shaped.

Ludwig: Who is the blacksmith? #00:02:27#

Helga: I think I am #00:02:30#

Ludwig: You are the carpenter, I think! #00:02:32#

Helga: No, carpenter (female form)! #00:02:33#

After this sequence the quest of finding the blacksmith is continued. Ludwig finds the blacksmith (Mustafa) and asks him for three pieces of metal, he needs to fulfil his quest. He gets metal and asks Mustafa what he needs in return. Afterwards Mustafa asks who has got wood for him. Ludwig is instantly answering that Helga is the carpenter and is able to trade wood with him. In that regard he used the German female version for carpenter. This scenario is shown in the following section of the transcript.

Mustafa: Who has got wood for me? #00:03:35#

Ludwig: Carpenter (female form)! #00:03:37#

After this short interaction, Helga did not show any reaction following Ludwig's hint that Mustafa wants wood from her. Because of this Ludwig got up and went to her place to watch what she is doing at her screen.

Helga: How is it about collecting energy? (10sec) Do I have to go into the forest now? #00:03:49#

(Ludwig is getting up and stands next to Helga to help her)

Ludwig: Dealing! Press the paper roll! Press okay. Now the task is over. (14sec) Did we argue yet? I do not think so. #00:04:07#

Helga asked how she is able to collect energy she needs for the character to stay awake, otherwise the character falls asleep. Thus, the ideal flow of the game would be interrupted. It seems that Ludwig did not want to risk his and stood up to explain her how she can do it by doing it instead of her. He is taking over the control of her role. This sequence is representative to show how mansplaining is working. He is showing her how is game is structured instead of letting her to figure it out on her own. Interpretively, Ludwig infantilize Helga because he does not believe in her skills to fulfil the task on her own.

3.2 Culture

The next passage is representative for a situation in which the culture aspect becomes important. It seems that Ludwig forgot Yussuf´s name. So, he was asking the attendant Researcher in a quiet voice to help him with finding Yussuf´s name. Afterwards he is addressing Yussuf loudly to ask him for material he needs to fulfil the game criteria.

Ludwig: How is his name again? (quiet voice; Ludwig is turning to Researcher 1; pointing with his finger at Yussuf) #00:08:35#

Researcher 1: Yussuf! #00:08:35#

Ludwig: Yussuf! Did you collect stones? (loud voice) #00:08:36#

Yussuf: Yes. #00:08:39#

Ludwig: I need three stones, Bro. #00:08:41#

Yussuf: Three? #0:08:41#

Figure 2: Ludwig supports Helga in form of physical interaction

Figure 3: Interaction while gaming - asking for the name

Ludwig was asking an extended person - in this case Researcher 1 - about his teammate's name instead of asking directly. It seems that Ludwig was not able to ask Yussuf about his name. He had to get support through an external third instance. One possible interpretation leads to the assumption that Ludwig is not familiar with Yussuf´s appearance and habits. Instead he tends to look for support in a familiar person who belongs to the same cultural background. In the end of this section Ludwig told Yussuf his needs and underlines his require with the word "Bro". The English word is the short form of brother. It is used in many countries to express sympathy, belonging and acceptance on a same level of equality.

4. Discussion

Situation 1 - The gender aspect. After describing what happened in Situation 1, we came up with guiding questions to interpret and analyse the habitualised ways and manners of interaction and communication. Why is Ludwig using the male version and not the female version when addressing Helga in her character? Why is Helga correcting him? How come that Ludwig uses the female version when addressing Helga for the second time? Why is Helga ignoring Ludwig's address? Why is Ludwig answering for Helga? Why is Ludwig resuming for Helga instead of explaining the following steps?

From a historical approach, following Bothe and Schuhe, it can be argued using the male version in German language is still in people's minds because till the 20th century women were more or less invisible in public society (Bothe & Schuh, 2015). Feminist and gender theory stresses that there is an "imbalance of power between the sexes that disadvantage women and attempts to re-negotiate them." (Offen, 1988, p. 20) This is also transferable to the lingustical point that using the female version is not *naturally* inherent yet. This leads to the assumption, that in linguistic usage there is still an imbalance of addressing gender-sensitively.

From a pedagogical approach, it is arguable that Ludwig was not using the female version quite often, because following Budde the gender discourse is still not being discussed in school that much (Budde, 2006, p. 58). Budde argues that even nowadays schooling produces gender stereotypes because of traditional teaching styles. Thus, de-dramatisation of gender could be on approach to foster gender-sensitive pedagogical interactions (ebd.). This includes also the linguistic usage of gender neutral or sensitive language. In conclusion, the historical and the pedagogical approach cannot see without an intersectional perspective because they condition each other in being framed by historical and present settings.

Hereby, it is necessary to mention a critical point about the game design. When starting the game four male characters appear. It is possible to change the gender, but the player has to figure out how it works. This is not clearly indicated. Compared to other games (e.g. The Sims) it is quite common to choose the gender before starting the game. Miller and Summer point out that these issues are based on laziness of the game designers (Miller & Summer, 2007, p. 733). This unreflected moment leads to reproducing gender stereotypes and the player identifies automatically with male attributive characteristics. From a technical point of view, it is manageable to choose gender before the game starts (ebd.). In 21st century it is not appropriate to neglect gender aspects in game design that lead to limitation of the cognition of persons (ebd.). They have to reflect on their societal responsibility of designing games in ways to not foster social inequality.

On the other hand, it seems that Ludwig has an immediate learning process. In the next situation he uses the female version instantly. This learning in terms of linguistics is not directly changing his behaviour. Because Helga is not responding to Mustafa's request of wood, he is taking over the physical lead. He gets up, takes over her mouse, and tells her or appeals what to do. This suggests the interpretation his behaviour could not adapt as fast as his linguistic learning process. There it is referred to further activities relating to gaming sessions to strengthen the new learnt approach.

To gain a holistic overview, we also have a look at the situation from Helga´s point of view. It can be seen that she is claiming the female version of carpenter for herself. Interpretatively, the discourse of linguistic gendering has already been an issue for her. It leads to the relevance for building her identity in the game. She clears out that her character is female what assumes transferring her own gender into the character even when the character is male shaped. Furthermore, it can be seen in a broader societal scale. It explains her social position as a woman *and* a person with disability. The reason appears in the situation when Ludwig is taking the lead in a physical way, she lets it happen. She does not comment on it neither claim for doing it on her own. This point can be argued with Walgenstein et al. that the mechanism appears because of the intersectionality of gender and disability (Walgenstein et al. 2012). Both categories condition each other and have to be reflected when it comes to structures of discrimination or even physical intervention like in this sequence. Being a woman as well as an attributed disability stands for characteristic traits which deals with an imbalance of power between individuals (Offen, 1988, p. 20). In here, the aspect of Ludwigs gender and ability shows that a hierarchical difference exists.

Situation 2 - The cultural aspect: The above described situation leads to the following questions: Why does Ludwig not speak directly to Yussuf? Does Ludwig think Yussuf is not able to speak German? Why is he not using English instead (although it is clear that he is capable of doing so)? Does he think it is awkward to ask Yussuf himself? Why does it seem easier to ask an extended person?

The gameplay forced Ludwig to interact with Yussuf because he has to cooperate with him to fulfill the given tasks. Hereby, the game can be seen as a facilitator to confront the players with each other. Sundermeier argues that only in participative interactions the *strange* can be experienced (Sundermeier, 1996, p. 73). So, Ludwig is confronted with Yussuf being different. He fulfills the role of a *stranger* to Ludwig because of their different cultural backgrounds. In Ludwig´s point of view Yussuf belongs to another culture including different habits and practices. Ludwig is not familiar with those practices. Thus, one interpretation is that Ludwig is not sure about asking Yussuf about his name in order not to act inappropriately. As there is an instructor round who everyone introduced himself/herself to. He is more likely to ask that person who happens to belong to the same or an apparently closer cultural background in order to avoid hurting statements. Just to make sure he is not interacting rudely to Yussuf.

Ludwig finishes the situation by initiating Yussuf as a member of the group. He underlines Yussuf's new belonging with the addressment "Bro" which stands for a denomination young people are using. Thereby, we can see the transformation process from unknowing to knowing (Simmel, 1908, p. 1). Furthermore, we can argue that the *stranger* completes Ludwig´s constitution because the *foreign* shows *deficits* and the desire of wholeness (Sundermeier, 1996, p. 75). These *deficits* could be appear because of his own migration background. Maybe he has experienced discrimination and denial as well. Thus, he does not want Yussuf to experience the same rudeness he did. Additionally, the desire of belonging could be an unconscious reason how Ludwig interacts and addressing him Bro later on. Inasmuch as Ludwig knows how it feels to be excluded because of his cultural background.

As already mentioned, Sundermeier argues that *the strange* can only be realized in the course of participation. He remarks that participation is a two-way process (Sundermeier, 1996, p. 73). This approach is in agreement with O´Brien's idea that inclusion is a process of equal participation (O'Brien, 2014, p. 9). To achieve his goal of solving the game task Ludwig needs Yussuf on a level of equal participation. Thus, Ludwig needs to build a bridge between Yussuf and himself. The bridge can be seen in the Researcher who was telling Ludwig Yussuf's name. So, it can be said that Yussuf is excluded and not part of the interaction in a first step to include him later on. This implies that a moment of exclusion has to continue before inclusive processes appear.

5. Conclusion

Content-related. The analysis has shown that it is possible to learn new manners and ways of interacting easily despite habits. Though the game or playing it seems that the medium forces people into creating or experiencing anticipated inclusive processes. If the game is not able to fulfil this task of building a bridge between the participants, the players decided to take the well-known way of asking for extended human-based support. Related to this output, the gender aspect in intersection with disability aspect appears in a more active or demonstrative way than the migrant aspect. It seems more likely to Ludwig taking over Helga's position than taking over Yussuf´s one. The interaction and one's behavior itself should be the first step to become aware of inclusive processes. The obviously gap between the participants can be closed or overcome by a supportive system either through the game itself or through human-based support. Here, the second step would be manifesting those in the situation new learnt issues. Maybe it is necessary to experience similar situations more often to enhance a permanent change of habits. So, action replay is one possibility to deepen new structures and change old habits. Another possibility is seen in a Game-Based Dialogue Approach (Schmoelz at el., 2017). Game-Based Dialogues engage participants in post-game activities the allow to discuss inclusion related topics such as gender, migration, discrimination and exclusion and reflect them in a direct way of talking about it.

Game-related. We saw that due to the game design the gender aspect stays immanent in the setting. It is not easy to decipher gender-related codes of the game if one is not familiar with it. On the other hand, it could be easily achieved to start a game with two men and two women. This would show equality and cause awareness of gender equality. It could also enhance inclusive processes for the gender aspect. In here, the game indicates a reproduction of stereotypical gender roles. Even if the jobs represent male typical jobs as in most cultural contexts, we argue that the game should also include *typical* female jobs. Therefore, we should demand, that the jobs can be executed equally by men and women. In order to the culture aspect, here we suggest optimizing the game for the migrant topic without causing the need for external support.

Methodology-related. We learned that time matters. In the first step we misprized the amount of time for screening the material. After this, we improved our time management. We also did not think that in such little encounters. There could be such an amount of interaction and consequently experience and knowledge. It also would be interesting to follow a participative or inclusive research method. Thereby, additional benefit would be to gain a insight perspective of all participants. But this idea leads to the next point of limitations.

Limitations. In this analysis two aspects - gender and culture - were focused in different situations for the analysis. In the future research it is necessary to analyse less obvious aspects such dis/ability to deepen our results as well as to look at the intersection of different aspects.

Outlook. It appears meaningful to look through the material once again and discuss other intersections which leads to exclusion and discrimination. Another important aspect could be the further learning processes. How is is possible that the participants recognize and reflect their behaviour in order to change it.

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Differences in Classroom Practices in Ordinary and Technology-Supported Mathematics Lessons

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Abstract: The goal of the paper is to show the specifics of technology-supported mathematics education, both using computer technology in classical school environment and in an e-learning course. The survey is conducted within the frame of the international *Lexicon Project*: *Analysing pedagogical naming systems from different cultures to reconceptualise classroom practice and advance educational theory.* In the research study the authors work with the Czech Lexicon (i.e. a lexicon of terms in Czech with their equivalents in English) that was designed for description of any general lesson of mathematics. The question the authors ask is which moments in a technology-supported mathematics lesson cannot be described using terms from the Lexicon. Detection of these moments show which aspects of a technology-supported mathematics lessons are unique and specific and need to be paid additional attention to in lesson planning, when conducting the lesson and in teacher training. The methodology used for detection of these moments was analogical to methodology of creation of the original, general Lexicon. The analyzed material consisted of three video recordings of mathematics lessons from the Lexicon set of recordings where technological devices were used at least in a part of the lesson and field notes from preparation, conduction and observation of an e-learning mathematics set of activities (considered as one lesson). When supplementing the Czech Lexicon, the authors used open axial coding. The entries that the original Lexicon did not contain or did not use them explicitly for description of computer-supported mathematical education can be divided into the following two groups: Terms that are used in the original Lexicon and refer to use of technological devices in a mathematical lesson regardless of whether the lesson uses e-learning or ICT in “traditional” lesson; terms that are specific for technology-supported mathematics lessons with attention paid to specifics of e-learning. The newly included terms are divided into the following categories: Used technological device, Time span, Activity in a lesson, Way of use, User, Use of results. The authors show that the newly included terms do not ask for major revisions of the original Lexicon and can be integrated into the already existing categories of the Lexicon.

Keywords: classroom practices, classroom management in computer-supported lessons and in e-learning, communication and interaction, Lexicon, stages of a lesson

1. Introduction

Our interactions with classroom settings, whether as learners, teachers, or researchers, are mediated by our capacity to name what we see and experience. The *Lexicon Project: Analysing pedagogical naming systems from different cultures to reconceptualise classroom practice and advance educational theory* (Clarke, 2015) investigates the pedagogical naming systems used by educators in nine countries (eight languages): Australia, Chile, China, Czech Republic, Finland, France, Germany, Japan and the USA to describe the phenomena of the mathematics classroom. The main goal of the project is to create a database of terms for classroom research on international level.

Cultural specificity of classrooms poses challenges for international comparative research. Educational theories, research and descriptions of practice are contemporarily framed in English, which names some aspects of the lesson but ignores key aspects named in other languages. This limits the capacity to access, connect, mediate and adapt the wisdom of other cultures. (Clarke et al, 2007) The Lexicon Project initiates cross-cultural dialogue to identify pedagogical terms from selected Asian, American and European educational communities and uses these as analytical tools to categorise, interrogate and enrich our classroom practice, classroom research, and educational theorising. Such lexicons consist of words of locally agreed meaning in a single language that collectively accord to lexical norms and conventions characteristic of the language community (mathematics educators) of the particular country. Clarke et al. (2016) investigate the function of language in mediating and shaping students’, teachers’ and researchers’ classroom experiences.

1.1 Czech Lexicon

The Czech Lexicon is bilingual. It was formulated in Czech as a book of reference for Czech community as well as in English to allow comparative studies in the context of international community. It was created in six stages (Search for common language, Search for structure, Condensation of the Lexicon structure, Validation at national level, Change of structure, International validation) in which methodological procedures were continually adapted to the situation (Žlábková et al., 2018) . In (Novotná et al., 2016), the first four stages of the process of creating the Czech Lexicon for mathematics teaching and learning are presented. As no similar study could be found, qualitative research design was used. The materials used for creation of the Czech Lexicon were mathematics classroom video recordings of one Czech mathematics lesson and eight video recordings of other project teams (Australia, Chile, China, Czech Republic, Finland, France, Germany, Japan and the USA). The main methodological approach used was open and axial coding of these episodes.

At first, open coding was used (Strauss and Corbin, 1999). The team members gave terms to events they saw. They divided the Czech lesson into shorter episodes they found distinct. They defined the beginning and the end of each episode. The episodes were labelled by a code. As expected, there were huge differences in approaches to the description of the phenomena used by each of the team members. Having finished individual work on this stage, all team members were shown the coding of other team members. The team met and different codes were grouped into larger codes using axial coding. The result of this process was a list of codes – the first draft of the Czech Lexicon. This was followed by verification of the Czech Lexicon. Verification had the form of coding foreign lessons – each member of the team coded two lessons, which at the same time meant each lesson was coded by two project team members. The results of their coding were compared and the list of codes extended and restructured.

The Czech Lexicon submitted to the national validation contained about 100 lexical items. It consisted of general didactical terms rather than being restricted to only "the mathematical didactical vocabulary". The structure of the Czech Lexicon was as follows: Classroom Management, Introductory Communication, Explanation of a New Topic, Revision of Previously Taught Topic, Solving of a Problem, Checking Individual Work, Institutionalisation, Summary, Non-mathematical Social Interaction, Assessment, Concluding the Lesson, Individual Consultation with a Pupil.

The fifth stage of the process of creation of the Czech Lexicon consisted of analysis and evaluation of questionnaires filled in by maths educators and pre-service teachers followed by interviews with them. We realised there were too many detailed items described in everyday language without a corresponding term, which resulted in difficulties when comparing different lessons, when looking for illustrative examples and during the national evaluation. It was decided to restructure the lexicon into a new form of fewer terms from general pedagogy and/or didactics of mathematics, all of which would be illustrated by several examples and non-examples. The Lexicon was transformed into an open system where new examples can be added. Currently the Czech lexicon consists of ten main categories:

- Stages of a lesson (the terms that allow the description of a lesson from the point of view of its phases)
- Organization of a lesson (E.g. "Teacher gives an instruction whose aim is to make pupils behave in the lesson.")
- Teaching methods (the terms that allow description of a lesson from the point of view of teaching methods used)
- Pupils' individual work (E.g. "Pupils work on their own. Teacher monitors their activity.")
- Processes supporting pupils' learning
- Assessment
- Homework
- Organization forms of instruction
- Use of didactical means
- Type of tasks

The sixth stage, international validation of the Czech Lexicon, was conducted on two levels: review of Czech Lexicon by the Chilean project team and thorough comparative analysis of Czech and French lexicons. This validation resulted mainly in précising formulations in English. Where it was not possible, relevant illustrating examples and/or non-examples were added in order to clarify and precise the meaning.

1.2 Specifics of e-learning environment

The basis for e-learning is learning supported by modern technologies. E-learning cannot be defined merely as some computer system. It also means a number of people who communicate, study, learn and produce texts. At the same time e-learning is a set of tools – computers, multimedia, websites etc. used for the teaching and learning process. Most definitions primarily focus on modern technologies ("use of computers and internet to support learning", use of information and communication technologies to improve and support learning"). Some definitions also focus on the learning content and its availability and on communication.

A complex definition is proposed in (Zounek, 2009): "E-learning includes theory and research as well as any real educational process … in which information and computer technologies working with electronic data are used. The way of using ICT tools as well as availability of learning materials are dependent on the learning gaols and content, the nature of the learning environment as well as on the needs and potential of all parties involved in the learning." (Zounek, 2009: 37-38)

The parties involved in e-learning are apart from pupils and teachers also the tutor or instructor, i.e. the person managing the learning process and the author of the module. The tutor, the author and the teacher may but may not be the same person.

But what is important, e-learning is based on communication among learners and the parties, i.e. we must be able to describe the learning process as such using appropriate and comprehensible terms in order to work on efficiency of the modules, to study the learning process, to propose changes, to make research, to communicate with the teaching community.

2. Our research: Technology-supported mathematics lessons – what terms are there in Czech Lexicon?

In the here presented research study the authors work with the Czech Lexicon, which was designed for the description of any lesson of mathematics. The paper answers the following research question: What are the terms needed for the description of a technology-supported mathematics lesson (both using e-learning or in a traditional classroom) that are not included in Czech Lexicon for mathematics education? To be more precise, the question the authors ask here is how well a mathematics lesson where technology is used, with its specific communication and practices, can be described using the terminology from the Czech Lexicon and what terms are missing in the Lexicon. While the Lexicon should provide all terminology needed for the description of any mathematics lesson, it may lack terminology needed for the description of how technology influences the development of the lesson and what novel aspects it brings into it.

We believe that if we manage to find what terms are missing in the Czech Lexicon with respect to the progress of a technology-supported mathematics lesson or e-learning module, we will be able to name the areas that are specific for such a lesson or module and that are likely to need to be paid more attention to by the teacher as they challenge the mathematics teachers' and their pupils' beliefs about what it means to be conducting and following a mathematics lesson. The missing areas are exactly those that will have to be addressed by the teacher if the pupils are to feel confident and safe in a technology-supported mathematics lesson. They are those where didactical contract (Brousseau, 1997) is broken and teacher's as well as pupils' self-confidence and assuredness may be wanting.

2.1 Methodology of supplementing Czech Lexicon for a technology-supported mathematics lesson

The methodology for supplementing the Czech Lexicon for technology-supported mathematics lessons was similar to methodology used for creating Czech Lexicon as described in section 2. The material consisted of three video recordings of mathematics lessons from the Lexicon set of recordings where technological devices were used at least in a part of the lesson as well as field notes and observations from an e-learning mathematics lesson. The authors used open axial coding (Strauss and Corbin, 1999).

The difference is in the fact that the coding was conducted only by the two authors of this paper. The discussion on how to sequence the video recordings and describe the different activities by appropriate forms was done only by two people. The task was easier for the authors as they had both been involved in the creation of the

Czech Lexicon. The authors were familiar with the method of work and were building on an existing lexicon. Thus it was much easier for them to come to an agreement on a specific term and the discussions were much briefer. The team of the authors of this research study have the needed qualification and expertise – one of them is a specialist in didactics of mathematics, the other ICT co-ordinator in an upper secondary school. Combining their views proved to be very valuable already in the previous research.

2.2 Terms in the Czech Lexicon referring to use of technology in lessons

The first stage of the research study was to find all explicit occurrences of technology in the terms in the existing Czech Lexicon. The outcome of this analysis is presented in Table 1. As the column Examples is far from exhaustive, more examples can be added at any point. However, the goal of this analysis was not to create an exhaustive list of all possible uses of technology in a mathematics lesson but detection of terms that are important for description of a technology-supported mathematics lesson. Thus Table 1 only presents those terms in which some concept from the area of technology is used explicitly or in which activities that use the concept are presented.

Table 1: Terms in Czech Lexicon explicitly focusing on the use of technology in lessons

<table>
<tr><th>Generic term</th><th>Pedagogical term</th><th>Description of the Pedagogical Term</th><th>Examples</th></tr>
<tr><td colspan="4">Direct use in an activity</td></tr>
<tr><td>Teaching methods (Terms that allow description of a lesson from the point of view of teaching methods)</td><td>Computer assisted instruction</td><td>Programmed pupils´ learning</td><td>Use of computer for calculations/
Use of some programme of dynamic geometry/
Use of computer to search for information</td></tr>
<tr><td>Organization of a lesson - Teacher organizes the lesson.</td><td>Organizational instructions</td><td>Teacher gives instruction by which they organize pupils' work.</td><td>Teacher reminds pupils to bring calculators to school and to use them.</td></tr>
<tr><td colspan="4">Instruction drawing to the future use</td></tr>
<tr><td rowspan="2">Use of didactical means</td><td>Use of PC with beamer</td><td>Teacher presents a visualisation created on a computer using a beamer.</td><td>Teacher uses a PowerPoint presentation projected on a beamer.</td></tr>
<tr><td>Work with smartboard</td><td>Teacher uses smartboard in their lesson.</td><td>Teacher presents/solves a problem using a smartboard</td></tr>
</table>

2.3 Analysis of video recordings of technology-supported lessons

The next step was an analysis of video recordings from mathematics lesson in which technology was used, either in one short teaching episode or as the main teaching strategy, either only by the teacher, only by pupils or by both teacher and pupils as well as study field notes from planning, conducting and observation of an e-learning module. The analysed material consisted of four video recordings of technology-supported mathematics lessons and notes from one e-learning "lesson". The analysis paid attention to all moments in the lesson where technology was used. Having detected these moments, an analysis whether this place can be described using an item from the current Czech Lexicon was conducted. Attention was paid both to explicit mentions of this particular use of technology and to items where the particular activity could be implicit.

2.4 Results

A list of terms needed for the description of a technology-supported mathematics lesson or an episode from this lesson was created (see Table 2). The table is structured into categories from the point of view of observation of the episode. The different categories can be combined, which should allow a clear and detail description of that was happening in the mathematics lesson in the particular time period. These categories were verified through analysis of two more lessons in which a smart board or computer were used. The analysis of these two lessons showed that no further terms are needed.

Table 2: Terms needed for description of a technology-supported mathematics lesson

Criterion	Variant	Possibilities
The used technological device	Smartboard	
	Computer and beamer	
	Calculator	
	Mobile devices	
	LMS	
	Internet	
Time span	The whole lesson	
	Part of the lesson	
Activity in a lesson	Setting a task	
	Projecting a text	
	Showing a short video	
	Teacher's explanation of the content	
	Discussion of a teacher and pupils	
	Process of solving a problem	
	Correcting pupils' solution in a lesson	
	Collection of data for further processing	e.g. Internet search Collaboration (e.g. using wikitools) Using Smart Response for evaluation of answers Collection of partial outputs for full solution Making graphs and charts
Way of use	Only projection	
	Adding ideas/data into the projected problem assignment	Only corrects answers Brainstorming of any ideas and then their verification
	Recording solutions/parts of projected solution	
	Animation of problem assignment	Use of dynamic geometry software
		Gradual supplementation into a projected picture according to the solving procedure, teacher's explanation or discussion
	Internet search	
	Projecting a set of formulae from which pupils select the needed one	
	Scaffolding[1]	
	Filling in text boxes on a web page, sending the form to the tutor	
	Reading and using HELP	

[1] To put it briefly, scaffolding is anything the teacher (and not only the teacher but also the author of a learning material, a parent or a pupil) does to make learning easier – both as far as language and the subject itself are concerned. (Moraová, Novotná, 2017)

Criterion	Variant	Possibilities
User	Only the teachers	
	Some pupils	
	Teacher and some pupils	
	Teacher and all pupils	
	Groups of pupils in group work	
	Individual pupils in individual work	
	Tutor and some pupils	
Use of results	Saving to the computer memory	
	Copying into paper notebooks	
	Sharing on some cloud storage	

2.5 Discussion of results

It was not difficult to place these new terms into the structure of the original Czech Lexicon. At the same time the authors of this text find it useful to leave them also in this isolated table as they are easier to access for the needs of analyses of technology-supported lessons than when incorporated in the original Czech Lexicon.

In the original Lexicon they would be mostly placed in the part *Use of didactical means*, also in the parts *Teaching methods, Processes supporting pupils' learning*.

Moraová and Novotná (2017) carried out a similar analysis of the Czech Lexicon for mathematics lessons conducted in English using Content and Language Integrated Learning (CLIL). The list of items is much more extensive with items from didactics of teaching foreign languages. The research study shows that the Czech Lexicon cannot be used exhaustively for a mathematics CLIL lesson due to its different patterns of communication and classroom practices. There are whole areas of doing things in a CLIL lesson that do not occur in an ordinary mathematics lesson and thus they are excluded from the Lexicon. A CLIL lesson is dual-focused. The objectives of these lessons are defined both for mathematics and foreign language. And it is achieving the language goals that uses other methods and patterns of interaction. This is not the case of technology-supported mathematics lesson where the goal of using technology is not improving the pupils' ability, skills and knowledge in the subject Technology and Informatics. The use of technology is the tool helping the pupils (but also the teacher) to improve their understanding of mathematics (and may be also motivation). Still a question we should ask is whether this implicit assumption that pupils do not have to be taught how to use technology does not become an obstacle to understanding mathematics for some. In a CLIL lesson a lot of attention is paid to whether the pupils understand what is being communicating to them. The teacher in a technology-supported lesson should be aware of the fact that the common practices change and some pupils may feel worried. The didactical contract takes on a new form and pupils should be reassured that and made familiar with what this new form of lesson means for them. Analyses of lessons carried out in this research do not show that teachers would be working with this deliberately, although, as Table 2 shows, new activities and forms of communication are brought into the lesson.

3. In conclusion

Work on the Czech Lexicon showed that Czech terminology in the area of mathematics education seems to be unsettled. The need to cultivate subject didactic discourse is seen as one of the prerequisites to emancipation of subject didactics (Stuchlíková, Janík, 2015: 449). This only highlights the importance of creation of the Czech Lexicon and the need of its circulation.

The point of the presented research is not to conclude that the Czech Lexicon must be adapted, the point is to show which areas of a technology-supported lesson need more attention both of the teacher and the pupils as they do not copy the general beliefs about what it means to be doing mathematics at school.

The goal of the paper is to trigger discussion in the pedagogical community on Czech terminology used in didactics not only of mathematics but also of other subjects. Moreover, it could be of interest also for the domain of didactics of informatics, as we draw attention e.g. to what pupils and/or teachers need to master if technology-supported teaching is to be successful. Teachers who face the situation of teaching mathematics using technological devices must be well aware of those practices that are different and require more attention, which was not the case of the observed lesson. The assumption is that the current generation of digital natives needs no explanation on how to use technological devices. However, using them in a mathematics lesson changes how mathematics is done and needs due attention. Among other, pupils must be expected to need extra time to get used to these new practices and patterns to develop a new classroom culture – the culture of a technology-supported mathematics lesson.

Detection of these moments show which aspect of a technology-supported mathematics lesson are unique and specific. The study is limited to the use of laptops and interactive smartboards. However, the authors are convinced that the presented results can be useful also for considerations of teaching with other technological devices and also for other subjects than mathematics.

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E-Learning in a Flipped Classroom Approach

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Abstract: This paper reports the results of an empirical study of a flipped classroom implementation during a full academic year. The idea is to have students carry out on their own, the readings and research on theoretical aspects to become the teaching content. In this case, students had to read internet postings of reading assignments and visual contents and a number of questions had to be answered, ahead of each class meeting, before class discussions and activities. Results indicate that students are often still expecting to follow the more traditional method, waiting for the teacher to explain things to them whenever they felt out of their comfort zone, instead of trying to figure things out on their own. This could be indicative of a number of things, like a lack of autonomy, not understanding the new role of the instructor, or may be some indication of an unwillingness to produce more effort. On the other hand it could indicate full trust in the teacher's explanations or a need for reassurance that they were on the right track. Findings suggest that students have to be made more responsible, that the teacher should modify the groupings weekly, and should resort to assessment reports on group members' participation. In addition, it was deemed to be helpful if strategies for more efficient group participation on-line were taught, adding to aspects of reflective teaching. Students who do not fully subscribe to the approach will not make the anticipated learning gains. Distributed participation is required. This study brings about insights into hidden aspects of student behaviors even in the case of outstanding student groups and would be useful for all educators using the flipped classroom approach.

Keywords: flipped classroom, avoidance, participation, enhancing learning

1. Introduction

With the ever-increasing pace in technological advances and dealing with students who are technically savvy, new approaches to teaching to make better use of all available possibilities have come to the forefront at universities and schools in general. At this time of high competitiveness universities have to come up with an added plus to enhance student recruitment (Bates, 2016). Aware of these needs, I have being favoring e-learning for some time and in particular in this study I report on a flipped classroom approach I engaged my students in during the 2015-2016 academic year. After a review of underlying theoretical considerations on recent research for learning, I explain the approach used, also outlining students' responsibilities. I discuss findings and expand by suggesting further pathways for improvement in the use of e-learning tools and classroom strategies.

Research into learning showed that there often is a part missing because of a lack of understanding of cognition. For learning it has to be understood that we create our own beliefs and representations, therefore learners will intake different things. Hence we cannot expect all learners to have the same knowledge or to have interpreted and apprehended the things we want them to learn or exactly how we want the knowledge presented stored into memory. So group work and activity based work would help in gaining some common ground.

As students appropriate data in idiosyncratic ways it is crucial to design content that will mediate students'activity systems in order to enhance the appropriation of concepts we intend to have them learn. E-learning helps promote ready access to vast amounts of information without the limitations of information gleaned only during a lecture. The flipped classroom approach encourages students to further the enquiry and pose questions to advance their understanding of concepts and helps develop their ability to apply them in activities in the classroom when they meet as a class.

The question is how to push learners further, get them to activate the most useful strategies and to take charge in order to bring about and activate the necessary knowledge base for themselves personally and bring support to their peer-group as well.

2. Theoretical background

A number of concepts as described in the sections below, inform the process underlying the articulation of the implementation. The proceduralization if summarized in Figure 1 below. Below I review some important elements that fed into the thinking arrived at.

2.1 Learning considerations

The objective in teaching is no longer to rely on accumulating declarative knowledge (Anderson, 1985), as was the case, with students only required to be able to state what they learned, through rules, theorems etc. or even to give brief explanations. Today the emphasis is on procedural knowledge (Anderson, 1985) and fluid knowledge with the aim at mastery and internalization so as to eventually allow for automatic functioning around the concepts involved as in an embodiment. In the flipped classroom this is rehearsed through in-class activities. Responsibility for understanding the concepts rests mostly on the students while preparing for class while the in-class activities provided by instructors is aiming at consolidation and verification of what was prepared to help proceduralize the contents and promote their crystallization and assimilation in the mind.

Today for many reasons group learning is favored over individual development or both are used (Canadian Council on Learning, 2005). Learning is complex and cyclical. The know-how for effective communication involves information processing capacities based on psychological functions. Capacities in social cognition have to be added, namely as regards attitudes, attribution and group dynamics. Personal characteristics like perception, memory, reasoning, attention, etc. are key factors in learning (Keith, 1999; Jensen, 2016; Hargreaves & Fullan, 1998; Fullan & Langworthy, 2014). Teaching is successful when activation brings about the correct carrying out of a role or function. In learning one must apply and compare the meanings contained in new information against what one already knows and perhaps learn new words in order to understand patterns.

For Van den Branden (1997, 2005) our understanding of interaction comes from an articulation of perceptions and actions, and also taking into account and being influenced, whether consciously or not, by peers' actions and their perceptions.

In the same vein, as language is involved, Bygate (1987) sees two categories in the actual uttering of these learned contents. One being a taking-on of the understanding of how to do this. Plus, the second one, having to do with actually using the capacities in effective production, here this would correspond to the completion of tasks and activities in class.

To ensure better learning, it is crucial to take into account every learner's experiences and recognize the value of all the activities the learner engaged in, just as the Common European Framework of Reference for Languages (Council of Europe, 1996, 2009) prescribes. This way, less time is wasted by people having to sit in classes to see things taught they might already have learned before. Differing capacities of students have to be given recognition although the experiences took place in largely diversified contexts. So through the preparation for class ahead of time, students with different backgrounds can devote the amount of time they deem to be necessary and they can also branch off and carry out more research if their background requires it for the treatment of the data to be covered. Learning has to be goal oriented, with a concentration on actions, with the underlying understanding that there will always be a constant need to pick-up students who falter and put them back on track (Gibbs, 1988; Van den Branden, 2009).

2.2 Memory

Other researchers stress the importance of working memory in problem solving. They caution about choice of strategy, pointing out that the one most suited to a given problem and best fitting the problem solver's personality will yield the best result since personality traits and motivation play a defining role in the process (Davidson, 1984,1995). They say that, in addition, a curious person will try to find the strategy best suited for the task at hand and will also be able to look at both what is explained and what the reasoning is, separately, checking on the logic of things, so to speak. In the Ontario Education system (Ontario Ministry of Education 2013, 2014) a lot of effort is put forth to take into account needs for variability yet the approaches could still gain from further refinement. Researchers (Broch, 1966; Brophy, 1998; Currie, 1995; Amabile, 1996) also state that concentration increases when both creativity and necessity are present, therefore it would be clever to create situations accordingly. These two modes of mental functioning are independent and are used in survival contexts, so why not activate them for learning if the outcome would be improved.

2.3 Social context

Approaches in schools with diverse students working together, placing people with different ways of reflecting and problem solving, with also different cultural habits coming into play, are certainly advantageous for new ideas to emerge.

Hence it is recommended to ensure that the crucial environmental elements surrounding the task at hand be represented (Allport, 1961; Furman & Sibthorp, 2013; Lee & Kahnweiler, 2000). To learn better one needs to be able to decompose questions into sub-questions, to find connecting patterns and develop a capacity for the transfer of problem solving strategies from one application to another where it is deemed to be useful. The authors also think that playfulness can alleviate stress in problem solving and may bring about a different perspective rather than lead to a dead end.

This points to the very controversial discussion on transfer (Davidson & Sternberg, 2003; Davis, 1990; Davies & Stone, 1995; De Corte, Verschaffel & Op'T Eyne, 2000) . Some researchers do not believe in transfer and in one of my studies (Myers, 2012) I found that direct productive use was not directly taking place as a result of understanding a skill or having figured out how to act in a given context. Extensive practice of « an activation » of such skill or action was necessary. This further supports the flipped classroom approach in that it aims at repeated observations of the practice of a competence to be acquired and this can be carried out through all kinds of tasks. This supports the new trends in current findings.

2.4 Experience

Theories about new ways for academic learning are numerous yet mostly favoring experiential learning (Wurdinger, 2005; Canadian Council on Learning, 2009). With this in mind, it makes sense to assign students to groups to support each other and to provide active learning through a flipped-classroom approach with access given to information on-line. This way students investigate information, discuss it with their peers and should reach a good level of understanding before coming to class. Then in class meetings, one should follow up with an “embodied” activity but also add the requirement of a script to add more constraints and verify conceptual scientific accuracy. The “participate-reflect-apply” cycle appears as a three-stage process, but it is not rigid.

However new research shows that active mind activity is not sufficient for deep comprehension and anchoring content into memory storage. In addition to "input +1" (Krashen, 1982) i.e. a slightly higher level of difficulty in the data presented, what is also needed is “modified output” (Swain, 2005), that is serious work on that input at a rather high level of difficulty. In order to achieve this the task has to be more demanding, let’s say at least by one degree; it has to be a happy medium: easy enough for learners to be able to complete the task, yet demanding enough that effort and serious work has to go into it, "output +1" is the proposed formula. This way, students get some experience using the new information. The development of neural connectivity is activity dependent. This means that a lot of practice helps. In order to become proficient and successful in some area, it would then be good to use the same strategies, over and over again.

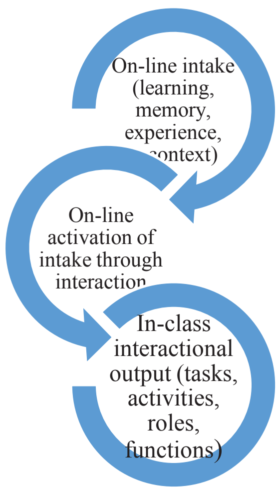

Figure 1: Proceduralization

3. Description of the study

The approach used in this study is ethnography (Denzin, 2013) as it is based on observation and it is qualitative in nature. The teacher researcher took notes of all relevant information on classroom procedures etc. in a reflective journal after each class. Analysis of the teacher's notes was carried out as follows. The findings were collated and grouped with similar topics grouped under one theme. Contents were analyzed and contextualized in light of the participant-researcher's experiences and knowledge of class procedure and student behaviors. The results below are based on the analysis of group work and flipped classroom characteristics. Care was taken to remain as objective as possible.

Flipped pedagogy was used in two classes conducted in the 2015-2016 academic year. In each class there were 26 students enrolled and classes met twice a week for two hours. In their course descriptions students had the list of documents, video, tables, graphs, to familiarize themselves with ahead of class meetings. The assigned task was for them to work in groups, prepare the materials, be critically reflective, in order to submit their summary of the materials, ask 3 questions or so, more if needed, fewer if the need was felt, and provide a novel idea, pushing the content beyond its limits.

The material for them to get familiar with were in You tube entries on key concepts, theoretical concepts etc., or other streaming in addition to on-line readings, including graphs, recounting of practical experiences, all mostly on theoretical content.

In order for the instructor to prepare for the class and plan further extension for in-class work, students were asked to send the result of their preparation work to the instructor by email, ahead of class and the questions the students had, were taken up in class and followed by activities.

The groups were constituted as follows. Students were asked to form work groups for each semester and six groups were identified in each class, for a total of 12 groups of approximately four or five students. Group work was intended to facilitate discussion, and to make them accountable to one another in the group.

4. Findings

4.1 Peers

Only six groups out of the 12 commented on group work. Out of the 12 groups, four groups reported that they felt they worked well together and among them, one group added that they liked working together and that there was also a good division of the work among them.

One group pointed out that they felt they had good ideas but they found it difficult to be very critical. One group would have liked to use the on-line discussion board. Another group suggested that the critical reflections and the novel idea entry, required to be sent to the instructor ahead of class, be postpone till after the class meeting when answers were provided by the instructor to the questions they had.

4.2 Preparation

Responses about assignments were obtained by 12 groups out of the 12. Six out of the 12 groups stated that there was too much to prepare. One group wrote that there was too much to read in order to be able to prepare thoroughly.

Among the other six groups one group stated that they had liked the videos. Whereas one group mentioned that they liked the readings and found them interesting, another group stated that they did not find them interesting. One group stated that they liked doing the preparations using the technology. However two groups reported having had problems with the technology, in one case they could not always access the websites, in another case they were not always able to connect at all. Another group felt that there were too many links to connect to.

One group qualified the class preparation activities as jigsaw readings, which had been neither required, nor suggested, but perhaps assigning parts of the preparation to different members in the group to make them the experts, allowed them to have good group discussions. However the idea was for every group member to prepare the material, only getting familiarized with part of it, was not what was intended nor was it in line with the underlying understanding for a flipped classroom approach.

4.3 Effectiveness

As regards the group just mentioned above it is clear that they worked well together and delegated responsibilities. However this could only have been effective if they all came together as a group and thoroughly shared their understanding of contents as well as their questions.

While most groups did not make mention of the amount they felt they learned, one group specifically stated that they liked summarizing the texts and other assigned contents to become familiar with, and felt that they learned from doing it.

One group suggested to add more practical oriented readings but did not complain about the assigned preparations; another group found that there was too much theory and these group members also suggested that more visual support would have been beneficial.

One group suggested making the questions to be submitted optional. In that group it was felt that they often understood everything and often had no questions. One group wanted to use the discussion board to improve the exchanges and perhaps for another reason they might have had but did not expand on it.

All student groups stated that they liked the follow-up activities.

4.4 Uneasiness

Some groups wanted changes in the flipped classroom procedures or perhaps did not care for the process at all. Two groups wanted to discuss the readings in class. Two other groups of students, instead of doing the summary of the materials to be prepared for class, wanted the instructor to provide the summary.

Another group felt they were not interested in listening to the answers to all the questions brought forward. Along the same lines another group suggested that when taking-up the questions, the feedback needed to be more organized, but they did not expand.

Yet another group supported the idea that the answers be taken up in class but wanted to postpone their response to the text (i.e. the graded assignment that included their summary, questions and their novel idea) until after the answers were taken up in class.

5. Conclusion

5.1 General comments

The instructor reading reports from groups submitted by email ahead of the class was intended in part to make them all complete the work and this way the instructor could also verify their understanding or gaps, if any, before the class meeting, in this case in a training course for French as a second language teachers.

It was clear that students did not always do the required work to the level expected. Some also took the opportunity provided by the new teaching format, not to attend class. This totally defeated the purpose of improved learning. It appears that thinking that students at that advanced level behave like mature adults wanting to learn, is obviously not true in all cases. In these courses, attendance was required as they were teacher training courses. We were told by the administration that some students in the classes already knew that they did not want to become regular teachers. For instance, one of the students wanted to be an arts' therapist and work with the aging population. However to obtain a teacher’s certificate in Ontario, they need to specialize in two subjects, so in this case my course was taken only to have the required second subject for certification.

The various comments made are indicative of a number of issues that have to be dealt with.

Some students were looking for shortcuts. It appears that perhaps some students did not want to do the preparatory work and suggested to discuss the readings in class instead of just taking-up the questions they had. Another group of students, instead of doing the summary of the materials to be prepared for class themselves, ahead of time, wanted the instructor to provide the summary. Some had no questions and did not push their thinking to find questions.

Some of the groups might have preferred to do the work by borrowing ideas from other groups during whole class discussions on the discussion board.

Some said that a lot of work was involved. In fact, some might have fallen behind and perhaps felt helpless. A lack of ability or insecurity could also have translated into the inability to really do the work well or not be able to do the work, as in the case of those who claimed they had no questions. They also asked to postpone their response to the text, (i.e. the graded assignment that included their summary and their novel idea) until after the answers were taken up in class.

They wanted to use the discussion board. The suggestion to use the discussion board in order to have access to everyone's reactions could reflect insecurity through the need to see others' answers. Although convinced that an exploratory approach is more interesting for students, some appear to be lacking confidence. The professional course is clearly making them face unfamiliar ways of doing things, face different professional jargon, different ways of being in the groups and in the flipped classroom which they were not used to.

There was a possible problem with technology. 10 groups had no problems with the technology but 2 groups did.

5.2 Recommendations

It would be a good idea to set up a discussion board for each group but not use the one set-up for the whole class. This would allow group members to interact in order to come up with the required summary of the prepared materials, yet not give them the capacity to use other groups' work to adapt and hand in as their own.

As well, they were required to provide at least three questions or more on the material and send them to the instructor ahead of time. In order to do this, they had to read the provided texts or at least someone had to carry out this task in the group even if all of them did not always contribute. This was necessary as it allowed the instructor to prepare for feedback and make the in-class follow-up meeting more beneficial. Students should be reminded regularly of the importance of preparing thoughtful questions and to collate the three or so most interesting ones from the group, as sometimes questions seemed superficial and in some cases even appeared to have been a quick last minute task carried out by one group member. It is also necessary to remind them of learning gains through distributed participation.

Pace was an issue. The students were allowed to join the groups they wanted for their in-class work and not necessarily stay with their class preparation group. After each class meeting during the first two weeks, the instructor reminded them that they could try another group. No-one moved to another group although some participants were slower. This pace issue needs to be monitored more closely over time. Placing the focus on the activity to be completed and giving groups different activities to choose from, might direct students to different peers based on their interest which may also get the groups to complete the activities faster. Perhaps a solution could be a programmed approach to learning with student groups only coming to meetings with the instructor when they feel they have grasped the material.

Perhaps the objective for providing a new idea for an application or a different situation as part of the assignment prior to class meetings was not understood in the context of transfer of learning and could have been explained better. However during each class the different novel ideas were read out, so in time they should all have understood the concept. So reading out the different contributions at the beginning of the class meeting is definitely a must.

Students should be made to feel the need to come to class and this could happen if there are specific gains to be had, which would have to be devised.

Developing meta-cognitive strategies further would enhance their ability to self-assess (De Corte, Verschaffel & Op'T Eyne, 2000) and make them engaged more in their own development.

For increased learning one needs to also improve upon motivation and gain better memory storage. Some of the group members did not appear as motivated as others and also had not retained all the key processes that they had worked through or that they were supposed to have worked through. There is clearly a need to present strategies for effective group work to them. Like for instance assigning them changing roles from one session to the next. Perhaps requiring them to have a responsible team captain to collate every group members' contributions weekly might ensure that they get a head-start and don't just work at the last minute. The university teaching and learning centre recommended group members evaluate each other's participation.

5.3 Conclusion

With learning by doing (Davidson & Sternberg, 2003) as the preferred approach, students will be more motivated to attend class. They also socialize and to meet their social group perhaps they should be encouraged to create a product that is to be sold. So there can be a financial gain had. Prizes or bonus points do not seem to be sufficient incentives any longer.

Another idea would be to have them sell the knowledge they gained and set up for professional consulting in a place where entrance fees could be collected.

One could also devise field trips, treasure hunts, organize a special guest invitation and other types of activities involving physical activity with the starting point being the classroom (Jensen, 2016).

Of course, due to the high tuition fees students are presently paying, they tend to come to class to get their money's worth from their contact with the instructor. However once in a fuller technological mode, this may result as wanting constant instructor's attention even from a distance and this will have to be included into the division of tasks of university professors.

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Towards a Blended Strategy for Quality Distance Education Life-Long Learning Courses: The Patras Model

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Abstract: The utilization of Technology Enhanced Learning and more specifically of Distance Education for Life-Long Learning and Continuous Professional Development are at the epicenter/focus of European policies for the improvement of the delivery of Vocational Education and Training. In this context, one of the important challenges is the design of versatile quality assurance strategies for training; providers that can guide the development of eLearning programs that achieve real impact in the participants' lives. The University of Patras has launched a project for the provision of short, accessible, certified distance life-long learning programmes. The main pillars of this project are Excellence, Specialized Personalized Training at cutting edge subjects, Quality, Deep Learning and Innovation. Quality is perceived as a vibrant, dynamic process that is evaluated in the eye of the beholder (learner). Deep Learning goes beyond (superficial) knowledge increase: it aims at the development of transformative knowledge, meaning and metacognitive skills. In this study we identify, propose and evaluate preconditions, criteria and strategies to achieve high quality blended learning online courses based on the relevant experience of the University of Patras' Educational Centre for Life-Long Learning (KEDIVIM). We present the methods used to assess the quality of the eLearning programmes, key findings of the evaluation process as well as early results of a research study on the quality of learning. The formative evaluation process was conducted by external assessors based on Context, Input, Process, Product approach. The evaluation instruments were online questionnaires, structured and semi-structured observation. The research study on quality was conducted by using an online questionnaire and aims at estimating the level of participants satisfaction using interactive learning methods such as collaborative learning. Early results of the study suggest that the project lead to the rapid provision of eLearning programmes that used successfully active learning methods to achieve high learner satisfaction and address training needs and skills gaps.

Keywords: elearning, distance education, blended learning, technology enhanced learning, life-long learning, deep learning

1. Introduction

The adoption of Technology Enhanced Learning has been widely recognized as a critical success factor for education in the digital era. European Union's Digital Agenda strategy encouraged the mainstreaming of eLearning for all subjects in all levels of education in the national policies of all member states (European Commission, 2010; Hernández-Ros, 2012). Subsequently, the EU's Digital Education Action Plan prioritizes the digital transformation of teaching and learning (European Commision, 2018). The constant development of new technologies and their applications influenced job market changes and trends and demonstrated the need for continuous professional development and upskilling. The latter is especially evidenced in the field of vocational education and training (European Commission, 2016a), where there has been created an emerging, dynamic field for Distance Life-Long Learning (LLL). According to a recent study, Distance Education is growing rapidly and was estimated to represent approximately 30% of the total education provision in Europe (Schneller and Holmberg, 2014). The European Centre for the Development of Vocational Training in its key policy priority "quality of VET delivery" links quality of learning directly to Technology-Enhanced Learning (CEDEFOP, 2016). In this context, LLL has been emphasized as a key policy objective in the Education & Training 2020 strategic framework (European Commission, 2016b).

Traditional and emerging training providers utilize distance education in order to offer life-long educational services to audiences far wider than those approached through traditional, classroom-based method. Further online learning is considered as critical for future long-term strategy by 70,8% US universities (OLC, 2014). This process open vast opportunities for the creation of flexible, agile and customizable educational programmes in a cost-effective way.

Training providers face the multi-faceted challenge to transition into a new and often unknown operation mode taking into account all aspects that influence learning quality such as the following: i) proper application of administrative procedures, ii) effective instructional and learning design, iii) sound use of media and materials, iv) the appropriate choice and utilization of technological applications and platforms, v) the certification of knowledge and skills, vi) the smart talent recruitment and onboarding, as well as vii) the optimal human resources management.

Several higher education institutions with aligning strategic approaches, experience, means and capabilities have undertaken the task to bridge higher education with LLL, continuous professional development, corporate training and vocational education and training by applying distance and blended learning methods. In the next sections we will present the relevant recent experience of the Educational Center for Life-Long Learning (KEDIVIM) in the University of Patras, in Patras, South-Central Greece.

2. Background: University of Patras distance life-long learning strategy

The University of Patras has a long track record in the adoption of innovative action in education and learning partly due to its strong technological component but also to its progressive culture. In 1995 the University of Patras founded its own Centre for Vocational Education and Training (KEK). KEK operated in fields of excellence where the institute's personnel had demonstrated rich experience, national and international presence through scientific, research and professional expertise. It implemented subsidized, national and European programmes, as well as self-financed actions and also open and free training courses. Following a new national higher education legislation, in 2018, KEK was transformed into the Educational Center for Life-Long Learning (KEDIVIM). Since 2014 KEK/KEDIVIM deployed the University of Patras' strategy project for Distance Life-Long Learning through the development of eLearning courses and programmes so as to offer "Smart, Certified Life-Long Learning for All".

Analyzing the project's philosophy, the label "smart" in the tag line on one hand refers to the flexible distance delivery of LLL and training courses open to the public, graduates, professionals, executives and employees. On the other hand it reflects a sophistication in the identification and expert choice(s) of the field(s) and subjects with high added value for the participants. The emphasis on certification reflects the focus on delivering high quality educational services that lead or are connected and correspond to the requirements of certification schemes determined by national or international bodies. Finally, the phrase "for all" expresses the conscious choice to facilitate the access and participation in the programs of as many as possible interested citizens, businesses and organizations, in multiple ways.

The two essential axes of the project are *Excellence* and *Specialized, Personalized Life Long Learning and Training* in cutting-edge subjects. These axes ensure that participants will be empowered to develop their knowledge and skills, enhance their professional profile and acquire competitive advantages in the job market.

For the sustainable attainment of the two above goals, three pillars have been selected as foundations for the design of University of Patras' eLearning courses: *Quality*, *Deep Learning* and *Innovation*. These three concepts need further explanation in the realm of distance education.

3. Rationale: Quality, deep learning, innovation in blended learning and distance education

Quality is a rather 'elusive' concept with multiple dimensions and varying definitions depending on time, geographical location and contextual factors such as economy, policy and culture (Harvey, 2009). While there is no single, unanimous definition of quality, in the context of this paper we accept the definition of quality as the degree to which a sum of endogenous characteristics satisfies set requirements (International Organization for Standardization, 2015) by the quality stakeholders (Berki, Georgiadou and Holcombe, 2004). In education, specifically, quality is associated with effectiveness, efficiency, equality, relativity and sustainability (Barrett *et al.*, 2006) and the way these influence learners, instructors and other stakeholders.
Deep Learning or deep processing in education encompasses the achievement of transformational knowledge, meaning and metacognitive skills (Marton and Säljö, 1976). Deep learning is positioned in the opposite spectrum

of surface learning (or surface processing) as a quantitative increase of knowledge (Marton and Säljö, 1997). It is directly linked to manifold thinking and, in particular, creative, critical and reflective thinking (Valtanen *et al.*, 2008). The achievement of deep learning is an even more challenging factor considering that the learner is the key stakeholder in distance education settings and where the learners isolation is an inherently inhibiting factor (Tyler-Smith, 2006).

Innovation is a dynamic priority for constant (both gradual and disruptive) change signals in distance education that focus on the identification, experimentation, evaluation and adoption of novel methods, environments and tools for learning, which improve quality and facilitate deep learning in the quest for excellence and personalized LLL.

According to various research studies' findings and reviews, distance education when designed, planned and implemented with an appropriate blend of pedagogical approaches, methods and technological means is equally effective and in some specific cases more effective than classroom-based instruction (Means *et al.*, 2010; Siemens, Gasevic and Dawson, 2015).

Therefore, for the achievement of the aforementioned three pillars, the University of Patras' eLearning courses are delivered using the *blended learning* model. Thus, the courses combine two or more of the following modes of learning: i) classroom instruction, ii) asynchronous eLearning (flexible self- and group study, production of individual and team assignments and projects), iii) synchronous eLearning (live meeting(s) with instructors and co-participants in a virtual environment); iv) social learning (informal, emergent learning). See e.g. Valtanen *et al.*, 2013; Mystakidis, Berki and Valtanen, 2017; Mystakidis and Berki, 2018.

4. Blended strategy for quality distance education – The University of Patras model

Reviewing quality assurance in education, we can identify approaches that focus on different aspects of quality. Some strategies focus on the system's internal structure considering internal stakeholders such as learners and instructors and examine whether specific measurements are consistently met. Other approaches assess the effect(s) of the system in question towards exterior recipients (e.g. customers, external stakeholders) and their satisfaction. Finally, alternative strategies correlate quality with the achievement or specific threshold or standards of excellence (Van Damme, 2000).

In KEDIVIM along with its strategic focus on excellence, quality is perceived as a live, vibrant process that is estimated in the eye of the beholder (learner), and not as a static object. For the purposes of quality assurance in educational or/and administrative processes we take into account the inputs, the outputs as well as the involved actors' feedback. Especially in the eLearning courses, quality assurance guidelines and policies are shaped, informed and updated by international schemes, models, quality labels, and good field practices.

International eLearning Quality initiatives such as ECBCheck, EFQUEL, E-xcellence and Epprobate offer the opportunity to the eLearning providers to assess internally or audit externally all aspects of eLearning courses' provision and courseware (Vlachopoulos, 2016) such as a) Information about and organization of the program, b) Target Audience Orientation, c) Course Design and Methodology, d) Learners' Motivation, e) Collaborative Learning, f) Assignments & Learning Progress, g) Assessment & Tests, h) Quality of Content, i) Media Design, j) Technology, k) Evaluation & Review.

The University of Patras' KEDIVIM blended strategy for quality eLearning programmes is realized through the fostering of a mixed culture of quality attributes, self-evaluation and innovation components in the following ways: i) Active commitment to quality and excellence empowerment on and for all levels (executive/top, managerial/middle, operational/low), processes and personnel; ii) the establishment of flexible/agile frameworks with clear procedures for all the life-cycle stages of the programmes; iii) resolutions to seek and willingness to accept feedback for improvement from various internal and external actors/stakeholders; iv) identification and dissemination of good practices, internally and externally.

More specifically, the University of Patras' blended quality LLL programmes model inspired by Morrison, Ross and Kemp, 2006 includes the following processes in five stages:
Stage I – Analysis & Initiation: Interested university faculty members or course leaders receive templates and guidelines to prepare the application of new LLL programmes in collaboration with KEDIVIM's personnel. Each

submitted application is examined and approved by KEDIVIM's Council. One essential evaluation criterion is the programme's sustainability and correspondence to existing or anticipated learning or certification needs. Also, apart from subject-matter expertise and experience, an essential course leader selection criterion is experience in distance education and certification in professional eLearning.

Stage II – Design & Development: In this phase, course leaders or instructors without experience in professional eLearning are expected to prepare themselves by experiencing and participating in an eLearning trainers' crash-course. One outcome of the course is the elaborated design of their new LLL programme. In this process, one quality measure is safeguarding the selection, formulation and commitment to adequate and achievable learning outcomes with an effective mix of learning activities, usually in various, blended modes. Simultaneously starts the flexible development of the learning environment, activities and materials for the new study programme. This can be produced usually by the members of the course teaching team with the guidance of KEDIVIM's professional staff or external collaborators.

Stage III – Marketing: At the same time, KEDIVIM prepares relative communication material and, upon completion of Stage II, starts the marketing campaign of the new eLearning program using a variety of media so as to reach the identified target audience. Here we highlight special considerations for sensitive population groups.

Stage IV – Implementation: After the minimum number of participants is reached, starts the implementation of each course iteration. Pilot iterations of courses are early encouraged. Special attention is given to the detailed onboarding of all registered course participants so as to ensure smooth participation without any technological or motivational barriers.

Stage V – Evaluation: Internal or/and external assessors evaluate the programs formatively and summatively based on the Context, Input, Process, Product (CIPP) model (Stufflebeam, Madaus and Kellaghan, 2006). Course leaders and KEDIVIM's management receive the formative and summative evaluation results to intervene rapidly whenever necessary or improve aspects of subsequent course iterations respectively.

Following, we will provide more information on three important aspects of the described processes; (i) the elaborated training, coaching and mentoring framework for professors and trainers that are new to distance education, (ii) the evaluation of the eLearning courses, and (iii) participants' onboarding.

Figure 1: Synchronous meeting in teachers' training

(i) Instructors, tutors and trainers in the University of Patras' eLearning courses are expected to exhibit advanced techno-pedagogical competences in distance teaching and learning according to the TPACK model (Koehler and Mishra, 2009). They are expected to identify the learners' needs and involve them in the curriculum focus of each course instance (Brinthaupt and Fisher, 2011). One basic goal is to combine elements and active learning techniques from three generations in distance education (Anderson and Dron, 2011) to contribute to the formation of a virtual community of inquiry and practice (Wenger, 1998). Course leaders and instructors have the choices to (a) participate in an experiential 8-week crash-course on eLearning course design, development and teaching (Figure 1), (b) prepare learning activities, lesson plans and lead synchronous meetings with the direct collaborative involvement and presence of a coach, and (c) young trainers can seek support and informal guidance to improve learning from mentors, more experienced practitioners.

(ii) An integral part of the quality assurance process is the systematic inquiry of the effectiveness of the course, the evaluation of distance LLL courses (Rossi, Lipsey and Freeman, 2004). For the evaluation we used the general quality indicators categories proposed early by the European Union, that are: *relevance, synergy, compatibility, effectiveness, efficiency, sustainability, impact, flexibility* (European Commission, 1999). According to the CIPP model, we evaluate three axes, the supportive framework of the course (infrastructure, content, support, coordination), trainers (teaching performance), and course implementation (learning methods, results). The evaluation takes place during and after the end of each course.

(iii) The participants' onboarding process includes all the necessary steps to help the learners' confidence and fluency with all the learning tools, platforms and methods; first they receive detailed instructions in text and video; second they are invited prior to the start of the program to attend to at least two test meetings, where they have the opportunity to use all the available tools and prepare for all upcoming activities. In case of technical problems in that stage or during the course, they can contact technical support personnel via email, voip systems or telephone.

5. Research questions and methodology: Evaluation and assessment procedures

In order to assess the performance of the measurements of excellence in KEDIVIM's eLearning course design and delivery, we conducted a mixed research study. The study aimed to answer the following research question:

How were the participants' perceptions and experiences in the University of Patras Distance LLL programmes while using a blended quality strategy for teaching and learning?

The research was conducted in two stages. In the first stage, we combined data from the formative and summative evaluation of the University of Patras' LLL courses that KEDIVIM delivered from January to December 2017. Data collection instruments for each course evaluation were (i) anonymous online questionnaires that participants completed voluntarily; the formative in the middle of the course, and the summative after its implementation, (ii) structured and semi-structured observation for virtual, synchronous and face-to-face meetings. The formative and summative evaluation questionnaires consisted of closed and open-type questions, 82 and 41 items in total, respectively. They featured 39 and 27 quality indicators respectively (66 in total) on all aspects of the course's design and delivery. The quality indicators were formulated either as an overall course component (e.g. assignment feedback) or as an individual trait (e.g. motivation provided by a specific trainer) to be rated in a scale from 1 to 5 (none, low, moderate, very good, excellent). The formative questionnaire included a section on participants' demographic data. The data was analyzed both quantitatively and qualitatively. Closed questions were analyzed statistically while open-ended questions were further processed utilising content analysis' techniques (Cohen, Manion and Morrison, 2007).

We collected and combined data from 17 evaluated trainers' training courses in the field of Educational Sciences with 318 total participants. These courses were delivered by 16 members of the training personnel in various roles and with distinct or shared responsibilities. Seven of them had no previous experience as trainers in distance education. Each course featured at least 5 trainers and had a duration of 8 to 16 weeks. All courses were delivered using blended learning and had overall a completion rate of 84.91%. In particular, we analyzed 182 responses from the formative and 158 responses from the summative assessment questionnaire, respectively. The majority of the participants in this study were female (69%). As far as age is concerned, the two main categories were 25-34 years (56%) and 35-44 (23%). Concerning their level of education, almost all held a higher education degree (97%) while 37% had an additional postgraduate degree. The participants had various backgrounds, the strongest representation being Economy & Management (22%), Humanities (21%) and Natural Sciences (15%). The majority are at the beginning of their professional life, with zero (13%) or less than ten years of professional experience (55%). In this context, 67% currently work while 33% are at the job search. Their main motivation is the improvement of their place in the job market (starting a job, CV improvement, extra income, promotion).

At the second stage, in collaboration with Hellenic Open University, we participated in an ongoing study on eLearning courses' participants' views on peer communication and collaborative learning for learning quality (Batsila, 2018). The study postulates that peer communication among learners and active learning methods such as social, collaborative learning are factors that can have a positive effect of the quality of distance LLL programs

(Ossiannilsson *et al.*, 2015). The study used an anonymous online questionnaire consisting of three sections; (a) demographics, (b) general views on communication and collaborative learning, (c) inhibiting factors for collaborative learning. It had a total of 36 closed type questions using mainly a five-point Likert scale on the degree of agreement. The study took place between January and April 2018. KEDIVIM's participants from the above past courses were invited by email to participate in the survey in April 2018, i.e. 4 to 12 months after the end of the courses. 66 out of KEDIVIM's 318 contacted participants completed anonymously and voluntarily the online questionnaire. The survey received 157 responses in total. Early data analysis led to relevant findings supplementing the first stage. All questionnaires and responses in both phases were written in Greek language. The translation into English was carried out by one of the authors.

6. Research results

6.1 Formative and summative evaluation results

6.1.1 Statistical analysis

Key findings on participants' satisfaction on quality from the evaluation process were the following:

(i) all 17 LLL courses met the overall participants' expectations (cumulative Mean=4.63; SD=.656)

(ii) 34 of 35 quality indicators concerning overall aspects of the course (Table 1) received very favorable ratings with average ratings ranging from 4.27 to 4.65. Aspects with the highest satisfaction rates were live meetings, technical support, content, assignment usefulness, organization.

Table 1: Main quality indicators concerning overall aspects of all courses

Quality indicators	Mean	St. Dev.
KEDIVIM's Organization	4.39	.655
Learning Material	4.46	.682
Synchronous Learning	4.47	.677
Asynchronous Learning	4.31	.760
Assignments Feedback	4.29	.857
Technical Support	4.63	.656

(iii) The overall quality indicator that received the lowest rating was Time Allocation (Mean=3.65; SD=.945). The qualitative analysis of open questions revealed details in depth.

(iv) All 31 individual indicators concerning the trainers' performance (Table 2) revealed very high quality with means ranging from 4.48 to 4.91.

Table 2: Main quality indicators concerning individual aspects of teaching performance in all courses

Quality indicators	Mean	St. Dev.
Synchronous Learning Trainer (SLT) Knowledge	4.83	.404
SLT Active Teaching	4.79	.517
SLT Trust	4.76	.539
SLT Motivation	4.66	.614
Asynchronous Learning Trainer (ASLT) Knowledge	4.74	.499
ASLT Active Teaching	4.60	.677
ASLT Trust	4.57	.674
ASLT Motivation	4.48	.732

6.1.2 Qualitative analysis

(v) Analyzing the responses to the open-ended items in the questionnaires, participants expressed their satisfaction for their learning progress and achievements as it was recorded in the ratings. Participants with experiences from similar courses praised both orally to the trainers and in their written comments the superiority of KEDIVIM's courses.

> *"I have no improvement suggestion. The program was very good and in comparison to courses from other universities e.g. (name), University of Patras' program is far superior in all aspects and especially in regards to microteaching".*

(vi) The biggest challenge that was reported by participants in certain programmes was the lack of time to participate in various aspects such as attendance to all synchronous meetings, study of the theoretical materials and completion of mandatory assignments, in alignment with the survey finding (iii). Thus they suggested longer course durations. This was an anticipated issue in LLL of adults who work and have additional roles and obligations. As this issue was detected very early, we countered it with increased flexibility and personalization in course deadlines as well as positive reinforcement in the communication.

> *"Concerning time, I would prefer the course to have a bigger duration."*
>
> *"The time allocation should be better. Time spans among virtual meetings and assignment deadlines could be longer so as to allow for better study of all units".*

(vii) Another interesting finding was the total lack of mentions of technical problems and frustrations, a frequent phenomenon in eLearning courses. This is consistent with the very high satisfaction rate with the technical support (AV=4.63; SD=.656). This fact exposes the successful selection of suitable technologic platforms, their smooth operation and above all, the effectiveness of the onboarding learning process.

6.2 Learning quality study results

(viii) The early analysis of the provisional data suggested that the delivery of the University of Patras' eLearning programmes used successfully peer and active learning methods to achieve high learning quality, learner satisfaction, confidence and optimism. First, despite the considerable long period since course completion and the rudimentary communication effort, the response rate (20.75%) reached levels significantly higher than the empirically reported averages in distance education programmes participants' surveys in Greece, which are around 5% (Batsila, 2018). This could be interpreted as an indicator of appreciation and trust; they did not just complete a course and ran away. This observation is consistent with responses to question item 40 of the summative questionnaire; 78% would be interested in participating in future eLearning courses provided by the University of Patras.

(ix) Moreover, 83.3% of KEDIVIM's respondents in the study confirmed that the communication among the participants was encouraged and facilitated. Further, 66.7% reported that collaborative learning took place during their course. In contrast, only 55% and 41.7% respondents from other Greek institutes and training providers reported the existence of peer communication and collaborative learning respectively.

(x) This experience led to another interesting finding in parts B and C of the survey. The University of Patras courses' participants responded significantly *higher* (stronger degree of agreement) to all six "positive", "optimistic" statements in part B on the value, feasibility and importance of the aforementioned two factors for the quality of learning. Reversely, in part C, they responded consistently *lower* (weaker degree of agreement) to 21 out of 24 "negative" statements about problems and troublesome conditions that can hinder collaborative learning.

7. Conclusions and summary

Evaluation and data analysis from completed eLearning courses revealed that the University of Patras' blended quality strategy had an overall positive effect. All aspects of learning quality regarding design, development, content, personnel, media, platforms, organization, implementation and communication were confirmed. Teachers in both synchronous and asynchronous settings performed at a very high level in accordance to respective environments' affordances. Participants expressed high satisfaction in KEDIVIM's distance life-long learning programmes that met their expectations.

The early findings from the research study on learning quality support the claim that the perceived quality in the eyes of University of Patras' distance LLL program participants was high, possibly higher than those experienced from other institutes. This can be attributed also to the successful use of peer and active learning methods. The courses' participants (and survey's respondents) also appeared to be more confident and optimistic both by recognizing factors for learning quality improvement (process improvement, in particular) and not being intimidated by potential obstacles in peer collaboration.

8. Limitations and Future research considerations

The empirical evidence of the current study needs to be extended in order to obtain a thorough picture of the Patras model. Thus, survey results are needed also from more courses with (perhaps) different durations from all disciplines in order to validate the sustainability of the quality strategy, possibly also among participants from different ethnicity and culture. Also, concerning the study's research design, other instruments such as focus groups or unstructured interview could possibly reveal different data and information. Finally, we consider extending the current study in the direction of assessing the impact of the current, blended quality strategy on teaching performance, learning quality and participants' satisfaction in the University of Patras distance LLL programmes.

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The Relationship Between Student's Characteristics and Online Discussion Activity

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Abstract: The effectiveness of online discussions during learning activities was examined using a large group of freshmen students at a Japanese university. The course content was the discussion of disaster prevention, and the approach adopted was intended to develop "critical thinking" skills. The course sessions consisted of case presentations and online discussions which used a bulletin board system. In the hypothesis that participant's characteristics might influence their behaviour in a learning activity and their performance, these were measured by using paper-based questionnaires. The metrics were concerned with "critical thinking", literacy of science and technology, rationality, and personality. The online discussions of each topic and of every participant were recorded. The features of online discussions, such as the frequency and the length of texts posted by the participants according to their discussion topic, were extracted from using a lexical analysis technique. Participants were divided into two groups according to the frequency of their postings. In the results, the mean frequency of postings was greater than 2 in the group of participants who posted, and in most online discussions the participants submitted multiple posts. The factor scores of the two groups surveyed were compared in order to extract the contributions of the individual characteristics of the freshmen students. The results showed that there was a significant difference in the factor scores for metrics such as "critical thinking" and personality. The relationships between task performance and frequency of postings were also analysed.

Keywords: online discussion, blended learning, critically thinking, student's characteristics

1. Introduction

Scientific literacy is essential in all societies. The ability to discuss risks and outcomes is necessary in natural disaster mitigation, for example (Höppner et al 2012). Because of this need, several scales were developed to survey and compare levels of scientific literacy according to location or country (Kawamoto et al. 2013). Although an appropriate educational methodology for developing this ability in students has not yet been perfected, several educational programs are currently introducing discussions in a science café of sorts, where students develop communication skills, "critical thinking" procedures and other abilities, such as "key competence" (Rychen and Salganik 2003) which is the same concept as "generic skills". Generic skills consist of critical thinking, analytical reasoning, problem-solving, and communication writing abilities (OECD, 2014). "Critical thinking" is defined as having participants practice expressing their own thoughts through discussions with peers. There are, however, some challenges that go with organising these activities, such as how to provide the opportunity to discuss a specific topic, or how to develop a participant's skills. In particular, during formal lectures it is not easy to organise student discussions due to the size of the hall and the numbers of participants.

One of the authors introduced an online discussion activity into a LMS-supported blended learning course, and the learning performance of participants was then evaluated. As online discussions have been introduced to large scale e-Learning courses such as MOOCs (Trehan et al 2017), a certain level of educational effectiveness could be expected. Student's progress in developing the ability to discuss specific topics with peers in online discussions should be measured carefully, and evaluated using a formative assessment of the educational activity. In general, participant's characteristics should also be considered because they may affect learning behaviour during e-learning courses (Nakayama et al. 2017). The contributions of factors such as participant's characteristics, online postings and learning activities on the LMS should be also considered in order to better understand the learning behaviour of participants.

In regards to the factors mentioned, above the following points are to be confirmed in this paper.

- The characteristics of participants, such as personality and literacy, affect some generic skills such as attitude toward "critical thinking".
- Online discussion activities are influenced by participant's characteristics, and the activity also contributes to learning performance.

- The relationships between participant's behaviour and learning performance should be summarised structurally.

These topics will be discussed using the analyses of survey data from a blended learning credit course.

2. Method

2.1 Blended learning

The survey was conducted during a blended learning course at Japanese University. The course subject was the Psychology of Natural Disaster Mitigation and Prevention, and most participants were university freshman in various faculties. Though the content of the course was mainly psychology and the discussion of various topics, the implicit objective was the development of "critical thinking" skills. As mentioned in the introduction, online discussion activity monitoring using methods more progressive than many that are currently employed were introduced to evaluate participants' learning performance during the course. The course consisted of 15 weeks of fact-to-face sessions and included a Moodle based LMS which provided an online discussion board. Since the course was taught as an academic credit, every session required the completion of assignments such as writing comments, or summarising reports of specific topics, in order to evaluate learning performance. The LMS also accepted student's task reports and presented assessment scores which had been given by the lecturer.

The online discussion was usually monitored and supervised by the lecturer and all content posted was readable by everyone. Since discussion was promoted as providing students with reward points for their learning activity, students were well motivated.

Most sessions asked the participants to present their assignments to the LMS. All submissions were evaluated by the lecturer and student's scores were accessed using the LMS. Therefore, all participants could readily obtain the results of their assessments. The total number of valid participants registered in this course was 215.

2.2 Survey metrics

In addition to the formative assessment scores for the assignments evaluating learning performance, the following characteristics of students were measured in order to understand the behavioural part of their "critical thinking" ability during the course.

2.2.1 Personality (Big5)

Scores of participant's personality were measured using a shortened version of Big5 inventories (Namikawa et al. 2012). The factors are Extroversion (P1), Agreeableness (P2), Conscientiousness (P3), Neuroticism (P4), and Openness (P5). The factor scores of Big5 are 7-point scales (1-7).

2.2.2 Critical thinking disposition (CTD)

Hirayama and Kusumi (2004) have developed a Japanese inventory of behaviour exhibited during critical thinking. Four factors were extracted from the inventory, such as Awareness of logical thinking (CTD-1), inquiry-mind (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 were also scored using a 5-point scale.

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 science literacy survey. It consists of 10 questions, from which four factors were extracted from the answers, namely Life-centered (LST-1), Sciencephile (people who are interested in science and technology) (LST-2), Logic-oriented (LST-3), and Authoritarian (LST-4). LSTs were scored using a 4-point scale (1-4).

2.3 Student group classification according to online discussion activity

The course provided online discussion opportunity with LMS beyond a face-to-face session in the classroom. All participants did not join the discussion, although the lecturer encouraged them to join in order to obtain the opportunity to think critically about something. The phenomenon suggests that the attitudes of active and non-active participants was completely different regarding the online discussion. Therefore, the participants were classified into two groups by using the frequency of postings of each active and non-active online discussion participant. The details of the grouping procedure are explained in the Results section, and are based on an analysis of the frequency of postings. To extract the differences in participants characteristics, measured metrics between the two groups were compared.

2.4 Causal analysis

For the purpose of this paper, it is necessary to extract the relationships between measured metrics which affect other variables. Simple correlation analysis may suggest that relationships exist between of variables. Further study of mutual relationships between multiple variables required structured quantitative analysis, such as causal analysis of students' characteristics (15 variables), behaviour during online discussions (2 variables) and learning performance (14 variables). In a preliminary analysis, correlation coefficients between all variables were summarised in order to extract the contributing variables. Also, one group which consisted of active online discussion participants was analysed once metrics of online discussions were introduced.

A causal analysis was conducted using a structural equation modelling (SEM) technique (Kline 2005) in order to examine the relationships between the metrics mentioned above. 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).

3. Results

3.1 Statistics of questionnaire surveys

Various factor scores were calculated, and the results are summarised in Table 1. All of the means are distributed around the middle points, and their standard errors also are not large, except for a few factors. In particular, most scores for CTD and LST are relatively high. Some participants may have sufficient "critical thinking" ability and be tech savvy.

Table 1: Statistics of metrics (N=215)

		Mean	STD
CTD (1/5)	CTD-1: Awareness for logical thinking,	2.91	0.66
	CTD-2: Inquiry-mind,	3.8	0.62
	CTD-3: Objectiveness,	3.56	0.55
	CTD-4: Evidence based judgement	3.5	0.59
Big5(1/7)	Extraversion	4.19	1.08
	Agreeableness	3.45	0.81
	Conscientiousness	4.42	0.9
	Neuroticism	4.73	1.11
	Openness	4.06	0.78
LST(1/4)	Life-centered	2.85	0.54
	Schiencephiles	2.96	0.81
	Logic oriented	2.61	0.66
	Authoritarian	2.49	0.52
IPS(1/5)	Rationality	3.19	0.55
	Intuition	3.02	0.52

As mentioned in the introduction, the purpose of this course is to develop the ability to think critically. The scores, as shown in Table 1, may have been affected by other individual characteristics. To determine this hypothesis, a simple correlation analysis was conducted.

Table 2: Correlation coefficients between factors of metrics (N=215)

	CTD-1	CTD-2	CTD-3	CTD-4
Extraversion	*0.00*	**0.35**	*0.02*	**-0.18**
Agreeableness	**-0.38**	*0.07*	*-0.13*	**-0.23**
Conscientiousnes	*-0.13*	*-0.07*	*0.00*	*0.09*
Neuroticism	**0.45**	**0.33**	**0.20**	*0.04*
Openness	*-0.13*	**-0.17**	**-0.35**	*0.01*
Life-centered	*-0.01*	**0.28**	**0.18**	*0.00*
Schiencephiles	*0.09*	*0.12*	**0.14**	**0.16**
Logic oriented	**0.38**	**0.15**	**0.29**	**0.23**
Authoritarian	*-0.04*	*-0.08*	*0.02*	*-0.07*
Rationality	**0.57**	**0.30**	**0.40**	**0.32**
Intuition	*0.00*	**0.24**	*0.11*	*-0.11*

CTD-1: Awareness for logical thinking, CTD-2: Inquiry-mind,
CTD-3: Objectiveness, CTD-4: Evidence based judgement

Table 2 summarises correlation coefficients between the four factor scores of CTDs, Big5, LST and IPS. Here, significant coefficients are displayed in Bold face, and some participant's characteristics correlate with factor scores of CTDs, such as personality (Extroversion, Neuroticism, and Openness), LST (Life-centered, Logic oriented) and Rationality of IPS.

In regards to the results for Neuroticism, three out of four factors for Literacy of Science and Technology, and Rationality significantly correlate with scores for “critical thinking” (CTD). Therefore, students’ characteristics may contribute to the development of “critical thinking” ability.

3.2 Online discussion activity

The posted messages were analysed for posting frequency per individual, the number of topics posted in, the number of discussions and mean lengths of posted messages. In total, 65 threads were created by participants. Since the posting activity for bulletin board discussion was evaluated as a learning activity, some participants were mindful about posting in the last stage of course. In total, 5 threads were established every week for 13 weeks. The number of postings by each participant was counted and the total number of the participants was 82. Over one third of the participants joined the online discussions. The length of the messages was also measured when the online discussion texts were recorded by the LMS. The remaining participants never posted any messages on the bulletin board on the LMS. The posting activities of participants were used to classify participants into two groups: the posting group (N=82) and no-posting group (N=133). The following analysis was conducted on the posting group.

The mean lengths in characters of posted texts are summarised in Figure 1. The horizontal axis indicates the number of postings per individual, and the vertical axis indicates the mean lengths of posted texts. The number of participants is displayed at the top of the graph. A few participants posted as many as 23 messages, but two participants were used to indicate means in order to avoid the possibility of irregular data. This result suggests that most participants joined some threads for a short period of time, since most participants posted less than 6 times. The lengths of posted messages remained at almost the same level, around 200 characters.

As these posting activities may have been affected by participant's characteristics, the relationships between posting activities and participant's characteristics were examined. In regards to the results of correlation analysis, the factor scores for neuroticism and agreeableness in the Big5 personality inventory correlate significantly with the number of postings and the lengths of posted messages. Also, the factor scores were compared between groups of participants who posted and did not post, and there is a significant difference in intuition for IPS-2 ($t(265)=2.46, p<0.05$).

In regards to the results of the correlation analysis between posting activity and participant's characteristics, there are significant negative correlations between the number of postings and the factor scores of Evidence-based judgement (CTD-4) (r=-0.24), and there are positive correlations between the sum lengths of posted messages and Neuroticism (P4) (r=0.24).

Though students' submissions to commercial SNS bulletin boards were very active, it should be noted that the online discussion for this course may have been moderated. The lecturer also participated in the online discussion, as it was a part of the course.

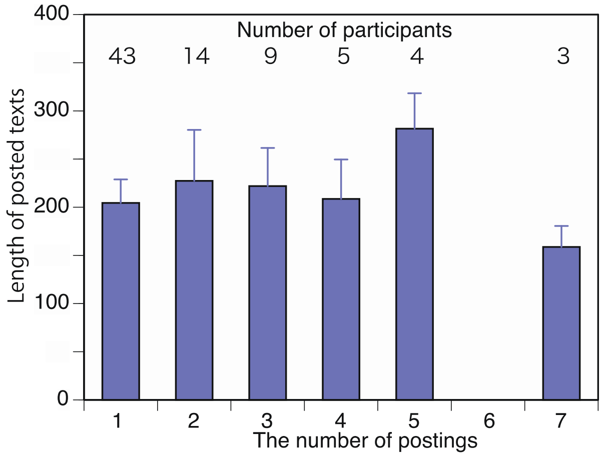

Figure 1: Comparison of lengths in characters of posted texts

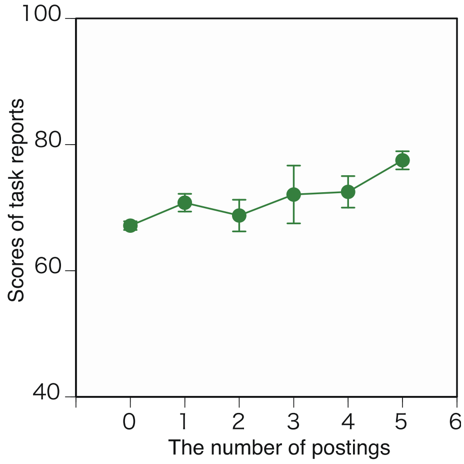

Figure 2: Scores of task reports and numbers of postings

3.3 Task assessment

During the course, all participants were asked to complete thirteen tasks and to present their work each week. The workload of the task varied according to its contents. The sum of all task responses was used to evaluate learning performance and was used for the final grade. Evaluating two topics was sufficient to measure participants efforts regarding the task, so the lecturer assessed two of the tasks completed by each student. This assessment is defined as the score of the task reports.

The task scores between the two groups (posting group vs. no-posting group) were compared, and there is a significant difference between the participants who posted and those who did not ($t(183)=2.82$, $p<0.01$). In addition, the relationships between task scores and the number of postings are illustrated in Figure 2. The scores increase gradually along with the frequency of postings. On the other hand, their task scores were not influenced by the characteristics of other participants, such as personality, literacy etc. The results suggest that participants who are proactive learners are already inclined to join the online discussions. Both the range of scores and the deviation in the number of postings are limited, though it was not possible to identify the cause.

3.4 Causal relationship

In this paper, student's learning behaviour and their learning performance may be affected by their fundamental personal characteristics and their attitude toward thinking and learning. Personal characteristics and attitude may encourage online posting activity, and thus affect learning performance. To examine these phenomena, a causal relationship analysis was introduced using a structural equation modelling technique (Kline, 2005). Figure

3 shows the structure of the hypothesis for the causal relationship. Path coefficients and indices of fitness of model were estimated using AMOS software (Toyoda 2007).

As mentioned in the above results, both Neuroticism (Big5, P4) and Evidence-based judgement (CTD-4) affected the number of postings to the bulletin board. Furthermore, Agreeableness (P2) and CTD-4 negatively influenced the scores of task reports. Finally, Sciencephiles (LST2), the number of postings, and the scores of the task reports all contributed to the overall assessment scores.

This result confirms that students' characteristics affected learning behaviour, such as the number of online discussion board postings or the scores of final assessments. Since personality may be a fundamental characteristic of participants, some personality factors contributed to their attitude toward "critical thinking" and literacy of science & technology. Some of these factors also influenced online discussion activity and learning performance. Therefore, overall assessment scores were affected by online posting activity and literacy of science & technology, which in turn was influenced by the participant's personality and CTDs. The details of a procedure to encourage students to participate in online discussions will be a subject of our further study. The characteristics and level of literacy of students may be dependent on cultural differences, and these factors should also be considered for further study.

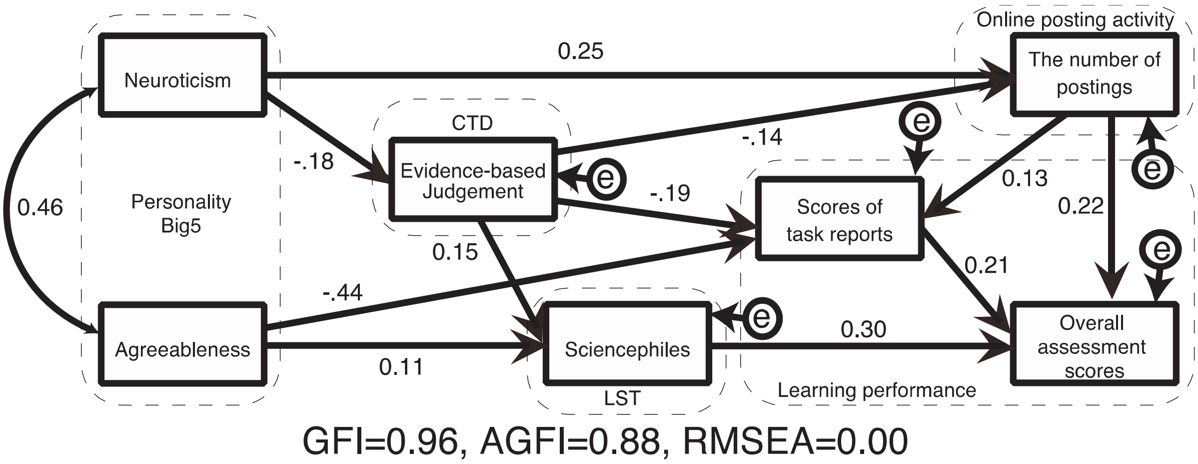

Figure 3: Causal relationships between learning performance, activity and participant's characteristics

4. Conclusion

The results confirm that "critical thinking" ability is a part of the "generic skill" set that can be developed by using discussion as a learning activity. "Critical thinking" ability also varies according to the characteristics of participants, such as personality factors, literacy of science and technology, or style of processing information. Participant characteristics and learning performance are mutually related to online bulletin board posting activities.

In considering these relationships, a causal model was created and actual path coefficients between key indices were calculated. This result suggests that factors of personality, "critical thinking" ability, literacy of science and technology, online posting activity, and learning performance are quantitatively correlated.

To promote better learning performance during online learning courses, a learning support procedure, such as the encouragement of online discussions, is required. This will be a subject of our further study.

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Podcast as a Learning Media in Higher Education

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Abstract: Within higher education, online courses have gained popularity, which has resulted in a massive expansion of e-learning and today many qualifications, courses, and teaching materials are offered online. This expansion has resulted in an increase of online approaches, methods and learning technologies. Therefore, engaging traditional pedagogy is necessary to achieve the learning objectives due to curriculums where the learning objectives are the same for online educations, as well as in the ordinary educations. This paper examines how the use of podcast (mp3) in a blended course can increase students theoretical understanding of an unfamiliar topic in relation to their field of study. This study focuses on the use of teacher-generated podcasts and how they complement the students' reflective learning skills. The podcast's point of difference is its flexibility, allowing an exploration of subtly and nuance in complex topics. In addition, they provide an opportunity to present counter examples and discuss implications. This study is based on a single case; a blended course in Communication at University College of Northern Denmark. The study used both qualitative and quantitative methods. The data collections included semi-structured interviews with students' and participant observations, the latter in form of a workshop. The semi-structured interviews was chosen to investigate the understanding of the use of podcast due to the students' reflection skills regarding the communication in relation to their field of practice. The observations gained in the workshop provided knowledge to understand how the students use the knowledge gained by listening to the podcast before attending the workshop. The quantitative data consisted a survey of 53 students all of whom participated in the workshop where they responded to an evaluation survey immediately after the workshop. The data in this study reveals that online learning resources needs support. The paper concludes that teacher-generated podcasts, where teachers discuss a subject in relation to practice and by visiting, interviewing and including relevant companies can support the students' reflections and understanding of unfamiliar topics in relation to practice. Finally, the paper provides suggestions for future research and practice of using podcasting in higher education focusing on students with a vocational background studying online courses.

Keywords: podcast, blended learning, flipped classroom, learning design, higher education, reflection skills

1. Introduction

Online learning has many variations, for example, web-facilitated courses which use web-based technology as course management system to post syllabus and assignments online (Allen & Seaman, 2010). In addition, the blended course blends both online and traditional (face-to-face) delivery and a large proportion of the content is delivered online, usually as online discussions, assignments, and video-lectures (Allen & Seaman, 2010). Allen and Seaman (2010) describe the different between blended learning and online learning where most or all of the content is delivered online and with no traditional meetings. The focus of this study is the use of a teacher-generated podcast in a blended course and how it can increase the student's reflective learning skills. This concept of blended learning gives the opportunity to mix both online and traditional lectures and, as in this case, to create space for the method of flipped classroom where some material are given before handed, in this case, a podcast. Given the theory before attending class, makes the actual time where the students attend a class at the campus more efficient and can cause active learning (Cass & Kravchenko, 2017).

1.1 A review on podcast in an educational context

In this study, the definition of Podcast and podcasting refers to an MP3 file that is distributed to listeners who have the ability to listen to the podcast "on the go" (McGarr, 2009). 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 at a website or at another internet location, like a Learning Management System (Palenque, 2015).

The use of podcasting has increased and now is common in several fields. Research states that podcasts supports active, social and creative aspects of learning, and strengthen reflection and self-regulated learning (Palenque, 2015). Previous research has revealed that there is a potential of using podcast as a tool for increasing the ability to stimulate reflective thinking and self-regulated learning for online students (Liu, 2015). A student who owns the ability to regulate their own learning and apply their academic performance into a specific action obtain a successful learning (Liu, 2015). To obtain successful learning the student needs to create a language, which he/she can apply into that action. By providing the students with a mediating artefact, and in this case a podcast on a certain topic, the student will achieve a language about that content, which will give them an opportunity to regulate their own learning and accumulated higher cognitive functions (Bagarukayo, et al., 2016). In the medical field, there are numerous examples of the use of podcast in relation to medical education. In 2006, 57% of medical students surveyed indicated that iPod technology with access to content was useful in learning (Palmer & Devitt, 2007). In this example, Fatima (2014) covers the use of podcast in form of a recording of a lecture as a supplement to traditional lectures (Fatima Mncube-Barnes, 2014). Studies found that podcasts were not designed to replace traditional lectures and did not affect class attendance. Instead, they supplemented live lectures and allowed students to study anywhere, at their own pace, and at their own time (Fatima Mncube-Barnes, 2014). Another study reveals that 45% of students in a course at Harvard Extension School discovered that podcast was a more efficient way of reviewing than their personal notes. Furthermore, Luna and Cullen (2011) describe that a majority of law students find podcasting useful for lecture content (Luna & Cullen, 2011). Luna & Cullen (2011) furthermore suggests other benefits of using a podcast in an educational use:

- Flexibility and convenience
- The ability to catch up on the content
- The capability of reducing distance-students isolation
- Student engagement
- Improving learning and boosting the learning experiences

In addition, there are several examples of student-generated podcasts where they are used as a method for generating a portfolio- (Dianne Forbes, 2014). Several examples on podcasting, used in the vocational field both in self-study but also in foreign language teaching, reveals that it helps learners to hear their pronunciation of certain words, and that it guides learners on how to use them appropriately (Ting, 2014). Studies suggest that students prefer short and moderate podcast episodes and episodes containing information about the educational overview, study guides or curriculum content (Almeida-Aguiar, 2016). Podcast and podcasting can be a supplement to traditional lecturing, however, this does not fully explain how podcasting as a technology can be applied to a learning design for a certain group of students. Malan (2007) pointed out, "*It is this technology's reach [educational accessibility] that we claim is significant, not the technology itself*" (Malan, p. 389) (Luna & Cullen, 2011). Overall, there is no generic approach to how a podcast can be useful in terms of learning. This paper focuses on teacher-generated podcast and therefor it is necessary to clarify the definition of teacher-generated podcast. In this paper, a teacher-generated podcast is a podcast, which is made by the teachers who do the actual lecture or workshop. In this case, the two authors created a podcast suited for some particular students within a certain content of a course. That means that the two authors targeted the content, made the recording, manuscript, music, editing etc. and that is the point of departure from previous research. The content consists teachers discussing a subject in relation to practice and by visiting, interviewing and including relevant companies aiming at supporting the students' reflections and understanding of unfamiliar topics in relation to practice.

1.2 Context clarification

This study takes place at The University College of Northern Denmark (UCN). UCN is situated in Northern Jutland of Denmark and are a university of applied sciences that provide higher education and perform research, development and innovation activities. This study is based on two online educations; 1. Service Engineering Electricity Power. 2. Service Engineering Sanitary. Both educations have in common that all the students have a vocational background as an electrician or a Plummer and are used to an apprenticeship approach to learning (Lave, 1991). At UCN, these two educations are located in the same department, Energy and Environment, and the students´ have numerous classes together. The students are between the ages of 22 and 50 years old. The education is an Academy Profession degree (120 ECTS) with 2 years of study, which contains 10 weeks of vocational internship. The students are present at UCN 9 (3x3) days during a semester. During the first semester, the students have classes, which are not technically related to their field of operation. These classes are participating in a mandatory course in Communication (5 ECTS) during their first semester.

UCN has a shared learning approach, called Reflective Practice-Based Learning (RPL) across all four campuses where the core is the interaction between theory and practice combined with personal reflections (Pjengaard, 2016). RPL is a continuing development work, where the focus is to reflect both on the needs of the companies/practice and the professions' (www.uvm.dk, 2017). In addition, the collaboration with practice is crucial to the learning design when the aim is to create teaching that relates to the student's field of study and similar to their future workplaces.

2. Method

The empirical study aimed to discover how the use of podcast in a blended course could contribute to increasing the students' theoretical understanding of an unfamiliar topic in relation to their field of practice.

The qualitative data collections included semi-structured interviews with students' and participatory observations, the latter in form of a workshop. The quantitative data consisted a survey of 53 students whom all participated in the workshop where they responded to an evaluation survey immediately after the workshop.

The semi-structured interviews were chosen to investigate the understanding of the use of podcast due to the students' reflection skills regarding the topic in relation to their field of practice. The use of semi-structured interviews provide an insight into the students' experience and thus an insight into their lifeworld (Kvale & Brinkmann, 2015). The semi-structured interviews allow the researchers to give an insight of the answers in the survey (Kvale & Brinkmann, 2015). The focus of the interviews classifies the participants understanding of the use of podcast due to the students' reflection skills regarding communication in relation to their field of practice. The participatory observations gained in the workshop provided knowledge to understand how the students use the knowledge gained by listening to the podcast before attending the workshop. The participatory observations was collected by the researchers, which also participated as lectures during the workshop. The participatory observations gained in the workshop provided an understanding of how the students used their knowledge gained by listening to the podcast before attending the workshop. A quantitative approach was chosen to identify and characterize the data and to give an overview of the students experience of using a podcast in a learning context. A parallel mixed method was used to validate findings using quantitative and qualitative data sources. The benefit of this approach is that it provides to compare findings from qualitative and quantitative data. In the analysis and interpretation of the collected data, the aim is to achieve what Kvale and Brinkmann (Brinkmann, 2009) describe, as a meaning condensation, where the analysis results for short and concentrated summaries of the core of the extensive data material (Brinkmann, 2009). Meaning condensation means development of three detailed schemas that contain all the students' statements from the interviews, observations notes and quantitative data. In this way, patterns are identified across the data through the schemas and the categories are based on the patterns identified. The categories which are crystallized through this meaning condensation are as follows: The students' experience of motivation, flexibility and reflexivity. These different categories will act as headlines and furthermore selected quotes are included to illustrate what and how the various findings are interesting in this study. The benefit of this approach is that it provides to compare findings from qualitative and quantitative data sources. The mixed method involved collecting both types of data at roughly the same time; assessing information using parallel constructs for both types of data; separately analysing both types of data and comparing results through procedures (Thisted, 2010). For example, the researchers gathered the qualitative data to assess the personal experiences of the students experience regarding the podcast, simultaneously with the survey data collection. The two types of data complement each other and thus increase the degree of validity and thus create a solid foundation for drawing conclusions (Thisted, 2010). However, a disadvantage of this approach is the risk of bias when there is a strong relation between the finding and the focus of the investigation.

3. Findings

As mentioned in the literature review podcasting can increase the reflection ability in higher education. Very little has been found in the literature on the question of how teacher-generated podcasts can gain more reflection towards the students' field of practice. However, in our study different themes addressing teacher-generated podcast as a facilitator and motivator of reflection is foundational. The themes identified by the responses are summarized below in three main categories; Motivation, Flexibility and Reflection.

3.1 Motivation

This study found that half of those surveyed reported that their first impression towards podcasting in a learning context was, that they found it exciting and all of the participants listened to the podcast. One interviewee stated that: "*It was exciting, I liked it because it has been a lot of PowerPoint (red. Voiced over Power Point) in the course. I like there is a dialogue.".* Another student notes that: "*That (a podcast) was an advantage. Then you can walk around and do stuff, so I was happy".* According to the participatory observation field-notes, the students showed motivation during the workshop, also the most obvious finding to emerge from the analysis is that all of the surveyed answered "Yes" when asked if teacher-generated podcasts made them motivated to learn more about the subject. Over half of those surveyed reported that by listing to the podcast, they felt well prepared for the workshop and the survey reveals that 90% of the students were looking forward to learning more about the topic. When asked if the podcast generated motivation one student replied: "Y*es, very much, but it is a matter of who is sitting and talking".* This may indicate that the student is fond of podcast as media and finds podcasting in a learning context interesting. A number of issues were identified in terms of sound. Over half of those surveyed reported that the sound in the podcast was unsatisfactory and that effected their motivation negatively. Our findings are consistent with what Luna & Cullen suggest in terms of an increase in the learning experience and thereby more motivated students (Luna & Cullen, 2011). Comparison of the findings with those of other studies confirms that the length of the podcast was acceptable and the rather short version (20min) kept the students interest, motivated and kept them listening and did not make them turn off.

Overall data illustrated that motivation can be improved by podcasting, however, the sound, topic, and level of the content have to be aimed for the target group involved. Therefore, teacher-generated podcasts can be a relevant supplement in a blended course.

3.2 Flexibility

Flexibility is a key factor for this exact blended course since numerous students hold a fulltime job alongside their study and therefore flexibility is extremely important and one of the main reasons why they attend this particular course. The survey shows that almost two-thirds of the students listened to the podcast "on the go". Examples from the data illustrate that they were listening to the podcast while driving to work or when lying down in bed. This finding is contrary to previous studies by Hew (2009) , which have suggested that the students choose to listen to the podcast at their computer and did not use the opportunity of flexibility that the media provides (Hew, 2009). In this case, the students used the flexibility and convenience of podcasting. Data illustrated that the students experienced a flexibility to study anywhere. These results are in accordance with Fatima's (2014) findings, which showed that podcasts gave the opportunity for learning outside of the classroom (Fatima Mncube-Barnes, 2014). Furthermore, over half of those surveyed reported that the combination between a workshop and listening to a teacher-generated podcast improved their understanding of the topic. Nearly two-thirds of the participants replied that they benefited from listening to the podcast before attending the workshop because it gave them knowledge about the topic. However, in response to questions about the content of the podcast half of those surveyed indicated that the content was rather simple. By simple, they elaborated that the content in the podcast which consisted of an interview with (a service manager employed by an EL company with only one year of experience) used everyday examples, whereas the students requested more complex examples from employees in higher positions within the field. However, both of the students interviewed replied that listening to the podcast gave them a feeling of being well prepared for the workshop. Furthermore, the field-notes also revealed that many of the students used some of the arguments from the podcast in their problem solving. These results indicate that the students found listing to a teacher-generated podcast gave them a stronger foundation to participate in the workshop. In accordance with our results, previous studies have demonstrated that student's find podcasting useful as a supplement to lecture content (Luna & Cullen, 2011). Comparison of the findings with those of other studies confirms that the combination between podcasting and a workshop is useful for learning (Palmer & Devitt, 2007). There are similarities between the attitudes observed in this study and those described by Ting (2014), who reports that podcasting helps students in foreign langue teaching to use words appropriately (Ting, 2014). The similarity, in this case, is that the participants in the workshop used words and expression from the podcast in problem solving, which indicate that podcasting can lead to the transfer of learning. With a teacher-generated podcast, teachers can reduce the distance to the online students and bring the reflection and discussion to the students. From our data, we can see that the flexibility given due to the media were used by the students. However, one-third did not benefit from the flexibility and choose to listen to the podcast in front of their computer and they were not familiar with the media podcast, which could have had an influence on whether they took advantage of the flexibility given.

3.3 Reflection

The learning approach at UCN (RPL) focuses on reflection towards the students' field of practice and therefore also a theme which was relevant to investigate. When investigating the students reflections in relation to their field of practice, the field-notes collected showed that the students used some of the theory presented in the podcast to solve their assignment. For example when analysing a case in groups during the workshop. The field-notes illustrated that the students, during the workshop, integrated the language from the podcast to explain communication cases from their own practice. Around 40% responded that the podcast caused reflection, one of the interviewed students replied that by listening to the podcast before attending the workshop, he acquired some "*…theoretical analysing-tools*" he could use when solving a case during the workshop. All the students, except one, answered that they understood the theory presented in the podcast and one interviewed students stated: "*I understood the theory, it was interesting".* 90% of the surveyed replied that they could make a direct transfer to their field of practice. One student replied: "*Yes, I could use the theory related to practice. I am self-employed and I do not have much communication with the customers but I could see the idea". This quote* supports the objective of reflection that draw on experience gained in s their field of practice. The results revealed that 90% of the surveyed could make a direct transfer to their field of practice and that they used the content from the podcast in their casework. Furthermore, the podcast gave them new insights into their field of practice. The study also confirms previous research by Palenque (2015) and the idea, that podcasting is associated with a creative aspect of learning and that it can strengthen the students reflection (Palenque, 2015). These reflection capacities are a key element in UCNs learning approach and as the data suggests, the majority of the students used the theory presented in the podcast and thereby reflected on the theory in relation to problem-solving during the workshop. These findings are consistent with existing literature, who states that podcasting is a tool for increasing online students' ability to reflective thinking (Liu, 2015).

In summary, these results show that teacher-generated podcast can be a supplement to online learning (voiced over PowerPoints).

4. Discussion

As stated in the literature review, previous research suggests that the most common use of podcasting in higher education is limited to teachers distributing recordings of lectures or student-generated podcast as different forms of evaluation. The findings in this study indicate that teacher-generated podcasts where teachers discuss a certain subject in relation to practice can support the students' reflections and understanding of a (new/unfamiliar) subject in relation to practice. Due to these findings, professionals in higher education can provide content-rich educational content relating to an authentic context, by producing and implement podcasts linked to their field of study or interests.

Deliberating the use of quantitative method in form of a survey, it can be discussed if the small size of the dataset is too small to generalize the findings throughout the field of educational use of podcast. However, the findings are useful in relation to the use of podcast as a supplement to online learning regarding students with a vocational background. Furthermore, the findings indicate that students with the same background but studying at a non-online course easily could benefit from the same podcasts and podcast also could be integrated into this context as a flipped classroom approach. Nevertheless, it can be discussed whether the questionnaire were exclusively quantitative as they contained both open and closed questions. The open questions give the opportunity for more variables and allow respondents/surveyed to elaborate their answers (Brinkmann & Tanggard, 2015). However, the survey is claimed to be quantitative in its form. Collecting quantitative data from a survey was chosen because of the class of 53 students and is therefore not representative to quantitative guidelines suggesting inclusion of large populations. The quantitative method in its form, nevertheless, gave us the ability to categorize the data and generate minor statistics on the small sampling of survey data in this study. Considering validity of the qualitative data collected throughout the entire research process, the semi-structured interviews were chosen because it's possible to add the interviewed persons 'voice' to the observations. Therefore, the collected results reflects the students "truth" of reality as they have experienced it (Kvale & Brinkmann, 2015). Thus, the use of a mixed method has contributed to highlight blind spots, which the researchers have not been aware of because of the dual role of both educators and researchers. Regarding the dual role as both educators and researchers in this investigation, there are several sources of error. The main error is that the researchers could influence the results in this data, as the researchers both collected data before and during the workshop and facilitated the workshop. However, the researcher' familiarity with the students and the content also contributed to access and understand the culture and practice in a real life setting. Nevertheless, in this case, the student's responses may be characterized by their relation to their lectures and this could have provoked what Brinkmann and Tanggaard describe as 'the pleaser effect', which is a pure obligation to not disappoint the interviewer (Brinkmann & Tanggard, 2015).

5. Conclusion

This study set out to investigate how the use of podcast in a blended course can contribute to increase the students' theoretical understanding of an unfamiliar topic in relation to their field of practice. This study has identified that there is a relation between that use of podcasting and an increase of reflection towards the students' field of practice. The research has also shown that podcasting can work as motivation tool for the students whom are participating in for an example a workshop. One of the findings of the study was to determine the flexibility of participants use of a podcast. It is concluded that in general the students used the flexibility and used the media on the go. The research has also shown that the teacher-generated podcast offers support for students to transfer theoretical knowledge into the field of practice. A limitation of this study is that only one class was surveyed based on one podcast and one workshop. Another weakness of this study regards the dual role as both educators and researchers in this investigation, which can lead to 'the pleaser effect'.

Overall, this study strengthens the idea that teacher-generated podcasting can stimulate the students' ability to reflect in relation to their field of practice.

Further research needs to be done to clarify whether podcasting can increase the students' reflection and understanding of a topic. Further research in this field would be of great help in understanding how podcasting can improve reflections in flipped classrooms and in particular online courses with students who have a vocational background.

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Principles of Efficient use of ICT in Mathematics Education

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Abstract: The paper addresses the important topic of implementation of ICT into mathematics education. Use of ICT in mathematics education on primary and secondary school levels and in pre-service teacher education is a very up-to-date topic. Implementation of ICT into mathematics teaching and learning should never be purposeless. It should be an 'added value' to learning activities. In the paper, one additional principle for selecting suitable activities with a solid potential for teaching are added to those already published. These principles follow from the use of new ICT tools. In the article, the new set of principles is illustrated. Examples of good practice are contrasted with the so called "for show" implementation of ICT in lessons of mathematics. The topic discussed in the article is relevant especially for teacher education.

Keywords: implementation of ICT into mathematics education, selection of suitable activities, problem solving, heuristic solving strategies

1. Introduction

The paper addresses the important topic of the use of ICT in mathematics education. Research in the use of ICT in mathematics lessons has grown substantially over the past years on both primary and secondary school levels (e.g. Turker, Saglam, Umay, 2010; García-Campos, Rojano, 2008) and in pre-service teacher education (e.g. Ruthven, 2007). It is a very up-to-date topic that attracts a lot of attention, which is documented by a high number of publications from recent years focusing on this topic. In Section 1 we present some of them. Our list is not and cannot be exhaustive but that is not the point; our intention is to illustrate the richness of the existing perspectives.

Inayat and Hamid (2016) focus on the technological tools available for effective teaching and learning of mathematics. They offer an overview of the latest technologies used by educators to make teaching and learning in mathematics more effective, student-centred and dynamic. They claim that "modern digital technologies including computers with increasingly sophisticated software, more advanced graphics calculators integrating graphical and symbolic manipulation, statistical and dynamic geometry packages, and virtual learning environments offered by web-based applications have innovated the teaching and learning process of mathematics". Immediate feedback on a student's efforts, motivation, interaction and cooperation, improved skills, active participation, integration of theory and practice into one, teaching mathematics better and teaching better mathematics are the main benefits of implementing ICT in mathematics teaching mentioned in the paper.

Implementation of ICT into mathematics teaching and learning should never be purposeless (Jančařík and Novotná, 2011b). It should have an 'added value' to the used learning activities. The fundamental question raised in this context is: What can the value added by the use of ICT be? ICT has become a tool of motivation and fosters comprehensible interdisciplinary links between mathematics and other subjects. However, use of ICT in teaching asks for new approaches to teacher's way of explaining and to mathematical content. This might be one of the reasons why recent studies in mathematics education show that, despite many national and international events targeting integration of ICT into mathematics classrooms, this integration in schools remains underdeveloped. The rate of this integration increases markedly slowly when compared to the speed of evolution of technology as such.

2. Theoretical background

Outhwaite, Gulliford and Pitchford (2017) state that "a potential pedagogical approach to support the development of early mathematical skills in the first years of primary school is combining play and technology". They justify that technology-based educational games have the potential to have a positive impact on early education. One of the important properties in this approach is the capacity of such use of ICT that addresses the different abilities of individual children. The authors analysed the impact of a hand-held tablet technology intervention with learner-centred interactive software. They compared mathematics performance before, immediately after, and 5-months after the intervention. The experiment was conducted in three UK primary schools with the total of 133 pupils aged 4–7. The findings indicate that "tablet technology can provide a form of individualised effective support for early mathematics development, when software is age appropriate and grounded in a well-designed curriculum … [It] could be particularly beneficial to low-achievers and could help to close the gap in early mathematics attainment from the start of primary school".

Fabian (2015) focuses on the results of using of mobile technologies in teaching and learning mathematics. The participants were 48 Scottish primary 6 and 7 pupils. Pupils evaluated lessons where the use of mobile technologies was included in the activities positively. There were no significant differences in pupils' results in the pre-test and post-test. But in the interviews, pupils underlined that the activities were fun, helpful and connecting mathematics topics with everyday life.

Hodaňová (2016) focuses on management of educational processes with the support of electronic tools. She claims that modern digital technologies enable development and strengthening of mathematical knowledge, guide pupils and students to work independently and teach them self-control. Modern digital technologies also show possible uses of mathematics in other scientific fields. In the paper, the main emphasis is put on the use of computer geometry and dynamic geometry software.

It is generally accepted that teachers play a significant role in integrating ICT in schools. Uluyol and Şahin (2016) investigated elementary school teachers' use of ICT and their motivation to do it. In their study, they used semi-structured interviews. The participants were 101 elementary school teachers from 24 elementary schools located in Ankara. The conclusion from analyses of the interviews is that "more concrete encouragement, support and opportunities must be developed to increase teachers' motivation to improve the level and quality of ICT use in classrooms".

Gudmundsdottir and Hatlevik (2017) investigate teachers' professional digital competence, which is growing more and more important nowadays when digital resources and digital media have become important parts of teachers' everyday practice. They focus on how newly qualified teachers are prepared to use ICT after their initial teacher education. 356 newly qualified Norwegian teachers participated in the survey. The newly qualified teachers reported fairly poor quality and benefit of ICT training during their teacher education. The authors claim that continuous effort is needed to review the quality of initial teacher education and to develop student teachers' ICT self-efficacy.

Tondeur et al. (2017) developed a questionnaire to measure pre-service teachers' ICT competencies in education. They collected data from 931 final-year pre-service teachers in Flanders (Belgium). In the paper, recommendations are made on how this reliable instrument can help assess the level and progress of preservice teachers' ICT competencies.

Despite the documented positive effect of the use of ICT in (mathematics) education (see e.g. Jančařík and Novotná, 2011a), examples from school practice show that in many cases the so called "for show" examples of use of ICT in a lesson contribute very little to the development of mathematical knowledge and may be even counterproductive. That is why Jančařík and Novotná (2011b) formulated the following principles for selection of suitable activities with a solid potential for teaching:

- The use of computers cannot be autotelic but must be linked to a specific educational content.
- The computing power must be used effectively; the results should be presented in a comprehensible way.
- The results from the computer should be further interpreted; they should provide space for follow-up discoveries.

Drijvers (2013) claims that "crucial factors for the success of digital technology in mathematics education include the design of the digital tool and corresponding tasks exploiting the tool's pedagogical potential, the role of the teacher and the educational context". He distinguishes three main didactical functions of technology in mathematics education as presented in Figure 1.

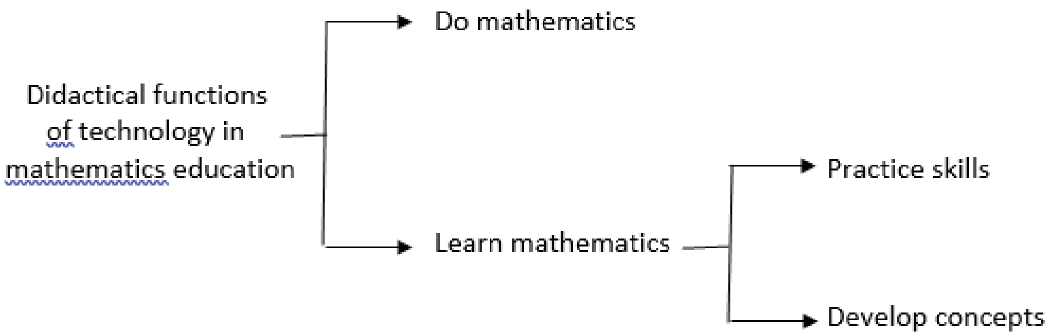

Figure 1: Didactical functions of technology in mathematics education (Drijvers, 2013)

3. Our research

In our research, we focus on the properties that discriminate between good and bad examples of the use of ICT in mathematics education in all three domains outlined by Drijves (2013). In (Jančařík and Novotná, 2011b), the ICT tools used were computers. Technological limitations of computers affected the ways activities could be designed and used and were dealt with in the article. They were identified as one of the important reasons for the use of computers referred to as "for show". Technological limitations of ICT tools have been largely overcome in the meantime although some are still an obstacle. The questions the here reported study tries to answer is: Are the principles for selection of suitable activities with solid potential in teaching appropriate for the new technological environment that is available in schools? Do these principles need to be further extended and if so by what principles? Are teachers better prepared for implementation of ICT into lessons nowadays? In order to answer these questions, several activities were designed and piloted at schools. Their use by different teachers and in various educational settings were analysed.

In the following text we present the activities that were used at schools. We analyse how they were conducted and draw conclusions from our observations, interviews with teachers as well as pupils' reactions.

Example 1 (Augmented reality)

One of the areas that works with computer technology is the area of augmented reality (AR). Currently a number of applications that enable the use of AR in teaching of mathematics are available. However, AR is not exempt from the above described principles and rules on effectiveness of use of ICT in lessons and from the need to understand the specifics and potential use if this technology bears. One of the applications that offer the use of augmented reality in mathematics lessons is the programme *Mirage – polygones augmentés*, which allows the teacher to visualize various geometrical bodies in the environment of augmented reality (Figure 2).

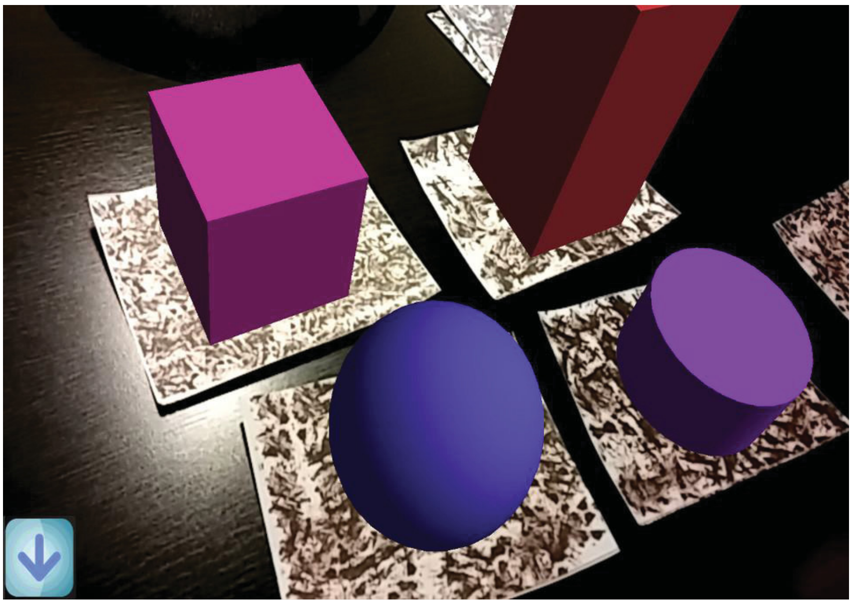

Figure 2: Examples of visualisation of bodies in the programme *Mirage – polygones augmentés*

When projecting a virtual object, the teacher may ask the pupils to explore the number of faces, edges, the ratio of their sizes or sizes of angles. For measuring, pupils can also use objects from the real world including a protractor. Situations were come across in the lessons when pupils tried to determine the area and volume of virtual objects, i.e. to measure their "real" sizes. The size of an object in augmented reality, however, usually depends on the observer and its exact determination is not possible.

Examples 2 and 3 illustrate the use of computing power of ICT tools. In the scope of the GAČR project Development of culture of problem solving in mathematics in Czech schools, Eisenmann, Novotná, Přibyl and Břehovský (2015) discuss the impact of the use of heuristic solving strategies, one of the ways of developing pupils' creative approach to problem solving. The strategies studied are: Strategy of analogy, Guess – check – revise, Systematic experimentation, Problem reformulation, Working backwards, Introduction of an auxiliary element, Solution drawing, Use of graphs of functions, Generalization and specification, Specification and generalization, Decomposition into simpler cases, Use of false assumption and Omitting a condition.

Two of these strategies, Systematic experimentation (Example 2) and Use of graphs of functions (Example 3) are used for solving problems with the use of ICT efficiently. The potential of a suitable use of ICT tools is illustrated clearly.

Example 2 (Systematic experimenting, see e.g. Figure 3)

Number of tickets at 220 CZK	Price in CZK	Number of tickets at 160 CZK	Price in CZK	Total price in CZK
97	21 340	0	0	21 340
96	21 120	1	160	21 280
95	20 900	2	320	21 220
...	...	...	...	...
75	16 500	22	3 520	20 020
74	16 280	23	3 680	19 960
...	...	...	...	...
65	14 300	32	5 120	19 420
64	14 080	33	5 280	19 360
63	13 860	34	5 440	19 300
62	13 640	35	5 600	19 240
...	...	...	...	...
18	3 960	79	12 640	16 600
17	3 740	80	12 800	16 540
16	3 520	81	12 960	16 480
...	...	...	...	...

Figure 3: Spreadsheet for example 2

Systematic experimenting is a strategy in which we try to find the solution to a problem using several experiments. First we apply some algorithm that we hope will help us solve the problem. Then we proceed in a systematic way and change the input values of the algorithm until we find the correct solution.

Problem: Some tickets in a theatre were sold for 220 CZK and some at the price of 160 CZK. How many tickets at each price were sold if the total sum of 97 tickets was 19 300 CZK?

The solution obtained with the use of a spreadsheet is in Figure 3 (shortened table). It becomes clear immediately that the correct answer is: 63 tickets at the price of 220 CZK and 34 tickets the price of 160 CZK were sold in the theatre.

Example 3 (Use of graphs of functions)

When there are functions in the wording of a problem or when it turns out within the solving process that it is desirable to introduce functions, it usually helps to draw graphs of these functions. These graphs often contribute to the finding of the solution to the given problem considerably.

Problem: Is there a natural number $n \geq 1$, for which $n^2 + n + 1$ is a square of a natural number?

The solution obtained using graphs of functions $x^2 + x + 1$ and x^2 is in Figure 4. It proves the hypothesis that such n does not exist. The use of software for drawing precise graphs of the two functions is indispensable

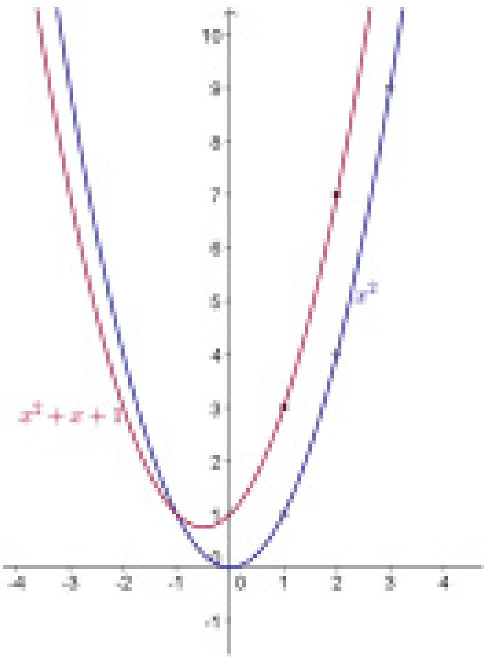

Figure 4: Graphs of functions for example 3

Example 4 (Space for discoveries)

Computer technology offers a lot of space for experimenting in the area of construction geometry. One of the typical tasks is the task to construct a triangle given two sides and one of the interior angles of the triangle that is not formed by the sides. When including this type of tasks in Czech schools, the method of formal division into two separate cases according to which of the sides is longer is used. The problem is solved and discussed independently for both of the cases.

When using dynamic software, this formal division of the two cases is not necessary and pupils can experiment using parameters. On the basis of these experiments they can determine whether the problem has a unique solution if it is the shorter side that is adjacent to the angle and to state under which conditions the problem has one, two or no solutions in the latter case (see Figure 5).

Example 5

A complex problem (Bullet and target) meeting all the three above mentioned principles for selection of suitable activities with a solid potential for teaching is presented in (Jančařík and Novotná, 2011b) and further elaborated in (Jančařík and Jančaříková, 2018).

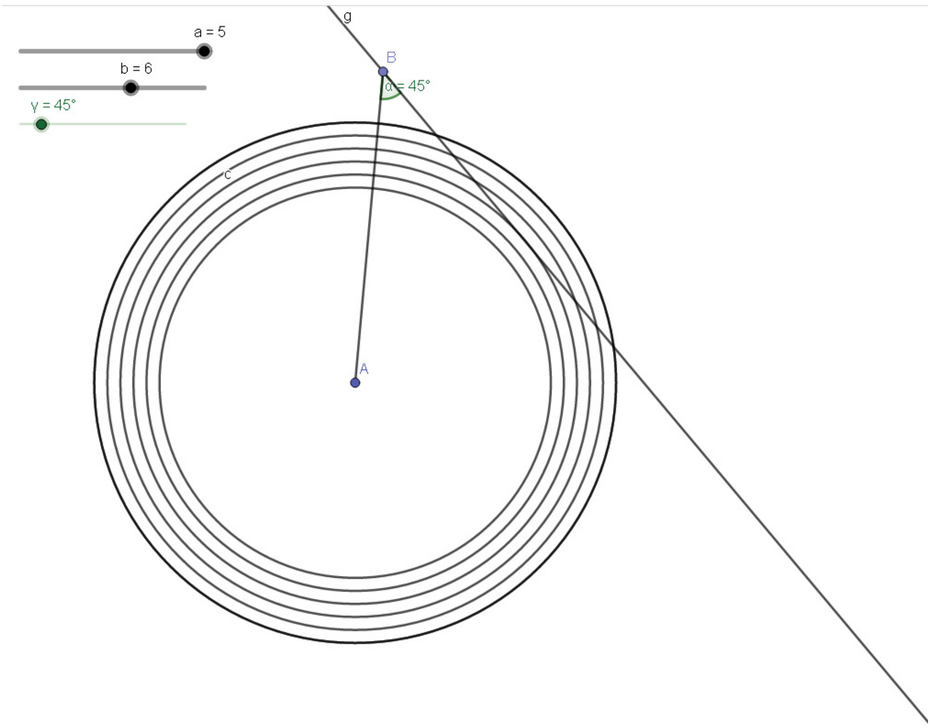

Figure 5: Use of dynamic geometry software in Example 4

4. Results and discussion

The conditions for effective use of ICT in lessons of mathematics defined in (Jančařík and Novotná, 2011b) still hold. New applications, especially in the area of virtual and augmented reality, make it necessary to develop and supplement one additional principle:

- Computer technology should only be used in situations when the result of its use is independent of the viewer or of other influences that make the solution unstable.

An example of a wrong use of this principle is the misleading use of measurements and sizes in Example 1. The principle should only be violated with the intention to show to the pupils the causes of this instability.

5. Concluding remarks

Use of ICT in teaching when learning mathematics does not necessarily mean its improvement. It is still the teacher's task to contemplate on what the use of ICT brings and how to involve ICT in the educational process efficiently. Assigning complex problems using ICT, as we demonstrate in Example 5, offers students a new way to approach mathematical problems. Students learn to model real situations, find approximate numerical solutions and gain experience with input data. Simultaneously, problems are both linked with the current subject matter – in this case functions and also have the role of preparation for calculus and integral calculus.

The topic discussed in this paper is especially important for teacher education. It is essential to train future teachers to use ICT effectively and to be well aware of its limits and drawbacks. Only thus computer-supported mathematics education can become really meaningful and beneficial.

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Sakai Device and Platform Usage: A Four-Year Campus-Wide Analysis

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Abstract: This paper examines data generated by Sakai analytics to determine platform and device usage over a four-year period, at one higher education institution. Sakai is an open source learning management system (LMS) used by over four million learners worldwide, across 350 colleges and universities, to collaborate and engage in a variety of technology-enhanced learning experiences. In 2016, our institution undertook a major Sakai upgrade, which provided a number of functional enhancements, including better tools and a more appealing user interface. In 2017, another upgrade provided a more optimised user experience—the LMS is now responsive to desktop computers, tablet and smartphone devices. This paper examines campus-wide usage data gathered over a four-year period—before and after the major campus upgrades—to determine how desktop (Microsoft Windows and Apple macOS) use has changed during that time and how users (students and instructors) use mobile devices (tablets and smartphones) to interact with the LMS. Findings show that the use of Microsoft Windows has declined overall, but still remains the predominant desktop platform. While mobile use—in particular the use of iOS and Android devices—has increased overall, users rely more heavily on desktop computers during intensive assignment and exam periods (May and December). The findings in this paper should be of interest to instructors who want to know how their students like to interact with the LMS. Greater use of mobile devices, coupled with responsive user interface design, and improved tools, can facilitate flexibility for instructors, in terms of where and how they can interact with their students. These findings can help instructors decide which kinds of synchronous (e.g. live polls and quizzes) and asynchronous (e.g. forum-based discussions) activities might be most appropriate at any given point in the academic year.

Keywords: data analytics, LMS, Sakai, mobile devices, desktop platforms, responsive design

1. Introduction

Learning Management Systems (LMS) are a type of software designed to deliver, track, and manage training and education. Through their development, these systems have also been referred to as Virtual Learning Environments (VLE), Course Management Systems (CMS), Collaborative Learning Environments, and a host of other names (Wright et al., 2014). LMSs became popularised with the advent of the Internet and high-speed broadband (Hill, 2017) and typically include methods to manage users, organise course information, engage in online communication, grading, and blended delivery of content. Berking & Gallagher (2013, *p.6*) define an LMS as *"a key enabling technology for "anytime, anywhere" access to learning content and administration"*. A more complete definition can be found in Dobre (2015, *p.314*) who define an LMS as *"a set of software platforms, delivered to users by instructors through internet and by the use of various hardware means, having as purpose the delivery in the shortest time possible a high level of knowledge into a domain assuring in the same time a full management of the entire educational cycle, including data and information"*.

There are three main types of Learning Management Systems (1) proprietary (2) open-source, and (3) cloud-based (Dobre, 2015). Proprietary LMSs are licensed by developers so the goal of the proprietary LMS vendors is to produce profits. Examples of proprietary LMS vendors are Blackboard Learn, D2L, and eCollege. Open-source LMSs make the source code publically available and are free of charge to all users. Examples include Canvas, Moodle, and Sakai. Cloud-based LMSs are a convenient and low-cost way of using an array of cloud-based tools in higher education institutions (Dobre, 2015). Two examples of cloud-based LMSs are Amazon Web Services and Talent LMS. A host of freely available cloud-based tools can be used in conjunction with any LMS; for instance, Google Drive can be used for document sharing and collaboration, Dropbox for file storage, Skype for videoconferencing, Flickr for photo sharing, and YouTube for video sharing.

The next section of the paper presents a brief overview of the use of Learning Management Systems in higher education. It discusses in detail the Sakai LMS, which is the main LMS in use at the University of Limerick. Section 3 presents the methodology. Section 4 presents the results and discusses their implications. Section 5 concludes with some recommendations for further work based on the findings.

2. Learning management systems in higher education

Academics have long sought to integrate contemporary innovations into teaching and learning (Rhode et al., 2017). In recent years, Learning Management Systems (LMSs) have become the norm (Gautreau, 2011). The steady growth of LMS adoption in higher education has been well documented (Carmean & Haefner, 2003; Daniels, 2009; Harrington et al., 2006; Malikowski, 2010; Mkhize, Mtsweni, and Buthelezi, 2016; Mills, 2005; Vovides et al., 2007). With Learning Management Systems being present in 99% of higher education institutions, their use is now ubiquitous (Dahlstrom, Brooks, & Bischel, 2014; Green, 2013; Lang & Pirani, 2014).

LMSs are widely used for the creation, distribution, management, and retrieval of course materials. They support interaction, enable institutional innovations in teaching and learning, and provide tools for active online engagement such as discussions, chat rooms, wikis, and blogs (Cigdemoglu et al., 2011; Lonn & Teasley, 2009). Recent studies of higher education students and their technology preferences have noted that nearly all students use an LMS and that the LMS is consistently identified by students as among the most important instructional technology for their academic success (Brooks, 2016; Dahlstrom, Walker, and Dziuban, 2013).

There are many LMSs such as Moodle, Sakai, Blackboard Learn, etc, which are either commercial or open-source. Moodle and Sakai are the most preferred open-source LMSs due to their flexibility, ease of use, popularity and compatibility (Caminero et al, 2013; Cigdemoglu et al, 2011). Sakai handles a large number of users than Moodle (Caminero et al, 2013) and has hundreds of adoptions worldwide (Dube & Scott, 2014). The remainder of this section focuses on the Sakai implementation at the University of Limerick and briefly reviews of some of the literature relating to the growing discipline of learning analytics in higher education.

2.1 Sakai learning management system

Funded by a Mellon Foundation Grant, Sakai was developed in 2004 by a consortium of five large U.S. universities including Indiana, Michigan, Stanford, UC Berkeley and MIT. In excess of 350 institutions worldwide now use Sakai, and the software has been translated into over 20 languages and dialects (sakaiproject.org).

Serving more than four million learners worldwide (sakaiproject.org). Sakai is an online collaboration and learning environment and comprises a set of generic collaboration tools such as Announcements, Drop Box, Email Archive, Resources, Chat Room, Forums, Threaded Discussion, Message Centre, Message of the Day, News/RSS, Preferences, Presentation, Repository, Search, Schedule, Search, Web Content, Wiki and Site Setup. Beyond the core tools, Sakai provides integrations with several other teaching and learning tools e.g. Turnitin (a web service for detecting plagiarism - integrated into Sakai Assignments tool) that can be enabled within course and project sites. Figure 1 presents a generic Sakai user interface, with some tools listed on the left.

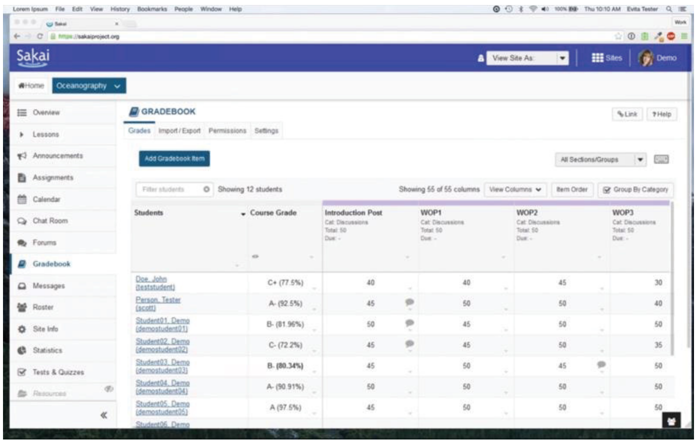

Figure 1: Sakai user interface (https://sakaiproject.org)

2.2 The application of Sakai at the University of Limerick

This section of the paper introduces the University of Limerick and its LMS 'Sulis' - a customised version of Sakai.

2.2.1 The University of Limerick

The University of Limerick (UL), has a student population of over 15,000, and is approximately 5km east of the city centre in the suburb of Castletroy, Limerick, Ireland. It was established as the National Institute for Higher Education (NIHE) in 1972, and in 1989 was the first university to be established since the foundation of the State in 1922. UL offers a range of courses and programmes up to doctorate and post-doctorate levels in the disciplines of Arts, Humanities and Social Sciences, Business, Education and Health Sciences, and Science and Engineering.

2.2.2 Sulis

The Sakai interface comes with a default look and feel. Any institution interested in adapting Sakai can customise its appearance—for example incorporating the institutional logo and banner (Chauhan et al, 2015). 'Sulis', a customised version of Sakai, is the name given to the University of Limerick LMS. Virtually all UL courses, whether fully online or blended, now use Sulis for all or a portion of the course content.

In July 2016, the University of Limerick undertook its first major Sakai upgrade to version 10.6, which provided a number of functional enhancements, including better tools and a more appealing user interface. In July 2017, a further upgrade (to version 11) provided a more optimised user experience—the LMS is now responsive to desktop computers, tablet and smartphone devices.

2.3 Exploiting the LMS for effective learning

Although LMSs have a wide range of features, it is generally the content repository and communication features that are by far the most popular ways in which LMSs are employed. This is closely followed by assessment management (Farrelly, et al, 2018). There are significant practical implications of widespread use of mobile devices for learning, taking into account also the specific mobile use of the LMS on smartphones (via a mobile browser) to support teaching and learning. These include redesign of both formal classrooms and informal learning spaces, and requirements for supporting campus infrastructure such as wi-fi (Raftery, 2018).

There is potential for flexible mobile access to the LMS outside of class to be complemented by increased in-class use to enrich innovative approaches to engage learners (Raftery, 2018). Through using the LMS via a mobile browser, previously underused LMS features such as live online chat and quizzes may enable active learning in the classroom.

Allowing students to complete formative, and possibly summative, online quizzes on their smartphones brings multiple advantages: engaging for students, a support for active learning (Didau, 2015), and a support for flipped learning approaches. As the quiz is within the LMS, students can see scores in real-time and their marks and attempts can be recorded in the gradebook. This has the potential to give valuable feedback to the instructor on areas of general difficulty - plus the potential to identify individual students who happen to be struggling with module content.

2.4 Learning analytics in higher education

In recent years, there has been a growing interest and awareness of learning analytics in the higher education sector (Siemens & Baker, 2012). Learning analytics, educational data mining, and academic analytics are closely related concepts (Bienkowski, Feng, & Means, 2012; Elias, 2011). Oblinger (2012) defines learning analytics as focusing on *"students and their learning behaviours, gathering data from course management and student information systems in order to improve student success"* (p. 11). Wong (2017) states that higher education institutions present an ideal context for the use of analytics due to their large student numbers and the increasing use of the Internet and mobile technologies – all resulting in a very substantial amount of data to probe.

Despite the many studies over the past number of years relating to learning analytics in higher education institutions, learning analytics is still an emerging field of education (Avella et al., 2016). By utilising the increased availability of big datasets around learner activity and digital footprints left by student activity in LMSs, analytics can be used as a tool to contribute to quality assurance and quality improvement of programmes, early detection of learner disengagement and enable the development and introduction of personalised or adaptive learning

(Arnold & Pistilli, 2012; Gammell, Allen, & Banach, 2012; Long & Siemens, 2011; Sclater, Peasgood & Mullan, 2016).

The possibilities for massive data collection understandably raise ethical concerns in the academic community. Pardo & Siemens (2014) define ethics in the digital context as *"the systematization of correct and incorrect behaviour in virtual spaces according to all stakeholders"*. Ferguson (2012) identifies the need for ethical guidelines as one of four major challenges for the LA field. According to Slade and Prinsloo (2013) there are three broad classes of ethical issues: (1) the location and interpretation of data; (2) informed consent, privacy, and the de-identification of data; and (3) the management, classification, and storage of data.

3. Methodology

In this section, we outline our research questions and how we gathered data.

3.1 Research questions

One of the most obvious characteristics of the current generation of LMSs is a more advanced and integrated learning analytics feature. The aim of this research is to examine data generated by Sakai analytics to determine platform and device usage over a four-year period, at the University of Limerick. Specifically, this research aims to address the following questions:

- How has desktop (Microsoft Windows and Apple macOS) use changed over a four-year period—both before and after the major LMS upgrades?
- How do users (students and instructors) use mobile devices (tablets and smartphones) to interact with the LMS?

3.2 Data acquisition

Typically, instructors only have access to analytics directly related to their modules—for example data relating to the number of logins, resources accessed, and number of words posted in discussion forums. For this campus-wide research study, we requested a bespoke report from the Information Technology Division (who are responsible for the cross-campus implementation and administration of Sulis) on platform usage over a four-year period (January 2014 – January 2018). The commissioned report presents monthly use by staff and students for the platforms presented in Table 1.

Table 1: Platforms

Desktop/Laptop:	Mobile
Microsoft Windows	*Apple iOS*
Apple macOS	Android
	Other

3.3 Ethical issues and considerations

Prior to obtaining data from the Information Technology Department (ITD) at the university, the authors applied for, and were granted, ethical approval from the faculty research committee to obtain and interpret learning analytics data about individual students taking specific courses. However, as the data reported in this study comprises only aggregate data from *all* students at the university, no students can be identified (*directly or indirectly)* and there are no ethical issues with regards the storage and management of individual student data.

4. Platform usage

This section presents LMS (campus-wide) platform usage data at the University of Limerick over a four-year period - January 2014 to January 2018.

Figure 2 presents the monthly percentage breakdown by platform usage. Findings show that the use of Microsoft Windows has declined overall, but still remains the predominant desktop platform. While mobile use—in particular the use of iOS and Android devices—has increased overall, users rely more heavily on desktop/laptop computers during intensive assignment and exam periods in May and December (see Figure 3).

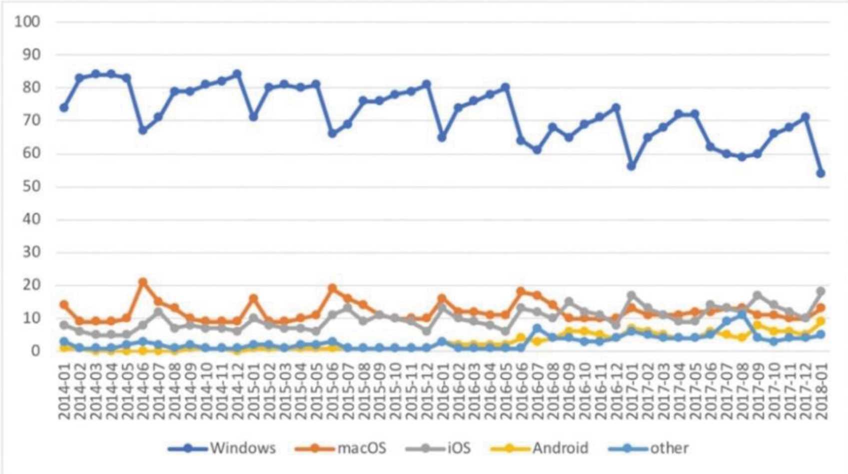

Figure 2: Platform usage (Jan 2014-Jan 2018)

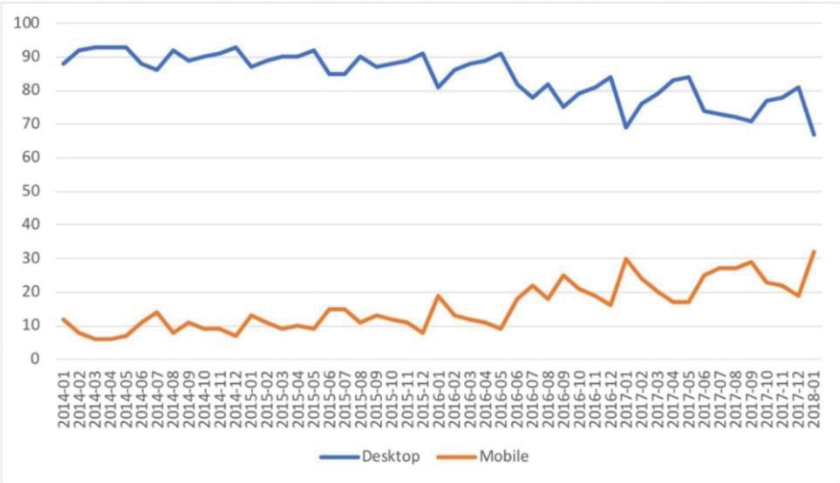

Figure 3: Desktop/laptop vs. mobile platform usage (Jan 2014-Jan 2018)

Figure 4 presents equivalent data comparing desktop/laptop platforms—specifically Microsoft Windows and Apple macOS. Not surprisingly, use of both platforms peaks at key times of the academic year (around May and December).

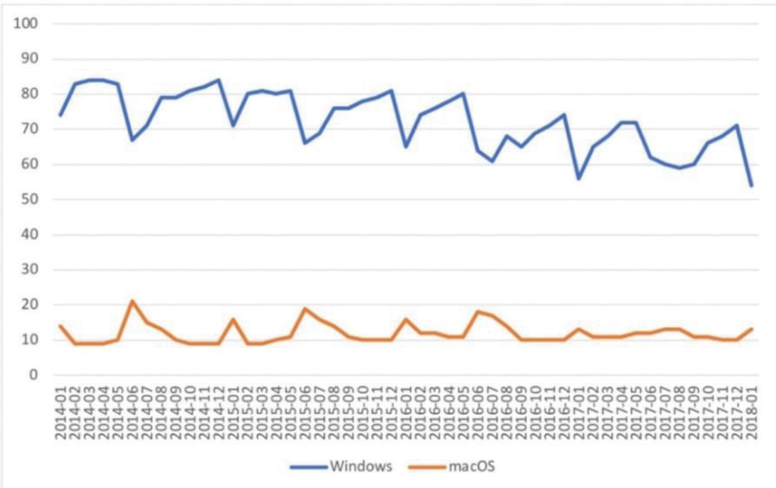

Figure 4: Windows vs. macOS Platform Usage (Jan 2014-Jan 2018)

Figure 5 compares usage on mobile devices (Apple iOS and Android). While Apple iOS is still clearly the preferred mobile platform, there has been a steady increase in Android usage in the past two years (2016-2018).

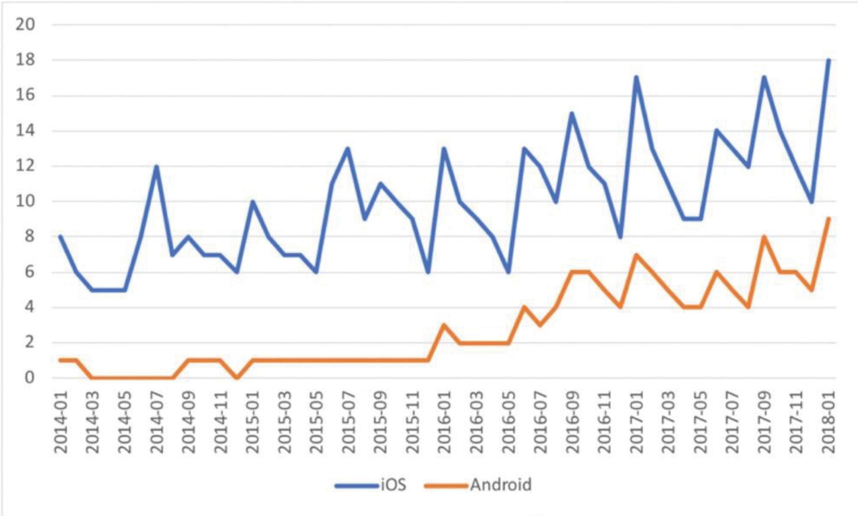

Figure 5: iOS vs. android platform usage (Jan 2014-Jan 2018)

Table 2 presents the percentage use of each platform for both desktop/laptop and mobile devices. Most notably, from January 2014 to January 2018, there was a 24% decline in the use of desktop/laptop devices (88% down to 67%). During the same period, there was a 175% increase in the use of mobile (12% up to 33%).

Table 2: Platform usage differences 2014/2018

	Desktop/Laptop			**Mobile**			
	Windows	Apple macOS	**Total**	iOS	Android	Other	**Total**
January 2014	74%	14%	**88%**	8%	1%	3%	**12%**
January 2015	71%	16%	87%	10%	1%	2%	13%
January 2016	65%	16%	81%	13%	3%	3%	19%
January 2017	56%	14%	70%	17%	7%	6%	30%
January 2018	54%	13%	**67%**	18%	9%	6%	**33%**

Table 3 highlights peak use for each platform (but not necessarily peak usage across all platforms over the four-year period). Taking Microsoft Windows as an example, usage peaked in March, April, and December 2014 (coincidentally 84% of the population used Windows during each of these months). MacOS peaked in May 2016 (21%), iOS peaked in January 2018 (18%), and Android peaked in January 2018 (18%).

Interestingly, 'other' platforms peaked in August 2017 (11%), which coincides with repeat examinations and orientation of new students. The previous month, the responsive version of Sulis was implemented, which possibly invited access from non-traditional devices (many staff would also have been on annual leave during this time). During this time, IT staff may also have been testing the responsiveness on different devices, so this may also impact this figure.

Table 3: Peaks in platform usage

Desktop/Laptop			**Mobile**		
Year	**Windows**	**macOS**	**iOS**	**Android**	**Others**
2014	84% (peaks in March, April, December)				
2015					
2016		21% (peak in May)			
2017					11% (August peak)
2018			18% (January peak)	18% (January peak)	

5. Implications for learning

This paper examines how desktop use has changed during a four-year period and how users (students and instructors) use mobile devices to interact with the Sakai LMS, at the University of Limerick. While use of Microsoft Windows has declined overall, it is still the predominant desktop platform. Mobile use—in particular the use of iOS and Android devices—has increased overall, but users still rely more heavily on desktop computers during intensive assignment and exam periods.

While the findings in our study will obviously inform infrastructural requirements at institutional level (e.g. the institution will not need to invest as heavily in desktop PCs for students going forward), these findings are also of great interest to instructors who want to know how, and when, their students interact with the LMS. The tools and features now offered in most LMSs, coupled with better plug-ins will provide greater opportunities for collaborative learning. For example, instructors who know that the majority of their students have access to a smart device during class, can employ live quizzes or polling exercises—activities such as these were not feasible a few short years ago. Large, passive lectures can potentially be made more engaging, using mobile devices.

However, the increased use of the LMS via mobile also has other consequences for how instructors use the LMS. For example, some LMS activities might not be sufficiently usable or accessible on mobile devices, which may hinder student engagement at certain times in the semester. For example, in our study, we found that students tended to use mobile devices more during the semester, but resorted to desktop towards the end of the semester. When key deliverables are due, students' mobile data allowances may not permit large file uploads or they may simply feel more confident uploading assignments using desktop devices. Furthermore, requiring *all* students to use a mobile device during class may not be feasible, without imposing additional financial burdens on students who do not already have mobile devices.

When students are asked to interact online, they may not engage immediately. Issues such as 'lurking' are often not as problematic as they initially seem—some students just need time to digest course materials, read other students' contributions, and devise their own responses—in a classroom environment, students may respond quickly just to break the silence in the room. Furthermore, while young students tend to be comfortable using mobile devices for personal recreation and entertainment, they might not be as adept at using mobile for *learning*. Consequently, institutions need to support students' digital literacies and meet the challenges of digital equity (Rafferty, 2018).

6. Recommendations for future work

Taking this study further, ideally, we would like to acquire data that separates desktop use from laptop use. Furthermore, a breakdown of 'other' platforms is not currently available, but we suspect platforms like Windows mobile are included in this figure.

Our future research will examine LMS data from a micro (course/module) perspective with a view to identifying if certain student behaviours on the LMS (e.g. when and how often they login) are linked with learning outcomes and grades. With the type of data that is now available in our LMS, we would also like to investigate if specific teaching strategies (e.g using discussion fora rather than face-to-face tutorials) lead to greater engagement among students.

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Improving Vocabulary Acquisition in a Second/Foreign Language With a Mixed Reality Environment and a Drone

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Abstract: Most computer language assisted learning approaches support that a new language for learners should be treated as a communication tool with a specific goal, which is incorporated in real communication activities. In this study, we will present the design and evaluation of a learning environment based theoretically on Content and Language Integrated Learning (CLIL), Task-Based Language Learning (TBLL) and embodied learning, and which exploits multiple technologies such as mixed reality environments, tangibles, drones and fingertrips, for delivering an authentic experience that promotes situated vocabulary learning. Twenty-four students were asked to interact in 6 sections with an augmented 3D model of a volcano and "climb" with their fingers at the top of it with the aim of acquiring vocabulary for a second language and learning about natural disasters and how to fly a drone. Data were collected with a pre and post vocabulary test, an attitudes questionnaire and semi-formal interviews. Students were excited with both the finger-based exploration of the augmented model and with flying the drone while they assessed the whole experience as integrated, innovative and attractive. Students' vocabulary was significantly improved in the post test and for some students this improvement was spectacular. Our study offers evidence that similar multi-technology environments may become motivating and effective learning platforms for interdisciplinary and authentic learning of a second language.

Keywords: vocabulary acquisition, second/foreign language learning, mixed reality environment, drones

1. Introduction

Globalization has increased the needs of language and communicative education (Coyle et al., 2010). Learning foreign languages nowadays offers rich rewards, including communication skills and strategies, networking opportunities, access to more sources of information, better cultural connection, and improved job prospects. Research on second/foreign language acquisition/learning and (SLL/A) is steadily growing (Ellis, 2015) and studies focus on both the educational approaches and the technological tools that can help SLL/A aims. Effective communication necessitates adequate vocabulary since it is closely associated with all four language learning skills: listening, speaking, reading, and writing. Students usually consider learning a second/foreign language vocabulary as a boring and passive activity since most times it is carried out through decontextualized learning input, which reduces their interest.

Computer Assisted Language Learning (CALL) has attracted a lot of interest as a research area and aims at finding ways to attract the students' attention, to strengthen their motivation and self-confidence (Pokrivčáková et al, 2015) and to bring the learning activities closer to their virtual or real life so as to become more authentic. CALL researchers search for applications that offer personalized assistance and feedback, allow for flexibility of pacing, provide a communicative and meaningful learning environment, incorporate multiple modalities, gamify learning, and, in sum, provide interactions that advance language skills. In the field of vocabulary acquisition for a second language, several approaches have been proposed such as word games (Lin et al, 2008), interactions with robots (Wu et al, 2008), detective games through mobiles and QR codes (Dourda et al, 2012), smart places (Edge et al, 2011) or virtual environments (Lan et al. 2015). Most of these learning environments promote situated vocabulary learning practices that help students acquire words in a natural way.

New learning technologies, such as Mixed Reality Environments and tangible interactions, are designed to improve even more presence and engagement, physicality and context-awareness. Mixed Reality environments merge the digital with the physical and allow students to become insiders of the environment they are trying to understand (Lindgren & Johnson-Glenberg, 2013), to immerse themselves in intriguing contexts and tasks in an embodied way. Mixed reality environments, such as FingerDetectives (Palaigeorgiou et al., 2017C), are considered by students as engaging, realistic and attractive contexts of play for vocabulary acquisition. Moreover, mixed reality environments offer opportunities to combine different technologies over the augmented spaces, address students' technological expectations and provide even more authentic perspectives of the learning activities.

In this study, we present the design and evaluation of a learning environment which is based theoretically on Content and Language Integrated Learning (CLIL), Task-Based Language Learning (TBLL) and embodied learning, and exploits multiple technologies such as mixed reality environments, tangibles, drones and fingertrips (Palaigeorgiou et al. 2017A), for delivering an authentic experience and promoting content vocabulary acquisition in a foreign language. The targeted vocabulary concerns natural disasters and students have to climb with their fingers through the augmented 3D model of Indonesia's Merapi volcano. Students should learn about natural disasters and also learn how to fly a drone in order to get it to the augmented model as an emergency help, when some unexpected events happen.

2. Related work

2.1 Situated and embodied vocabulary acquisition

Students should experience foreign language as a communication tool with specific goals in order to facilitate its acquisition. They must be immersed in linguistic and cultural contexts that are similar to that of the native speakers. Content and Language Integrated Learning (CLIL) approach includes a dual focus on language learning and cognition, the construction of safe and enriching learning environments, the use of authentic materials, the enhancement of cooperation among students and teachers and the promotion of active learning (Griva & Deligianni, 2017). CLIL integrates four interrelated principles for effective classroom practice, the '4Cs Framework' which emphasizes the interrelationship between content, communication, cognition and culture, and focusing on teaching both the target language and the content knowledge (Coyle et al., 2009; Ioannidou et al., 2017). Language learning in a CLIL context starts out exclusively in an implicit way. The emphasis is on activity/task, i.e. learning by doing in the target language (de Craen & Surmont, 2017), usually in a task based framework. Similarly, Task-Based Language Learning (TBLL) focuses on the use of authentic language when asking students to perform meaningful tasks using the target language (Ellis, 2003; Robinson, 2011). TBLL focuses on selecting adequate tasks, supporting their progression and helping learners comprehend their meaning and reflect on the results. Both approaches follow an interdisciplinary approach to language learning and try to generate more interest to the learners.

Recently, language learning has also been focusing on how embodied action may help students on vocabulary acquisition/learning. In the embodied learning perspective, knowledge is grounded in a person's experiences which include verbal, visual, sonic, motoric, tactile, and kinesthetic aspects. For example, Macedonia et al (2011) demonstrated that verbal associated with non-verbal communication have an impact on the recall of verbal information in the speakers' mother tongue and second/foreign language. Similarly, Rueschemeyer et al. (2010) found that participants accomplish more if they process functional words while doing an intentional action and less if they work with nonfunctional words while doing an arbitrary action. As Toumpaniari et al (2015) propose, students, through embodied learning, are able to make authentic use of the language. The use of authentic education input is a key factor since it provides students with the opportunity to focus on communication meaning and messages and not on specific linguistic and grammatical items and patterns.

Ubiquitous technologies seem to fit well with all previous theoretical approaches since by augmenting objects and spaces, they enable students to practice tasks and roles in real contexts. There is a new generation of educational environments that attempt to support language learning in smart spaces and by embodied actions on real objects e.g., TANGO (Tag Added learNinG Objects) (Ogata & Yano, 2004), HELLO (Handheld English Language Learning Organization) (Liu et al, 2007), MicroMandari (Edge et al, 2011) and iSpy (Lee and Doh 2013), Vocabulary Wallpaper (Dearman and Truong 2012), FingerDetectives (Palaigeorgiou et al., 2017C).

2.2 FingerTrips

One of the first mixed reality environments proposed, concerned augmented maps which also could be used for learning scenarios (Piper et al. 2002). In such cases, 3D landscape models are constructed using clay, sand or similar material, a depth sensor understands the structure of the model and projects over it a digital enhancement of the landscape e.g. Augmented REality Sandtable (ARES) (Amburn *et al.,* 2015). Palaigeorgiou et al (2017A) have proposed a new interaction technique for navigating and interacting with such augmented maps, the Finger Trips approach. With this technique, learners are asked to follow with their fingers predefined engraved paths on the 3D terrain to sense distances, changes in altitude and “touch” the topology. The hypothesis is that by “feeling” the map, student will understand spatial references and will learn both by visual and sensed information. FingerTrips have been used successfully for acquiring content knowledge either in geography (Palaigeorgiou et al. 2017A), or history (Triantafyllidou et al. 2017), as well as for acquiring/learning general and content vocabulary when applied to an augmented 3D miniature home (Palaigeorgiou et al. 2017C). FingerTrips, in essence function as fieldtrips on the augmented landscapes, and can simulate events and interactions that may happen in the real places. That’s why FingerTrips seem to be an interesting platform for vocabulary acquisition/learning.

2.3 Drones in education

Over the last few years, educators have exploited even more the power of drones to engage students. Although there is a limited number of research studies, media support that drones promote innovative thinking, encourage group participation and problem solving. Opportunities and the challenges have been discussed until now in robotics education (Krajnik, 2011) in multidisciplinary engineering education (Jacques et al., 2016), in sports education (Zwaan, 2016), in programming (Wheeler, 2016), in virtual field trips (Palaigeorgiou, et al., 2017B), in mathematics, physics, and geography (Fokides et al., 2017) but not for second/foreign language vocabulary acquisition. Flying a drone can probably become an intriguing activity for students and an excellent canvas for task-based language learning.

3. Aim and the proposed mixed reality environment

In this study, an attempt was made to create a tangible, playful interface for second/foreign language vocabulary acquisition/learning related to natural disasters and drones. Our goals were to:

- offer a gamified activity for vocabulary acquisition/learning which engages students in a task-based context;
- familiarize students with Merapi volcano in Indonesia, volcanos in general and their effects;
- teach students how to fly a drone;
- take advantage of fingertrips-based embodied interaction to make vocabulary acquision/learning more efficient and effective in an authentic environment;

The environment is based on a 120X80cm 3D tangible model of Merapi volcano in Indonesia (see fig 1). The Merapi volcano is active and has been regularly erupting since 1548. The 3D model is enhanced with the use of a projector that transforms the 3D model in a true living environment.

The scenario of the game involves a group of climbers that have organized an excursion for exploring the volcano. Their base is at the foothill of the volcano and that place is the starting point of their journey. The game goal is to help the climbers to walk and reach the top of the volcano by encountering a series of problem solving situations: the volcano erupts often and launches lava but also causes seismic vibrations, and hence the climbers have to react property. They have the right equipment in their bags with the necessary tools to confront whatever may happen to them in the wild forest with the dense vegetation. Students participate in the game in groups of four. When the signal is given and the game starts, the students go through the path and stop at different points due to oral or visual indications that that something is happening.

Almost all the instructions are given in the foreign language (English) and a dictionary presenting up to 4 words for each task appears at the bottom (fig.1) of the model. Students can touch the words and see their meaning in their mother tongue.

There are three types of interactive activities: activities to be performed on the augmented model, activities that function as bridges for proceeding to drone tasks, and activities directly related to flying a drone. As an example, for the first type of activities, at some point a bear appears and the “mountaineer” have to solve a problem: to select the most appropriate item form a list of things in order to distract the attention of the bear.

An example for the second type of interactions, due to volcanic eruptions, a seismic vibration is caused, a tree falls and a mountaineer is injured in her leg. The students listen, read and have to comprehend the dialogues between the climbers, explore a question about first emergencies aid and then click on an emergency button, connected to the authorities. At that moment, help comes with the unmanned aerial vehicle (drone).

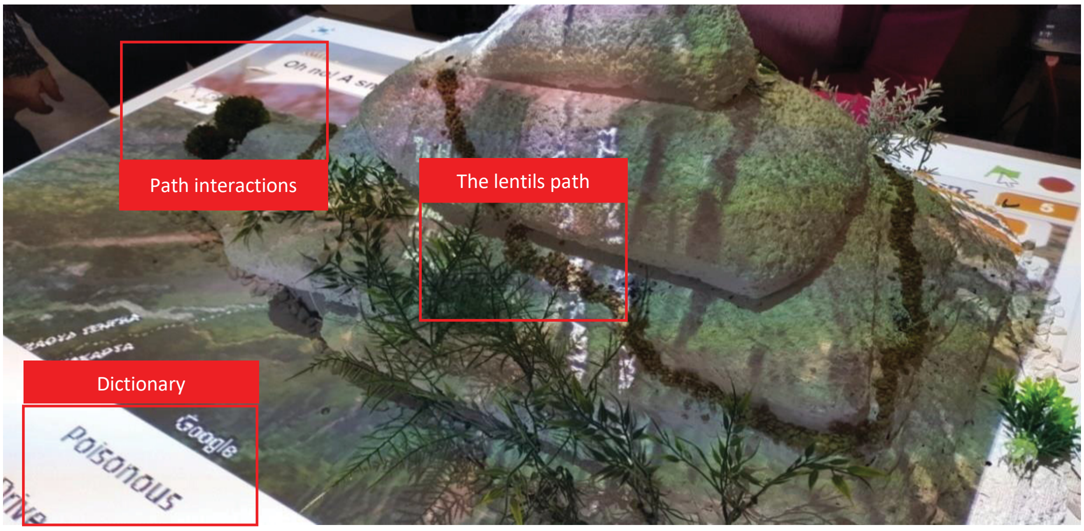

Figure 1: The augmented Merapi volcano

In the third type of activities, students have to move on the mezzanine of the exhibition space where the drone is landed (fig.3) and where cards with piloting instructions lie (fig.2). Students have to fly the drone from the mezzanine to the lower floor and next to the model and the climbers' position. Immediately after they have to execute the reverse root for transferring the injured person to the hospital. A prerequisite for students, before taking off the drone, is to understand the meaning of the instructions well enough so as to be able to later fly it. Then, the students have to return to the augmented model and continue together with the other mountaineers their way to the volcano. The above procedure is performed 3 times. The game ends when students "climb" to the highest point of the volcano and place the finishing flag.

Drone exploitation was introduced to offer a powerful motivation for children to participated in the journey but also because it can be a rich source of vocabulary-related tasks. The drone also gives a sense of alertness to the proposed scenario as students have to run up on the mezzanine to save climbers and return later.

In order to indicate the available finger paths on the mountain, lentils were glued on the paths. The lentils were also used for hiding interaction points in the model since students were called to explore the environment without knowing where the different events may unveil. The program provided several different augmentations next to students' fingers.

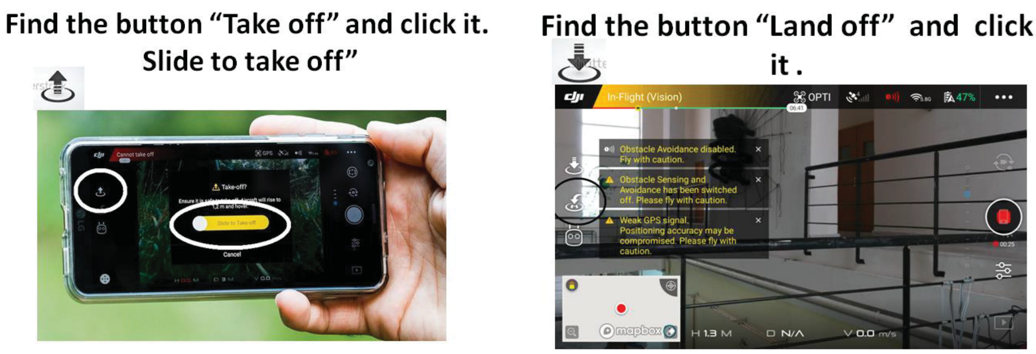

Figure 2: Sample cards for flying a drone

All tasks were designed considering the fact that repetition in a natural way and authentic tasks contribute decisively to vocabulary acquisition. All targeted words were repeated at least twice. The game augmentations and interactions were programmed in MIT Scratch while the fingertrip interactions were made possible through two Makey-Makey prototyping boards. Both technologies are affordable and accessible to teachers and students and, thus, the wide replication of the proposed environment is feasible.

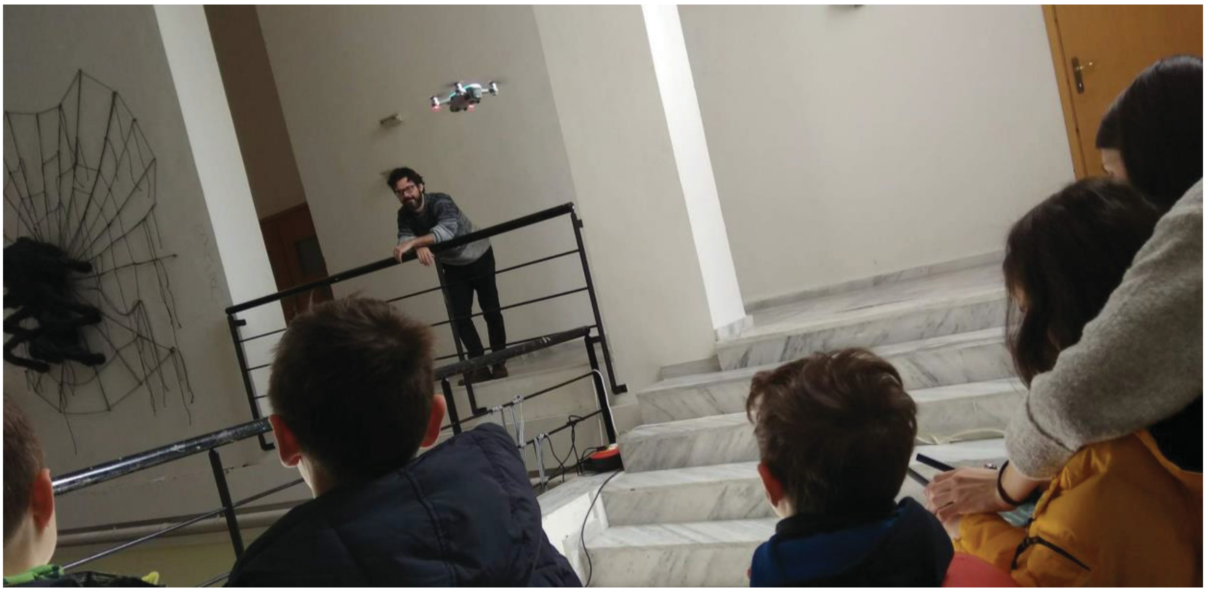

Figure 3: Students on the mezzanine piloting the drone towards the augmented volcano

4. Methodology

4.1 Participants

Indonesia's Merapi volcano was explored by 24 primary school students of 4^{th} grade, in the context of an interactive exhibition related to Tangible and Mixed Reality Interfaces for Primary Schools in Greece. The participants cooperated in groups of four students and they played with the environment in six sessions.

4.2 Procedure

Initially, students sat for a pretest related to the target vocabulary. Afterwards, they started their fieldtrip on the augmented model and with their fingers reached the highest location of the volcano where the last activity was presented. During the game, they had to fly the drone for three times. The game endured about 30 minutes. Upon the completion of the game, students participated in the posttest related to the target vocabulary, reflected on their experience in an attitude-questionnaire and participated in focus group discussions.

4.3 Research instrument

Data collection was based on pre/post test, an attitude-questionnaire and focus group discussions. The pre/post test consisted of 21 English words that students had to translate in Greek. The attitudes questionnaire consisted of 22 5-point Likert questions and evaluated the tangible environment in regards to its usability and attractiveness. Some of the questionnaires' items were derived from AttrakDiff (Hassenzahl & Monk, 2010) and Flow State Scale (Jackson & Marsh, 1996). The following variables were assessed:

- *Ease of Use* (3 items): Measures how easy to use the system is (e.g. *the environment was easy to use*);
- *Autotelic experience* (3 items): Measures the extent to which the system offers user fulfillment (e.g. *the experience left me feeling great*);
- *Perceived learning* (3 items): Measures students' perceptions about the educational value of the system (e.g. *I would prefer to learn vocabulary with similar environments*);
- *User Focus* (3 items): Measures the students' perceived focus on the learning activities during system usage (e.g. *I was completed focused on task*);
- *Pragmatic Quality* (4 items): Measures the extent to which the system enables a user to achieve his goals (e.g. *the environment was simple – complicated*);
- *Hedonic Quality-Stimulation* (3 items): Measures the extent to which the system is perceived as innovative and interesting (e.g. *the environment was conservative - innovative*);

- *Hedonic Quality-Identity* (3 items): Measures the extent to which the system lets the user to identify with it (e.g. *the environment was cheap - valuable*).

All questions were 5-point Likert scale questions and all variables can be considered as consistent since they had satisfactory Cronbach's a as seen in Table 3.

The focus group discussions were conducted upon the completion of each session and aimed at recording students' views about the environment. The questions were focused on what students enjoyed and disliked and their perceptions in regards to the learning success and efficiency of the environment.

5. Results

5.1 Pre-post test

Pre and post scores followed a normal distribution according to Shapiro-Wilk normality test ($p>0.05$). Paired samples t-test were conducted and the results showed a significant increase in the number of words students could recall after the intervention ($t=6.723$, $df=23$, $p<.001$), as presented in Table 1. Although the difference seems to be 6-7 words on average, when we excluded two students who scored more than 90% in the pre-test and three students who had very low scores both on the pre and the post test due to their minimal experience with English as a second language, nineteen students improved their score by an average of almost 10 words. Interestingly, there was also a student who learned 15 words. Hence, we can admit that the particular educational environment could provoke significant learning outcomes. In table two, we present also a short sample of the most frequent words acquired by the students.

Table 1: Pre/post test results

	Min	Max	Mean	SD
Pre-test	1	16	6.41	3.82
Post-test	6	20	12.92	4.17

Table 2: Words learnt more

Words	Before (num. of students)	After (num. of students)
The volcano exploded	6	23
Honey	9	23
Hook	8	21
Seismic vibration	0	13
Poisonous	4	15
Injured	1	13

5.2 Attitude- questionnaire

Students' overall assessment of their learning experience with the proposed environment was very positive. As seen in Table 1, students assessed the proposed environment as easy to use and claimed that it retained their attention for the entire duration of the learning session. They stated that they would like to use similar environments often ($M= 4.63$, $SD=.71$) and that they were very focused on the tasks presented and the things to be done ($M= 4.50$, $SD=.72$). Students were pleased with their experience (autotelic experience) and, for example, they strongly supported that they enjoyed the learning experience ($M= 4.87$, $SD=.72$). They also claimed that they would prefer to acquire vocabulary for a second/foreign language through the same environment in the school context. Students' answers in the mini AttrakDiff questionnaire validated that they considered the environment as appropriate to achieve both second/foreign language learning and content knowledge (geographical fieldtrips). Students indicated that the environment was exciting, innovative, and engaging without moments of boredom and discomfort (hedonic quality). Students' answers showed that they identified themselves with it (Hedonic Quality-Identity) and they thought that it offered inspiring and novel functions and interactions (Hedonic Quality-Stimulation). Students' answers in the last two variables were particularly high.

Table 3: Students' attitudes towards the learning environment

	Min	Max	Mean	SD	Cronbach's a
Easiness	2.67	5.00	4.43	.63	.82
Focus	2.67	5.00	4.42	.65	.77
Autotelic Experience	3.33	5.00	4.69	.46	.75
Learning Preference	2.00	5.00	4.13	.97	.88
Pragmatic Quality	2.75	5.00	4.34	.79	.79
Hedonic Identity	3.00	5.00	4.72	.56	.94
Hedonic Stimulation	3.33	5.00	4.79	.51	.84

5.3 Focus group discussions

Students' comments validated their answers in the questionnaires. At the beginning of the game, all of the players looked excited because of the interactive augmented space and the expectancy of flying the drone. However, in order to follow the virtual fieldtrip, students had to understand all the instructions in a different language, and some of them were a bit nervous about the English vocabulary that will be needed. The students quickly understood the rules of the game and began to interact with the dictionary and the other interactive elements. They liked the game, and their comments were enthusiastic.

> *"I have not done anything like that in the past…."*

> *"I liked it too much."*

Several students commented that the proposed approach improves learning efficiency while it also adds a playful character to the learning process. Their comments confirm that an interdisciplinary, multi-technology, task-based, tangible learning approach is a promising design direction for second language learning.

> *"I liked learning English words in a different way."*

> *"Through the game you learn more because you are more focused, it makes you concentrate your attention."*

> *"We learned things about the environment, the drone, the animals in a foreign language. It's easier! "*

> *"I learned that technology can be used in a lot of things, for learning and playing together."*

Students thought that the augmented model of the volcano with the drone as assistance for the climbers was realistic, attractive and stimulating. Students didn't have difficulties in piloting the drone with the guidance of the help cards. They also claimed that piloting the drone was inherently integrated with their field trip on the model while the role of the drone was of major importance for their experience.

> *"The drone was perfectly amazing and was connected to the [augmented] model."*

> *"I did not expect the drone to be in the game, I was surprised! Smart connection."*

> *"It was very interesting that the scenario was not focused only on the Volcano but was also connected to a drone."*

6. Discussion

In this paper, we presented an interactive game for vocabulary acquisition/learning that was consisted of an augmented interactive volcano model and drone-related activities. The proposed pilot intervention was based on CLIL (content and language integrated learning) approach, task-based language learning, CALL (computer assisted language learning), mixed reality environments, drones and embodied learning. Students considered their participation in the game as effective and interesting. They were excited with both the finger-based exploration of the augmented model and the drone flying while they assessed the whole experience as integrated, innovative and attractive. Students' performance in acquiring content vocabulary in a FL was significantly improved in the post test and for some students this improvement was amazing. Hence, there is evidence that similar environments may become motivating and effective learning platforms for interdisciplinary and authentic learning of a second/foreign language.

The proposed environment follows a new trend for *multi-technologies mixed reality environments*. These proposals try to combine concurrently the use of divergent technologies that are particularly attractive to students (e.g., tangible interactions, drones, educational robotics, mobile phones), to support the realization of learning objectives in the context of specific interdisciplinary and problem-based learning scenarios for humanities and not only, and to integrate these technologies under the umbrella of a mixed reality environment. Mixed Reality environments offered also in our case a vivid and immersive audiovisual interface for eliciting body activity and allowed students to immerse in the hypothetical scenario. Additionally, the exploitation of multiple technologies empowers students to approach school subjects from multiple perspectives through the idiosyncratic characteristics of each technology.

The environment was constructed taking into consideration to be affordable, easy to use and replicable. Hence, it can even be constructed by primary school students or their teachers and they can alter both the augmented terrain and learning scenario. Thus, it is also a creative starting point for calling students to imagine their own versions of the game, in different contexts and with a variety of learning objectives e.g., for different emergency conditions. This approach is synchronous with the maker culture popular nowadays in schools and promotes the need to enable students to design and develop their own learning tools.

Although the study seems to have achieved its objectives, there are still limitations and shortcomings. The study did not involve a control group, the sample was small, so we cannot safely generalize the specific results. Moreover, there was no in-depth inquiry of the learning mechanisms which may provoked them. It is suggested that further implementations should be conducted for evaluating the specific learning setting.

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Designing a Prototype Training Environment for Physiotherapists Building on Advanced Gaming Technologies.

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Abstract: Recent years have seen the proliferation of digital games in areas beyond entertainment. Serious games have quickly gained momentum in professional training, as they allow for authentic learning experiences that are closely aligned to real-world issues, problems, and applications, provide immersion, and incorporate the essential ingredients of training: critical thinking, awareness of emotions, (collaborative) knowledge construction, creative problem solving and innovation. Incorporating advanced AR/VR technologies, serious games are revolutionising fields like medical training, which traditionally relies on textbook-based theoretical education and clinical placements. The paper first discusses the important role that gaming technologies increasingly play in training healthcare professionals and reviews state-of-the-art applications and best practice in the field, to then investigate the requirements and present the design of a prototype training environment for physiotherapists that builds on advanced gaming technologies. This professional group is purposely selected due to the inherent complexity of physical therapy, a type of treatment that encompasses a wide variety of aspects (kinesiology, physiology, pathophysiology, etc) and takes place in various healthcare settings. Physiotherapy refers to the recovery, improvement, and maintenance of a person's movement abilities. Physiotherapists should be able to analyse and assess the functional and physical state of a person, treat by movement, compensate disability, guarantee health care and prevention, and stimulate and educate healthy living. They are also called to manage psychological issues that impact rehabilitation. Physiotherapist training is a continuous process aimed at keeping professionals constantly up to date with new scientific insights, methods, technologies and tools. Advanced gaming technologies can allow physiotherapists to gain a greater understanding of possible therapeutic interventions and develop their clinical reasoning and decision making in the selection and justification of their chosen therapeutic approach. The paper applies the Design Science Research Methodology (DSRM) to design a suitable training solution for the promotion of authentic, comprehensive learning. Within the proposed system design, augmented reality modules are embedded alongside the game simulation and virtual world environment to provide participants with an authentic simulated game scenario in which to immerse themselves.

Keywords: serious games, professional training, e-learning

1. Introduction

Recent years have seen the proliferation of digital games in areas beyond entertainment (Michael & Chen, 2005; Squire, 2011). The term Serious Games was coined to describe games that engage users in activities other than pure entertainment, such as learning or training. The idea of using game-based learning is not new. In the last 40 years we can track activity in this area, for a variety of educational tasks (Abt, 1970; Loftus & Loftus, 1983; Egenfeldt-Nielsen, 2007). Modern Game-Based Education/Learning employs digital games to create "immersive digitally mediated learning environments"(Squire, 2011) and balancing the gameplay with pre-defined learning objectives (Protopsaltis et al., 2010). Serious Games are designed to promote personalised learning, active participation and interaction, and critical thinking, awareness of emotions, (collaborative) knowledge construction, creative problem solving and innovation. Connolly et al. (2012) note that Serious Games can enhance the effectiveness of learning, improve knowledge acquisition and content understanding and also allow for affective and motivational outcomes. Their impacts thus span several dimensions: perceptual, cognitive, behavioural, affective and motivational (Connolly et al., 2012). As a result, Serious Games have rapidly gained momentum in all fields of education, including professional training. Effective training implies the attainment of skills and thought processes necessary for operating properly under regular conditions and for responding suitably in times of need, under various real-life situations. While traditional training has significant limitations, offering passive training based on theoretical instruction and memorisation, Serious Games allow for immersion and authentic learning experiences that are closely aligned to real-world issues, problems, and applications, but are not limited by practical constraints of real-world settings and, additionally, incorporate the essential ingredients of training. This facilitates a deeper understanding and the assimilation of theory and allows trainees to evaluate their skills in a variety of complex, real-life eventualities, which will ultimately allow them to perform consistently and effectively in their professional life, even in new and unexpected situations. Immersive technologies such as virtual environments Virtual Reality, VR) and Augmented Reality (AR) have the potential to improve the effects of Serious Games and to revolutionise fields like medical education, which traditionally rely on textbook-based theoretical instruction and clinical placements.

AR and VR (Azuma et al., 2001; Slater et al., 2010) technologies have been around for decades, with their use extended to several applied fields (Allen et al. 2017) in recent years. Virtual reality and augmented reality technologies provide the ability to create fictitious spaces and/or to augment real-world spaces with virtual objects or even layered spaces. An AR system allows for combining or "supplementing" real world objects with virtual objects or superimposed information (Bacca et al., 2014), while in a VR system the user is found completely immersed inside a synthetic space, called a Virtual Environment (VE). In this sense, "AR supplements reality, rather than completely replacing it" (Azuma, 1997). This allows serious games to be played through natural interfaces (Foletto et al., 2017; Bortone et al., 2017, Milani et al., 2017).

This can lead to new services and applications about the traditional sense of space and place and the interaction with other humans that are not in the same place. Bits coexist with people allowing the physical space to be replaced or co-exist with virtual and digital space. A review by Bacca et al. (2014) noted a progressive increase in the use of AR in education. Santos et al. (2014) identified the three main affordances of AR that make it suitable for such applications: real world annotation, contextual visualisation and vision-haptic visualisation.

1.1 Serious Games for healthcare

Serious games as educational tools, are increasingly used in patient and health professional education (Arnab, 2012; de Ribaupierre et al., 2014; Drummond et al., 2017), including continuous medical education (Ricciardi & Paolis, 2014). Sawyer & Smith 's (2008) taxonomy of Serious games notes the application of SGs in healthcare for training healthcare professionals and patient education. A later taxonomy proposed by McCallum (2012) identifies 5 critical areas of application in the health domain (preventative, therapeutic, assessment, educational and informative) that span several stakeholder dimensions (personal, professional practice, research, and public health). All point to a widespread use of digital games explicitly designed for healthcare. Important application areas include preventative care, rehabilitation and behaviour modification for patients and education for medical professionals. For example Graafland et al. (2012) studied several medical education Serious Games linked to the surgical practice to conclude that blended and interactive learning by means of serious games can be effectively applied to train both technical and non-technical skills relevant to the surgical field. Latest research studies and application examples are provided in Table 1.

Table 1: Digital games for healthcare

Health purpose	Examples	Reference
preventative care & health promotion	- Active healthy ageing - Diagnosis/detection (e.g. cognitive screening) - Cognitive improvement (e.g. dementia games)	Pyae et al. (2016) Gaggi & Ciman (2016) Boletsis & McCallum (2017) McCallum & Boletsis (2013)
therapeutic intervention (rehabilitation & disease management)	- Study of rehabilitation featuring games for physical, social and mental activity - Cognitive training (e.g. on stroke) patients - Motor rehabilitation, e.g. Upper limb rehabilitation Traumatic bone/soft tissue injuries	Rego et al. (2010), Rego et al. (2018) Burke et al.(2010), Bonnechère (2018) Gamito et al. (2017), Tanaka et al. (2010) Tăut et al. (2017), Foletto et al. (2017), Jaume-i-Capó et al. (2014) Proença et al. (2018), Dehem et al. (2017), Tageldeen et al. (2017) Meijer et al. (2017)
mental health & behaviour modification	-mental health -health behavior change	Fleming et al. (2017) Baranowski et al. (2013)
medical education	-surgical skills training -medical cultural competence education - examination skill development (case of eye fundus) -patient communication -computer supported reflection	Graafland et al. (2012) Khan & Kapralos (2017) Nguyen et al. (2017) Dennis & Parry (2017) Pannese et al. (2013)

The acquisition of problem-solving skills through hands-on experience is of paramount importance in the case of medical professionals. Serious games for health can be applied for a variety of purposes, since, beyond knowledge of specific medical and care topics and/or technical and operational competencies for the delivery of a high standard of therapy and care, the training of medical professionals also involves the development of soft skills and interpersonal or social competencies, such as coping with demanding situations or conducting conversations with patients and relatives, etc.

To address these wide-ranging topics, several types of Serious Games applications have emerged. Ushaw & Morgan (2017) identified five classes of benefit delivery mecha-nism which are applicable across all types of serious games for health (repetition, exploration, strategy, progressive goal attainment and social interaction).

The present paper investigates the opportunities offered by and the ways in which Serious Games and new immersion/augmentation technologies can enhance the training of medical professionals and describes the development of the Gamepharm concept to support the training of health professionals in the field of physiotherapy. Physiotherapists training is a challenging application area that can draw significant benefit from gaming innovations(Mori et al., 2015; Roberts & Cooper, 2017). The paper first discusses the important role that gaming and augmentation technologies increasingly play in training healthcare professionals and reviews state-of-the-art applications and best practice in the field, to then investigate the requirements and present the design of a prototype training environment for physiotherapists that builds on advanced gaming technologies.

We argue that while new technologies offer several advantages, a holistic examination of the needs of medical professionals is required, calling for tailored solutions and a combination of training interventions coupled by relevant digital solutions. To derive the appropriate training service mix, the analysis follows the principles of the Design Science Research Methodology (DSRM).

1.2 Methodology

The present work employs the **Design Science Research Methodology (DSRM)** for Information Systems development (Peffers et al. 2007; Hevner et al. 2004). DSRM provides a framework that is well suited to the creation of artefacts in the broader Information Systems arena while in parallel it helps researchers to legitimise their research using understood and accepted processes. The design-science paradigm seeks to extend the boundaries of human capabilities by creating new and innovative artifacts (Hevner et al. 2004). In the design-science paradigm, knowledge and understanding of a problem domain and its solution are achieved in the building and application of the designed artifact. The design process of the Gamepharm Concept following the Problem-Centered approach that builds on the DSRM methodology is shown in Figure 1.

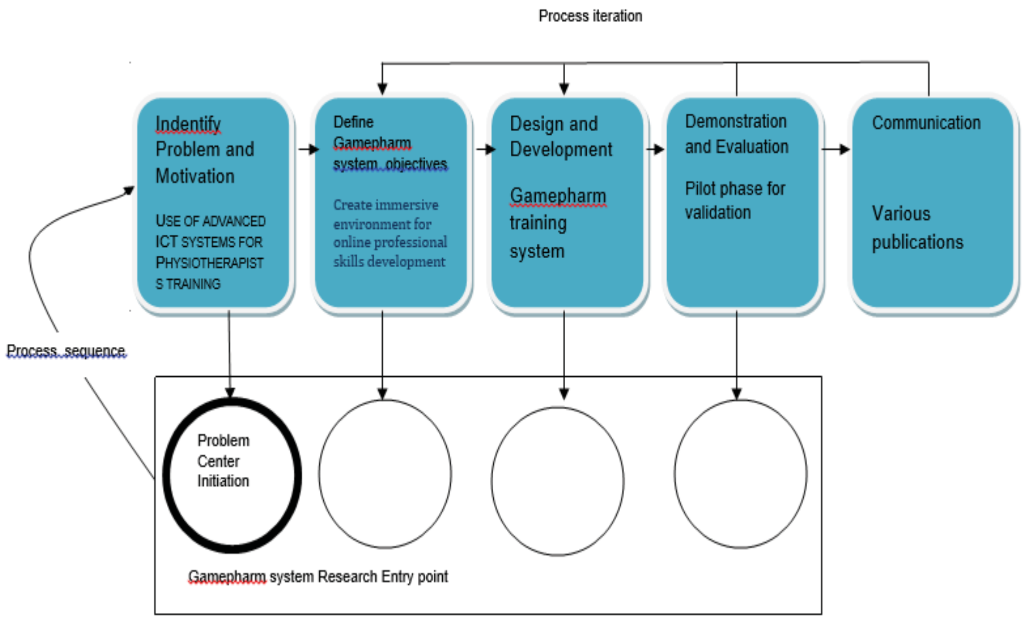

Figure 1: DSRM process for the GAMEPHARM system

The rest of the paper is structured following the main activities of the DSRM methodology. Section 2 reports on the problem identification and motivation, Section 3 presents the definition of the objectives for a solution, Section 4 describes the design and development where we describe the core elements of the Gamepharm concept, Section 5 concludes the paper.

2. Problem identification and motivation

2.1 Problem-Centered approach

Virtual world environments and augmented reality technologies hold the promise of integrating the experiential and interpretive dynamics of the learning experience. Virtual reality technologies and approaches combining a real environment with the virtual objects and information provides better reality and immersiveness to the subjects. It provides a safer environment and a motivating context for skill practice. Virtual reality approaches contains useful contents can put into practice by maximizing the interaction between real-time and sensory information (Azuma et al., 2001).

In view of the above a question is how to implement innovative gamification techniques and state of the art gaming technologies to create an immersive environment for online professional skills development that breaks away from traditional norms. And more specifically our main question is how to integrate AR with virtual reality immersive environments, alongside other leisure gaming modules in order to improve learning experience and achieve greater transference to physiotherapist practice.

This question triggered a problem and motivation initiation-centered approach building on the Gamepharm concept that builds on a foundation of open source virtual world technologies, enriched with augmented reality and leisure gaming modules, to offer a solution that enhances learner experience, where learning objectives are seamlessly interwoven with game objectives.

2.2 The application area: Physiotherapist training

Physiotherapy refers to the identification, recovery, improvement, and maintenance of a person's movement abilities. Physiotherapists should be able to analyse and assess the functional and physical state of a person, treat by movement, physical factors, compensate disability, guarantee health care and prevention, and stimulate and educate healthy living. Physiotherapists are also faced with the need to manage psychological issues that impact rehabilitation. Professional learning and development of physiotherapists is pursued through a range of learning programmes, increasingly involving advanced technologies (Stiller et al. 2004; Mori et al., 2015; Jones et al., 2017; Roberts & Cooper, 2017; Phillips et al., 2017). The training involves both periods of theory and clinical experience gained by meeting and working with patients. The theory part of the training program covers anatomy, physiology, physics and pathology. It also features courses to develop communication skills, knowledge of psychology and gain experience off practical treatment. Once qualified, physiotherapists usually begin in a rotational role, working in different departments for three to four months in order to gain experience in different specialities, e.g. outpatients, orthopaedics, etc. They are encouraged to further develop their knowledge and skills by attending briefing sessions, short courses and reflective practice programmes. Newly qualified physiotherapists usually require clinical supervision on the job and mentorship support. Physiotherapist training is a continuous process aimed at keeping professionals constantly up to date with new scientific insights, methods, technologies and tools in the profession. In some countries continuing professional development is mandatory in order to maintain the professional license. For example in the U.K. this is a requirement in order to stay registered with the Health & Care Professions Council (HCPC). For this purpose a range of dedicated post-qualifying courses is offered (regulatory training). Qualified physiotherapists may also opt to study for further specialist postgraduate qualifications, which can enhance career prospects.

We have to notice that during their professional life physiotherapists are working with use cases that require multidimensional professional capabilities, e.g. designing effective interventions for people at risk of fall (over the age of 65). Advanced gaming technologies can allow physiotherapists to gain a greater understanding of possible therapeutic interventions (e.g. motor training, human anatomy simulation), and develop their clinical reasoning and decision making in the selection and justification of their chosen therapeutic approach. The solution builds on experiential learning principles, pursuing the creation of knowledge through the transformation of experience. The aim is to empower professionals by engaging them in "real-life", "real-time" personal learning experiences, powered by state-of-the-art gaming technologies. The aim is to transfer implementable knowledge in the day-to-day activities of targeted professionals. The design approach should thus explore situations in order to gain better knowledge of what to do, when, and why, namely in order to gain a greater understanding of possible therapeutic interventions to help further develop clinical reasoning and decision making in the selection and justification of their chosen therapeutic approach.

On a technology level, this implies the application of motor training solutions for physical training, i.e. the acquisition and retention of motor skills (muscle memory), with human anatomy simulation and others in the framework of a virtual and augmented environment. Augmented reality technologies should provide among others a hands-on exploration of phenomena relating to human anatomy and secondary support—graphic panels, animations, etc.— to assist the physiotherapists in reflecting on the experience.

3. Defining objectives of the solution

The following objectives have been identified during the development of the Gamepharm concept:

- design an exercise and training program for physiotherapists to help them improve the balance and strength of their patients/subjects
- train them in movement and balance therapies – lower body, walking activities and others
- construct digital games to offer an enhanced, effective, non-threatening, fun, educational learning environment, with increased student engagement and satisfaction.
- involve engagement with the content or story, entertainment, education where possible and reasoning (e.g. games that include puzzle solving and logic) in order to increase the retention and the transfer of knowledge.
- emphasize experiential learning (i.e. learning through reflection on doing) and interpretive dynamics of the learning experience.
- help physiotherapists through game environment to participate and experiment in real-life inspired scenarios. In that case use immersive learning environments (combine a real environment with the virtual objects and information) to provide better understanding, improve context and situational awareness and enhance learning retention, while helping contain the implementation costs (situated learning).
- provide a safer environment and a motivating context for skill practice.
- reflection stories and the further refinement of the storyboards.

4. Gamepharm concept design and development

The design of the Gamepharm concept is based on well-defined objectives. Following the Design-Centered Approach we preferred to approach the design of the concept using and integrating existing technologies with preference to open source technologies. Within GAMEPHARM, augmented reality modules will be embedded alongside the game simulation and virtual world environment to provide participants an authentic simulated game scenario in which to immerse themselves. The aim of real life simulation either through augmented reality or virtual world approaches in replicating elements of real-world situations to develop learning through action and interaction is well documented (Gaba, 2004, Issenberg et al, 2005). However the degree to which participants immerse themselves in the simulated environment is likely to be influenced by authenticity, realism and gaming techniques. Considering that the skills development process is a highly personalised activity that is different for every individual, the proposed solution explores different approaches to authenticity, realism and gaming. GAMEPHARM represents an enhanced gaming environment, featuring an array of advanced gaming modules and tools to support adaptive, personalised storylines for professional skills development. At the centre of this virtual learning path is the individual who interacts with the virtual environment by responding to dynamic challenges and/or opportunities, measuring and analysing the impact of those responses and, from the ensuing feedback is presented with fresh challenges and/or opportunities. This builds on the continuous and non-invasive assessment of learning progress (skills assessment) and motivation states (motivation assessment). By monitoring a user's progress through in-game experiments in a non-invasive manner, as well as through explicit assessments, the environment will ascertain whether users have reached their targeted learning objectives and their skills level at any point. Individual motivation to participate and engage is critical. Users become motivated to develop and continuously improve as long as each proposed action is attractive, accessible and affordable. The technologies and modules embedded in the storyline will support the personalisation of the learning process in order to engage and motivate individuals to continuously develop. The proposed gaming approach will provide opportunities to enhance experience and increase engagement and participation. The architecture of the GAMEPHRAM technology will consist of several subsystems that are integrated together to provide the user with a comprehensive, motivating experience:

4.1 Open simulator virtual world environment

The virtual world is part of the Platform and encapsulates all the interaction into a motivating coherent experience. On each progress the User will get positive feedback adjusted to his level, status and needs: animations, new fun games, as well as virtual Coins that enable the user to get the things he likes for his virtual place within the virtual world.

4.2 AR-based virtual gaming environment for professional learning and skills acquisition

AR gaming and interaction open source platforms will be used to develop a new gamified training environment will be developed that will enable the creation of fully interactive virtual engaging AR training and learning experience on top of any standard guide-books, workbooks, e-books, websites, equipment, posters and other traditional training materials. Physiotherapists will be able to benefit from AR games displaying human body sections in actual 3D action using the hype realistic AR experience. Clinical tools and equipment will come to life and the trainees will be able to “use” them while experimenting in the 3D virtual world within the realm of the game that will be adapted.

4.3 User management and profiling engine

The users will get registered in the game application using an access and profiling module, storing user profile information and system log and interaction data. The profiling engine will suggest the right level and type of interaction suitable for the user, based on their profile, usage history (e.g., adjusting level of difficulty according to previous success level), user selections and location in the virtual world (e.g., specific area/type of activity). The profiling engine will generate the selected activity for the specific user, based on the pre-defined scenarios, activities and content.

4.4 Advanced AR/VR technologies

The system will expand into advanced technologies for the capture of 3D-spaces and the development of applications that enable users to interact and alter such spaces. The former will involve both further development of existing technologies such the combination of 360-degree video capture with LIDAR/point-cloud data. Apart from capture technologies (which have been both demonstrated and in limited use), the rest of the elements which would complete a proper workflow, involving web distribution, integration of haptic control and bespoke user interfaces, remain mostly independent of each other and appear to follow non-connecting development paths. The result is that a unified environment, integrating a complete end-to-end workflow, from capture to immersive experience, does not exist today especially to cater the needs of physiotherapists.

5. Conclusions

The motivation behind the development of the Gamepharm concept is to suggest innovative methods using advanced immersive technologies to provide real –life training experiences to physiotherapists. We also sought methods that actively engage physiotherapists in the training process and consolidate existing concepts to support lectures.

Our design concept appears to be a promising aid when used additionally to training physiotherapists professionals. We seek to proceed in the development of the training game within the framework of a funding project in an effort to quality of training in this key health area and promote learning for the future. The Gamepharm system artifact should be validated after the development phase. More specifically in order to fully evaluate, improve and validate the whole Gamepharm system, lab testing and pilot studies should be implemented. These trials will demonstrate the efficacy of the proposed system to provide better training in real life use cases for physiotherapists.

This paper describes the design process of the Gamepharm system while its aim is to demonstrate the use of the Design Science Research Methodology (DSRM) to design a training solution for real life use cases for physiotherapists.

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Characteristics and Learning Needs of Generation Z

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Abstract It is recognized, nowadays, that youngsters have a different profile from those of older generations. This may cause some challenges to both potential employee and employer when youngsters look for a job. In order to contribute to build bridges between the two key actors of this equation a consortium of 7 countries is developing a project called "iGEN - Interwork Between Gen Z and Employers". The main goal of this project is to try to close the gap between employers and youth, building up cooperation between the two major players of job markets and creating an effective and successful work environment. To contribute to this goal, the consortium is following a methodology which consists, as a first step, on a research about the work experiences and needs of Gen Z using quantitative and qualitative surveys. In this paper, the results obtained at the referred stage using desk research, focus group sessions, semi-structured interviews and questionnaires are presented. An analysis combining the results of the survey with the ones obtained in the interviews and focus group allow us to say that Gen Z members are experts in technology and they are aware that this is one of their main strengths. Results obtained allow to describe the main characteristics of the Gen Z and could help to support the process of providing professional training for both.

Keywords: Generation Z, Training Youngsters, European job market

1. Introduction

In the years to come, a new generation (Generation Z) will enter the workforce, bringing with them new demands and challenges for companies. Moreover, it is recognized that youngsters have a different profile from those of older generations. As a matter of fact, this generation is more technologically savvy than any previous generation and more likely to collaborate with colleagues to complete a task (Knapp, 2017). From the point of view of companies, expectations are also high. According to O'Boyle (2017), today, many organizations ask their entry-level workers to wrangle with data, perform research and program advanced technologies. Very often, the degree is the basic requirement to qualify for a job. These shifts in work and expectations, along with economic recessions and advanced technologies seem to have already begun to have a significant impact on workers (op. cit.).

It is in this context that emerges the iGen project. Its main goal is to reduce the gap between the two main actors on the labour market – members of generation Z and employers -, building up cooperation between them and creating an effective and successful work environment. In the next sections, we will present the main results obtained by the consortium at the first phase of the project – the description and characterization of the situation in all the partner countries of the project.

2. The iGEN Project

2.1 Description

The project "iGEN – Interwork Between Gen Z and Employers" - http://igenproject.eu/ - is implemented in the framework of Erasmus+ VET program. It started in 2016 and will end in 2019. Partners are from Czech Republic (CULS), Hungary (Trebag), Cyprus (Dekaplus Business Services), UK (Exponential Training & Assessment), Poland (Inneo), Portugal (Polytechnic of Porto) and Spain (Media Creativa 2010).

As said above, companies face several challenges due to changes in labour market trends, such as a trend of labour demand exceeding labour supply in the near future or the already three different generations (baby boomers, X and Y) present in the labour market augmented with the new generation, so called Gen Z (aged between 16-21), recently entering the job market with whole new expectations, and so little known about. The two main target groups of iGEN project therefore are companies who already have or will have Gen Z employees and members of Gen Z, with the aim of harmonizing the needs of both sides and bringing effective solutions to help them be more prepared for the new ways of cooperation.

The project will produce several outputs. The first output will be a methodology providing methods, tools and best practices for SMEs (small and medium-sized enterprises) to create an attractive, supporting and retaining working environment. The second output will be the Mentor training, developed based on surveys of European SMEs and demands of Gen Z. The third output of the project is a soft skill training material produced for members of Gen Z, based on the company and Gen Z survey and also on the research process, adequate to the Gen Z learning styles. This will help young employees to be better prepared for, and more confident at work, more assertive and able to solve problems due to understanding the demands of the job market and the working styles of older generations. In this paper we only focus on the first output - the characterization of youngsters.

2.2 Generation Z

A generation is defined as a "group of people born in the same general time span, who share some life experience" (Blauth et al., 2011). One of the most accepted definitions refers to a generation as "a group of people or cohorts who share birth years and experiences as they move through time together" (Kupperschmidt, 2000). Research indicates that different generations exhibit different value priorities (Bogdanowicz, Bailey, 2002). A generation can influence styles and trends in business, while learning from the mistakes and successes of the previous generations. Generation Z represents the greatest generational shift the workplace has ever seen. Generation Z will present profound challenges to leaders, managers, supervisors, HR leaders, and educators in every sector of the workforce (Tulgan, 2013). The Institute for Emerging Issues (2012) refers to Generation Z as the most ethnically diverse and technologically sophisticated generation. Hence Generation Z has an informal, individual and direct way of social networking as a part of their everyday lives. Generation Z tends to be more entrepreneurial, trustworthy, tolerant and less motivated by money than Generation Y. They are more realistic about their work expectation and optimistic about the future. Based on the findings of Generational White Paper (2011), Generation Z tends to be impatient, instant minded, lacking the ambition of previous generations, have acquired attention deficit with a high dependency on the technology, individualistic, self-directed, most demanding, acquisitive, materialistic and entitled generation so far. According to a survey performed by Robert Half the top three priorities of the members of generation Z, when seeking a fulltime job are with 64% opportunities for career growth, 44% generous pay and with 40% making a difference or having a positive impact on society. In their lifetime, the generation Z has expectations to change their employer up to four times. According to the report published by the Chartered Management Institute and the EY Foundation Young people across the UK struggle to find jobs and want more support from. Young people aspire to lead but they lack confidence in their leadership and management skills (EY Foundation, 2016).

Considering the main results from previous studies shortly described above, with this iGen project we intend to analyse and attest these issues in the partners' countries and determine trends that could support the future training design.

3. Research Design

In order to fully understand the Generation Z, we adopted a 4-step exercise implemented from October 2016 to March 2017:

1. Identification of the field of investigation and agreement on an operational proposal including the design of the tools and a first set of schedules to complete the research.
2. Issue of a final operational proposal including survey and interviews questionnaires and focus group (field research).
3. Translations and adaptations of all the research tool. Make the questionnaires available online and implement them
4. Analyze the results.

A) Questionnaire

The questionnaire was developed by the consortium taking into consideration the results of the desk research and the aims of the project. The questionnaire was then made available online. Some partners decided also to provide it in paper in order to facilitate students to fill it in. The dissemination of the questionnaire was made using several solutions: Facebook post with a link to the questionnaire; post in groups of youngsters; message sent to individual persons asking them to answer the questionnaire and inviting friends to do the same, among other solutions.

The questionnaire consisted of 18 questions. Questions 1 to 5 helped to characterize the sample. The remaining questions were about their experience at workplace, communication, the use of technology, relationship with the boss / leader, how to look for a job, how well prepared the youngster was for the workplace, the preferred training and factors to make them loyal to the workplace. In the majority of the questions some alternative answers were provided to choose always with the option to add another option in case those provided did not apply to the situation.

B) Script for the Focus group and Interviews

The script used for the focus group and interviews corresponded to the questionnaire. This means that the questions were similar and our aim was to go deeper into the reasons underneath each answer.

In the next section, we present the results of each step of the research design.

4. Results

4.1 Questionnaire

The distribution of respondents by partner country is as follows:

Table 1: Distribution of respondents by partner country

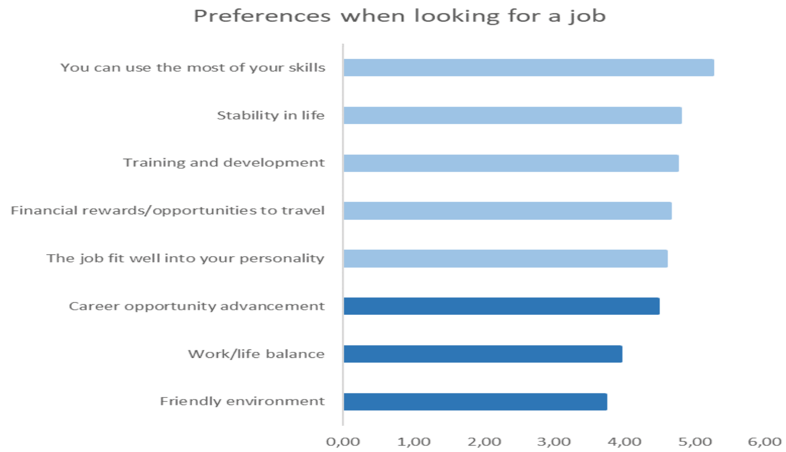
Country		Number of respondents
CY		49
CZ		199
HU		107
PL		46
PT		68
SP		65
UK		62
	TOTAL	596

The majority of the respondents were born in 1998. Nevertheless, there are respondents born since 1995 till after 1999. As for the gender, the majority is female (62%). The majority of the respondents attended the 12th grade, followed by the 9th grade. When asked if they had any type of professional experience, the majority (495 out of 596) said Yes. From now on, we only take into consideration the answers provided by the respondents who said have already had a professional experience (N=495). The professional experience of the respondents spans the occasional job, part time job and professional internship. Most of this professional experience lasted less than 3 months. When asked in which area would you most prefer to have a job, respondents say they prefer commerce, engineering and information technology the most.

Table 2: Areas of work of the respondents

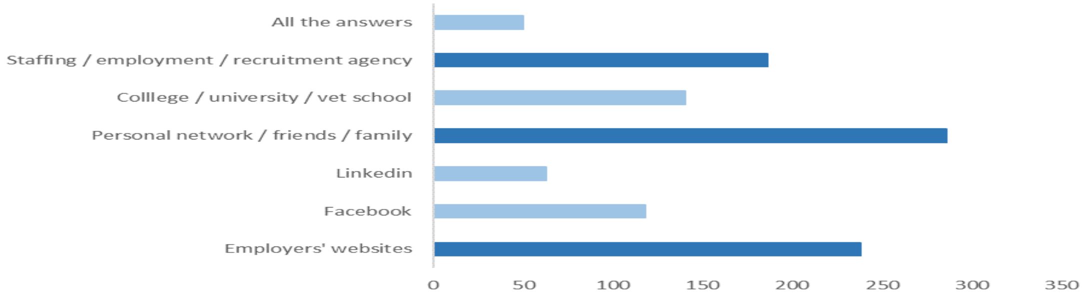
Areas	**%**
Arts	11
Commerce	15
Education	10
Engineering	12
Healthcare	5
Information Technology	12
Media and entertainment	10
Office and administration	7
Other	17

Facebook and Instagram are the more popular social media among respondents. Answers are uniform all over Europe. In Spain, the majority of the respondents prefer to use Whatsapp to communicate. In all the other countries, the preference goes to Facebook. As for the most important factors when looking for a job, respondents had to give different degrees of priority to the factors from 1 to 8 (where 1 is the most important, 8 is the less important) The most important ones are friendly environment, work / life balance and career opportunity advancement (see graph 1).



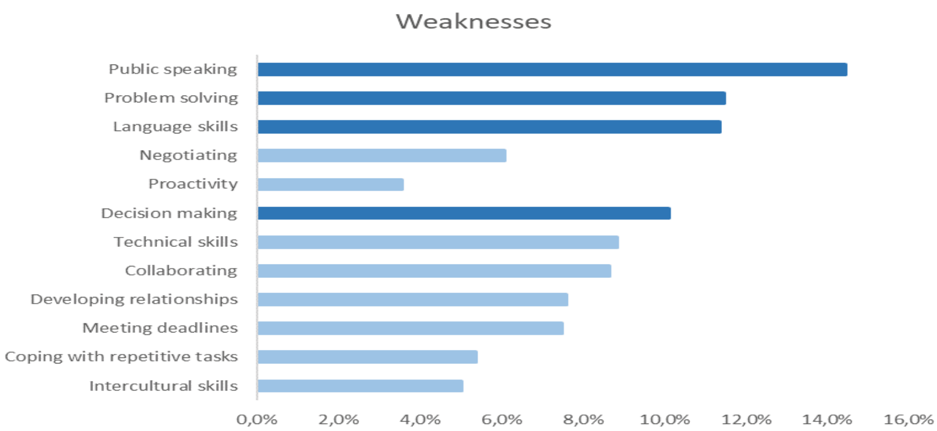
Graph 1: Preferences when Gen Z looking for a job

Generally speaking, respondents when looking for a job, talk to their family and friends first and then go to the employers' website (see graph 2).



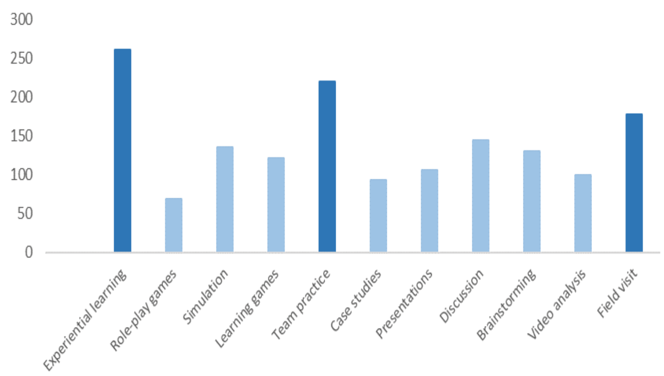
Graph 2: Methods used by Gen Z to look for a job

Respondents also say that education institutions should provide internship opportunities, career services and contact with the alumni network in order to better prepare them for the workplace.
The weaknesses felt by the respondents as for skills they need to strengthen before going to the job market are Public Speaking, Problem solving, Language skills and Decision making (see graph 3).



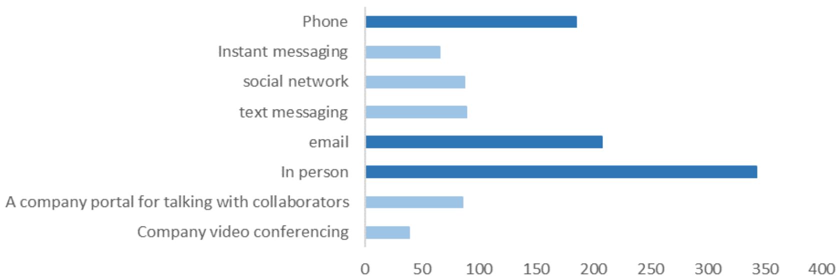
Graph 3: Weaknesses of Gen Z

As for training practices respondents prefer experiential learning, team practices and field visit as training practices (see graph 4).



Graph 4: Learning preferences for Gen Z

The most effective ways to communicate in the workplace is face-to-face followed by e-mail and use of phone (see graph 5)



Graph 5: Communication preferences for Gen Z

4.1. Interviews

After the approval of the script for the interviews, partners started to look for youngsters to be interviewed. All partners did at least 5 interviews. These were recorded and then transcribed. The following table presents the main results of the interviews:

Table 3: Main results of the Gen Z interviews

QUALITIES	DEFAULTS
"Better relation with technology" ("as we are a transition generation (…) we control it but we don't live too much absorbed")	"Lack of experience and many things to learn in workplace"
"Languages"	"Demotivation, disillusion" (because of the hard reality and job market) and "frustration" ("educated us in false mythos")
"Adaptability and resilience"	Lack of "patience" ("we want everything quickly") and "perseverance" ("we give up too soon")
"Competitiveness" (we all "have more than one master, we know many languages, etc.")	"Low self-esteem"
"More opened" ("we started leaving the comfort zone")	"Low spirit of sacrifice" ("as now everything immediate and expires soon, spirit of sacrifice is depreciated")
"Integration and multicultural skills"	"Lack of commitment and responsibility"
"Improvement in gender equality"	"Gender equality is still insufficient"

"Vitality and motivation for working and impact society"	"Image has too much value"
"Entrepreneurial spirit "	"Excessive competitiveness"
"Global vision of the world" ("international perspective of labour market")	"Lack of humility"
"Use of Social networks"	
"Ease of communication"	
"I feel technology is in our veins. We are comfortable using it for personal or professional reasons."	"I sometimes find myself thinking about only what I want. I need to be reminded about what others want."
"Technology leads to creativity and innovation."	"The economic crisis excuse is starting to wear off. Other generations had the World War, we had this economic war. What's the difference?"
"Start-ups are a consequence of productive use of technology. It is not the easy way out for those who are after fast money."	"Is it so bad we'd rather text than to call a friend? After all, it's cheaper!"
"Sexuality is not a significant variable in our minds. People are free to have their preferences.")	"We live in an information bombarded world. Sometimes too much info is not good. It shutters your trust on people."
"I have gay friends at school and I am not concerned about their preferences. I value more other things about them."	"I see forms of aggression at school but never bother to report them, simply because I will be victimised if I do."
"Our school attracts many different cultures. I have friends from Russia, India and Germany. Basically, I don't care where they come from."	"There is an outburst of bullying at schools. Even teachers turn the other way because they fear retaliation. "

4.2 Focus Group

Finally, to complement the findings of the previous steps, we also did some focus group with a minimum of 10 persons (in total). In some cases, partners opted to do more than one focus group, each one with less than 10 persons. The script used was the same for the interviews. However, at this point we wanted youngsters to discuss the themes and see if they were consensual in their ideas.
In the next paragraphs we present the most important results.

Workplace

The participants underlined the importance of the meritocracy in the workplace. They highlight the necessity of being recognized for the work developed. They also talked about the good relationships among the workers. They recognized the importance of having a regular schedule but they prefer a schedule according to the nature of the work that they need to develop. They demonstrated the necessity of feeling fulfilled in their workplace. The motivation is the biggest issue in a good workplace environment.

Career attitude

Concerning the career attitude, they suggested that the labour market is too much regulated. They feel that they must follow too many rules and standards. Thus, lots of them prefer to work by themselves, creating their own job or they ask for more flexibility from their bosses and tasks. They like to be able to develop their own tasks initiatives, to implement process and product innovation. They are not expecting a career for their life.

Technologies

Related to the technology participants said that they like to use it mainly web technology but when they need to communicate they prefer face-to-face communications in the labour communications. They prefer to use technology to have their work organized and to be updated with some issues that they like or are related to their work. For them technologies also seem to be helpful to spread information but are not their preferences when they are talking about personal communications.

Studies / Knowledge / competencies

When they were asked about their own knowledge and skills they recognize the lack of some skills that they must learn in the work context. They refer that the educational system didn't prepare the participants for acting on labour market. They learned a lot of theoretical material, while they lack practical skills such as organizing tasks, solving problems, collecting and analyzing data.

They lack soft skills such as time management, organization of work, cooperating with others. They refer having problems with maintaining work-life balance. Most of respondents stated that they are often distracted, e.g. by social media (they check Facebook or Snapchat during their work).

Skills to write and oral communications

The same happens when they talk about their own skills. They underlined the lack of many transversal competences, specially written and verbal communication in other language.

Leadership

Related to the leadership participants like a close leadership, they would like to have a boss to look up as an example to be followed and to learn with. They underlined the importance of the respect among workers, independently of the work level in the organization hierarchy. They also referred the need of freedom and the importance to have a good support from their boss. They appreciate the opportunities to grow up in the hierarchy of the company. They appreciate when they can learn from their boss.

5. Discussion

An analysis combining the results of the survey with the ones obtained in the interviews and focus group allow us to say that Gen Z members are experts in technology and they are aware that this is one of their main strengths. Even though not everybody likes it, technology is totally integrated into their personal and work daily life and it accelerates and improves their work. ICTs control provides them with many tools and makes them feel more confident and able to face any task at work. The Gen Z that emerges from this study considers relations, team climate and team work as the most important factors to do the best work. In the workplace they unanimously opt for face-to-face interactions, both with managers and with colleagues. They consider communication skills as essential to enter in the job market and they always prefer a work environment with good and closer relations.

They value almost positively the education received at University, but they assume that Masters and post degree courses train them more specifically for work. Moreover, they consider that they will need training in the workplace. They mention various aspects to be improved in college curriculum: to increase the offer of work experiences (internship since the second year and in different type of companies), to work more on Communication skills (through seminars, debates, public presentations, etc.), to provide competences on project design and management (as it is an important part of the jobs nowadays), to provide initiative skills and resources to be creative in the generation of new job opportunities ("as there are always more people and less workplaces").

To access the job market they usually make use of internet and personal network. Job services are disregarded and considered almost ineffective. This data should generate a reflection about their compliance to new generations' needs.

What kind of work do Gen Z members prefer? They desire a job consistent with their studies, which they can enjoy, develop and advance. They prefer small companies/organisations and small teams for the closer relations and friendly climate, but they also recognise the benefits of a big company (training opportunities, more resources and departments, etc.).

Even though they are aware that they will have to change work and they will receive a low salary at the beginning of their career, they all aspire to a stable and well-paid job and this is one of their main concerns for the future. For them it is not a problem to go abroad for a job. Instead, they have really clear that they don't want work to take up all their time. Work must be a part of their life but they aspire to conciliate professional and personal life.

In work environment, they really value respect, mutual appreciation" (between personnel and among employer and employees), flexibility, creativity, transparency, the possibility to ask for and receive help (from managers and colleagues) and to express ideas, creativity and self-organizing.

They don't see themselves as entrepreneurs, at least not in the immediate future, as they still have many things to learn and to do apart from work.

They prefer to work with closer generations because they feel more complicity and reliance. Older generations' members are wiser and have more experience but they have a different approach and style at work; they are less flexible and more hierarchic and they miss the technology factor, which is not only a tool but a working style, characterised by multitasking, quickness, dynamism, network…

Their relationship with hierarchies is not really good. For them a good boss is not the one who stays out of the team or closed in an office; someone far from their employees and to fear. A good boss is a person that is a part of the team; he/she organises, motivates and supports the employees, and rewards their efforts and results; he/she is patient, empathic, comprehensive…

On the other side, Gen Z members have many qualities to bring to a company: their control of technology, languages, adaptability, responsibility, high education, vitality, creativity, bravery, multicultural skills, gender perspective, etc. They also recognise as their main defaults the lack of experience, low patience and spirit of sacrifice, volatility, laziness, introversion, low self-esteem, disillusion and a certain doses of insensibility due to an excess of information.

Lastly, they are quite optimistic about the future. Rather than fear of not finding work, they fear of precariousness and having a job where they cannot fully develop and enjoy. This is probably the main challenge of future employers: make new generations express and develop all their potential, offering them stability and fairy work conditions.

6. Conclusions

Currently, different generations co-exist in the labour market, with differences between them being evident. If the generations Y and Z (the latter still not very representative in the labour market) are determined to challenge the rigid standards of their previous 'congeners', the older confess not to bear the arrogance of the younger. An analysis of Global Trends reveals that knowing the generational profile of workers, anticipating the needs and values of the next generation that will enter the market in the coming years, is an important step to increase productivity and business success and avoid inter-generational conflicts. Knowing and perceiving the characteristics of each of these groups (especially those that bring young people into the labour market) is fundamental for companies, as it allows them to adapt their offer to the profile they seek (and who seeks them). One can say that mobility and flexibility are the "magic potions" to attract young people.

Although separated for a considerable period, there are several aspects that these age groups (Y and Z) have in common, especially with regard to the conditions they value at work. Flexibility, mobility, and immediacy (or thirst for the "here and now") are the characteristics chosen as the most appreciated. Living in "real-time", combining and articulating work with personal life, is fundamental for these workers, particularly those belonging to generation Z, who view social networks and cyberworld in a way that members of previous generations cannot understand or even accept.

Privileging well-being, they defy conventional working standards (considered rigid or not very flexible), for flexibility and mobility, leaving fixed working hours, but not commitment. Seeing life and enjoying every moment - not making a distinction between work, family and fun - is one of the great characteristics of these new (and future) workers, who are regulated by the maxim "work hard, play hard".

The way to look for work is one of the main points of "disunity" between the two generations: a study by the Center for Executive Education reveals that while generation Y prefers to look for opportunities in specific sites for this purpose, social networks and outsourcing companies or temporary work. While the Y does not show a real preference for the size of the companies in which they work or intend to work, when considering a potential future employer, generation Z will be less interested in working in large organizations.

Although both generations do not dispense with the world through electronic devices, their attitude towards technology is also very different: the former has grown with computers and is adopting the new technologies as they become more sophisticated; the second, in turn, was born in the digital world. For these so-called digital natives, a world without touch screens, intuitive gaming devices, mobile phones and applications is simply unthinkable. As IT will increasingly become a must in the workplace, employers, present and future, will need to bear in mind the importance of IT about information demand, skills to collaborate. However, both generations, Y and, most likely also Z, will continue to choose face-to-face communication with their leaders. In addition, if generation Y has become accustomed to the execution of several tasks at the same time, Z will be "compulsively" adept at multitasking.

Social and environmental responsibility is another major concern of these new generations. According to a global questionnaire on the future of talent, 70% of respondents aged 18-34 said they preferred to work in companies that were concerned about their social and environmental impact. A curious fact is that respondents in emerging markets are even more concerned about this (77%) than their peers in developed countries (67%). Also, engaged in "doing good" and "generating impact", generation Z places greater importance on social issues, seeking to articulate their functions with the resolution of problems such as discrimination or poverty. This is linked to the ambition expressed by both generations to seek inclusive enterprises that do not discriminate against their employees based on age, race or culture (a concern expressed by Generation X, although not so pronounced). These generations support diversity and see in it a learning and a tool to become better people. It should also be emphasized that social entrepreneurship occupies a preponderant position in terms of future career.

Often there are comments about the fact that baby boomers or members of Generation X still remember things they learned in elementary school (such as the tables, the names of rivers, railway stations), and that younger generations forget everything (or learn nothing) quite easily. And it is true ... According to this report, the brains of generations Y and Z are not as prepared as those of previous generations to store information for the simple reason that they have never had to do this exercise. On the other hand, as already mentioned, they are much more apt to perform several tasks simultaneously and to change registration almost immediately.
However, easy access to information generates a great feeling of impatience in these generations, especially when they do not see their work recognized (perhaps because they are aware that nothing lasts forever, or because they have grown up in a "feedback culture" motivated by social networks). Moreover, for these generations, transparency and information are obligatory for a good working environment, since they do not understand or accept the traditional model which presupposes that all information is only accessible to the higher bodies of the companies and is prohibited to the rest workers.

One of the "secrets" to attract and retain these workers is to motivate them and engage them in the "mission" of the company because they value the praise or constructive criticism of colleagues or superiors who dominate the area where they work. However, and partly motivated by the economic crisis, Y-generation workers are now starting to value money more for a rewarding job, contrary to the Generation Z elements who claim to prefer jobs or companies where they can evolve. In addition, both groups prefer "leaders" (who show them how to do it) to "bosses" (who tell them to do something). Mobility and flexibility, combined with creativity, allow us to do different and innovate, without the rigidity of a schedule but with equal commitment.

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Activities for Developing Explain Computational Thinking

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Abstract: Various documents issued by the Ministry of Education, Youth and Sports influence education in the Czech Republic, the most important of which being the Framework Educational Program for Preschool, Primary and Secondary Education. As any other document, the Framework Educational Program, too, needs to be updated. The update should be based on the document titled Strategy for Education Policy of the Czech Republic until 2020. Published in November 2014, it stresses the importance of implementing modern technology into education, i.e. the development of digital literacy and the full use of this technology to solve problems (i.e. to develop computational thinking). These are enormous changes which will influence all levels of education – from kindergartens to elementary schools to high schools. The current Framework Educational Program does not include the aforementioned points. The update is primarily aimed at the area of information and communication technologies, which has not been updated since 2004. This section should now include information on how (using what methodology) to help students develop their computational thinking – to formulate a problem, organize information in a logical manner, find solutions to problems, use algorithmic thinking to automate problem solving (solving problems step by step). Since this is an unexplored area, the aforementioned "Strategy" focuses on creating study materials for both the students and the teachers. The teacher needs to be digitally literate and think computationally in order to be able to help their students develop these skills. However, we are in the beginning of this "renaissance" – creation of study materials, methodological manuals, e-learning courses in the form of massive open online courses. The paper focuses on various strategies and methods which would support the development of computational (algorithmic) thinking. As the changes influence all levels of education, the authors decided to focus on preschool children. In preschool children, computational (algorithmic) thinking can be developed effortlessly through didactic games.

Keywords: framework educational program, digital education, computational thinking, algorithmic thinking, activities, preschool education

1. Computational thinking concept

The term "Computational thinking" was first mentioned by Papert, the creator of the LOGO program, in his paper "An exploration in the space of Mathematics Education" (Papert, 1996). However, it was Jeanette Wing who first mentioned computational thinking in connection with technology. She defines it as a way of solving problems, proposing systems and understanding human behavior through the basic computer science concepts (Wing, 2010). Liu and Wang define computational thinking as a complex system which contains abstract thinking, logical thinking, model thinking and constructivist thinking (Liu, Wang, 2010). The Royal Society introduced its own definition of computational thinking, stating that it is a process of learning to understand computational aspects of the world around us and using technological tools in order to understand both natural and artificial systems and processes (The Royal Society, 2012). However, the most widely used definition of computational thinking is the one by the CSTA/ISTE, which describes it as a problem-solving process that includes (but is not limited to) the following characteristics (Sykora, 2014):

Table 1: Key aspects of computational thinking

Formulating problems in a way that enables us to use a computer and other tools to help solve them
Logically organizing and analyzing data
Representing data through abstractions such as models and simulations
Automating solutions through algorithmic thinking (a series of ordered steps)
Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources

Aside from the aforementioned characteristics, there are other skills that are related to the development of computational thinking. These are (Sykora, 2014):

- Confidence in dealing with complexity;
- Persistence in working with difficult problems;
- Tolerance for ambiguity;
- The ability to deal with open ended problems;

- The ability to communicate and work with others to achieve a common goal or solution.

2. Computational thinking in strategic documents

Nowadays, everyone is expected not only to have digital technology skills but also to be able to effectively use them in everyday life. Schools should produce children who not only understand digital technology and know how to use it, but who can think as a computer, i.e. to face a problem head on and find an appropriate solution; thinking logically and constructively, they should be able to solve the problem step by step (algorithmically). As a result, they should be able to apply the acquired skills not only in other school subjects, but also in everyday life.

2.1 Framework Educational Program for pre-school education

Czech schools are subject to a document titled the Framework Educational Program (FEP). There are framework educational programs for all levels of education, i.e. for pre-school education, basic education and secondary education. One of the main points of the Framework Educational Program for Pre-School Education is the development of the following key competencies – learning, problem-solving, communication, social, personal, activity and civic. There are different levels of competency development (FEP, 2018).

If we take a closer look at the levels of development of the individual competencies, we will discover that the word ***computational*** is not mentioned in the document (either as a part of a term or as a separate word).

The following part is related to the word ***information***:

Communication competency

- The pupil can make a full use of information and communication resources that they encounter every day (books, encyclopedias, computer, audiovisual technology, phone, etc.).

The terms ***method***, ***algorithm***, ***problem***, ***solution*** are mentioned in the following parts:

Learning competency

- The pupil learns not only spontaneously, but also consciously with effort; focuses on the task at hand and chooses to remember; when assigned a task, they finish what they have started; is able to follow instructions; is able to arrive at a correct solution.

Problem-solving competency

- The pupil solves problems based on direct experience; uses a trial and error method, experiments; spontaneously devices new solutions to problems and situations; searches for different possibilities and options (has original ideas); draws on previous experience and uses imagination;
- Solves problems that are not too difficult for them; tries to solve recurring problems/situations on their own (based on imitation or repetition); solves the more difficult problems with the help of an adult;
- Applies logical, mathematical and empirical approaches to solve both thought and practical problems; understands simple algorithms for solving different kinds of problems/situations and uses them in other situations;
- Understands that avoiding solving a problem does not lead to reaching the goal and that a timely solution brings advantages; realizes that their activity and initiative can make a difference;
- Can distinguish between functional solutions (those that lead to reaching the goal) and non-functional solutions.

The Framework Educational Program is the basis for the School Educational Program, which is created by each individual institution. Each institution defines its own educational objectives and divides the curriculum.

The development of computational thinking not only requires specific conditions. However, it is also necessary to interconnect different forms of education, update educational documents, create study materials, etc. 'Strategy for Digital Education in the Czech Republic until 2020' is an important document that, among other things, stresses the importance of implementing computational thinking into the school curriculum.

2.2 Strategy for Digital Education until 2020

Published by the Czech Ministry of Education, Youth and Sports in 2014, this document was created in response to the development of digital technology and its incorporation into all areas of human life.

Quoting directly from the document, digital education is such education, which reacts to the changes in society related to the development of digital technology and its use in different areas of human activity. It includes both the education that effectively uses digital technology in instruction and the education that aims to develop pupils' digital literacy and thus make them more competitive on the labor market (as the information technology requirements are growing at unprecedented rate). The aim of the strategy is to create conditions and processes which would make digital education possible (Strategy for Digital Education Until 2020, 2014).

As part of a long-term plan to realize digital education, the following measures need to be taken:

Table 2: Measures

Provide non-discriminatory access to digital study materials
Provide conditions for the development of ***pupils' digital literacy and computational thinking***
Provide conditions for the development of teachers' digital literacy and computational thinking
Develop digital infrastructure
Support innovative approaches, monitoring, evaluation and the sharing of results
Design a system which would help the schools integrate digital technology into instruction and the school's life
Increase public understanding through integrating digital technology into education

Point 2 in particular responds to the need for developing pupils' computational thinking at all levels of education. The following are the required conditions (Strategy for Digital Education Until 2020, 2014):

- Create a system which would make sure that the framework educational programs are regularly updated – regularly update education-related documents and standards to reflect the current trends in the scientific field and technology;
- Update the curriculum to include digital technology – update educational standards across all levels of education and ensure their interconnectedness and continuity;
- Stress the importance of computational thinking – focus on areas that can help develop computational thinking and lay the foundations for the future development of informatics and programming;
- Interconnection of formal, non-formal and informal education – support free online education.

3. Developing computational thinking at preschool age

Computational thinking can be developed in children in kindergarten. Game-based activities and tasks are used to develop children's computational (algorithmic) thinking in a natural way. Every day pupils encounter activities in which they can see certain regularity, repetition and sequence of individual steps, e.g. brushing their teeth, making a drink, baking a cake, their daily routine (from getting up in the morning to going to bed in the evening), etc. Children need to realize that every activity has a specific progression – the sequence of individual steps (one always knows which step follows which). If a child omits any of the steps, or changes the sequence of the steps, they need to expect an incorrect result. The same can be said about various programs or machines which we encounter in everyday life. If the commands are incorrect, the program cannot be executed or contains errors.

First of all, one needs to realize how children's computational thinking can be developed. Even though the use of technology can make the entire process much easier, the methodology is equally important. The following chapters describe activities that may serve as a basis for the initial development of computational thinking in preschool children.

3.1 Reading algorithms

The basic activity for this category is designing a simple labyrinth in the form of a square network with Start, Finish and the route from Start to Finish marked. Children are expected to describe the marked route verbally, using commands, e.g. go straight ahead, go to the right, go to the right, go to the left, go straight ahead, etc. The teacher can change the route, using different markers to highlight different routes. The teacher needs to tell the children that there are different routes to get to Finish which differ in length or the sequence of commands. To make the task more visual, it is recommended to use an object which would move along the route, e.g. a car or a train. In this case, children need to realize that the object's starting position needs to be set correctly.

The task can be modified by the teacher writing the route using symbols and signs, e.g. ↑→→←↑, with the children's task being to write down the route correctly or trying the commands out on themselves.

Explaining the individual steps in an algorithm would be an entirely different task. For instance, it could be daily activities pictured on cards arranged in a correct sequence (getting up in the morning, brushing one's teeth, going to and staying in kindergarten, lunch, showering in the evening, going to bed), with the children's task being to explain why the steps were arranged in this particular order.

During such formulated activities, children practice plane and spatial orientation, basic commands and movements, control the correctness of direction, learn how to quickly evaluate the situation, are aware of chronological order.

3.2 Problem solving

Again, a square network with Start and Finish marked can be used. However, this time no route will be marked as it is the children who are expected to find the route. The teacher can modify the task and have the pupils find either the longest or the shortest route. Moreover, the teacher can also place various obstacles along the way between Start and Finish and have the pupils find such a route which would avoid all the obstacles, thus making the task more difficult.

Children can go through the so-called obstacle course in real life. The teacher marks the route and places obstacles along the way (a chair, a table, a rope) which the children need to overcome in a particular order.

Searching for the correct position may be another activity. A task card has a drawing of a house on it. The house has three stories, there are rooms on each story and there is only one toy in each of the rooms (a car, a teddy bear, a ball, a building kit, a doll, etc.). Children are handed a card with an empty house and empty rooms. The teacher places a question mark in any of the rooms and the children are expected to find out which toy should be in the room.

During such formulated activities, children practice their memory (as they need to remember the order of obstacles), plane and spatial orientation, the sequence of actions and steps.

3.3 Task modification

In this category, the teacher can draw on one of the previous tasks where the children had cards with daily activities arranged in a correct sequence (getting up in the morning, brushing one's teeth, going to and staying in kindergarten, lunch, showering in the evening, going to bed). In this modified task, they would be asked to use the same approach to solve another problem. They can draw on their own experience, e.g. First I wash my feet. Then I put my socks on. Then I put my shoes on. And only then can I go outside.

Another version of the same task could be cards with scenes from everyday life which the children would be expected to arrange in a correct order (baking a cake, crossing the street, making tea, how a plant grows, the sequence of numbers, seasons, months, etc.).

The children may also be asked to find errors in an already created sequence. It could be either the card method with the events arranged in an incorrect order (the children would need to arrange them in a correct order) or the square network method with Start and Finish marked (using symbols, the teacher would draw a route and the children would be expected to verify its correctness, and find and correct the error, if necessary).

During such formulated activities, children practice temporal and spatial orientation (which event follows which), making decisions based on their own experience (arrangement, stages of life), understanding logical relationships (cause and effect).

3.4 Recognizing patterns

One of the main activities is recognizing basic geometric shapes. There would be a figure made of basic geometric shapes of different colors and sizes (a circle, a triangle, a square, a rectangle). The children would be handed a set of geometric shapes (cut out of color paper), with their task being to arrange the shapes in such a way to make it into the original figure. When arranging the shapes, they would find out that they could make similar figures which would differ in color or size. Moreover, they could also learn that using the same set of geometric shapes, they can make a completely different object.

Doing a puzzle may be another interesting task. The teacher prepares any picture (a house, a tree, an animal, a castle) and cuts it to both regular and irregular pieces (it may or may not be geometric shapes). The children's task is to assemble the pieces to form a picture. In so doing, they need to realize that each piece has its position.

Another task could be to identify repeating patterns. In this activity, the children need to realize that some situations, events, phenomena, objects repeat themselves, e.g. changing of seasons, moon phases, a square has four identical sides, climbing the stairs is a repetitive activity, the traffic light colors alternate in particular intervals, etc. The children's task is to find other repeating activities and shapes.

During such formulated activities, children practice spatial orientation (handling, assembling and turning the pieces), being aware of the logical sequence, linear arrangement, the sequence of objects, determining the position of objects.

3.5 Categorizing objects

Another interesting activity could be categorizing objects based on various characteristics using an algorithm. The teacher would provide a photo frame with three different pictures of the same animal (a mouse) in a given order – picture from left side, picture from front, picture from right side. This would be a model picture. The children would be handed other photo frames with different animals (a dog, a cat, a horse, a goat, etc.), with some of the picture(s) missing. The children's task would be to not only fill in the missing pictures (the correct kind of animal), but also to follow the algorithm which determines the order of pictures.

A regular task would be to categorize cards with geometrical shapes of different sizes, colors or types. There are numerous modification possibilities – create groups which would only contain red shapes, square shapes, round shapes, etc. To have children create a group based on the size of shapes and have them arrange the shapes from the smallest to the largest ones would be a more difficult task. In this case, the children need to realize that it is not only the sequence of objects which is important, but also the position of each object in the sequence.

During such formulated activities, children practice categorizing objects based on identical characteristics (color, size), become familiar with group conditions (focusing on more things at once), realize the meaning of the term "and at the same time".

3.6 Object combinations

The basic activity could be creating a necklace. The necklace would be made of beads which would alternate in particular sequences, e.g. three red beads, two blue beads, one yellow bead and so on. The children would be expected to create a necklace following the pattern. The teacher could modify the task by omitting some of the beads, with the children's task being to fill in the correct beads.

Instead of the necklace/beads, ice cream scoops could be used. The teacher would prepare cards which would represent an ice cream cone and scoops of different colors/flavors (brown would be chocolate, red would be strawberry, yellow would be lemon, green would be pistachio, etc.). The children could select different flavor combinations. Their task would be to find out in what order the ice cream vendor needs to place the scoops on the cone in order for the children to have the kind of ice cream they created.

Also an interesting task would be to create color codes representing movement commands. The teacher would distribute color cards (red, green, blue) to the children whose task would be to design codes by creating different color combinations (triple combinations, color repetition, etc.). Each created code would represent a command, e.g. red-green-blue would mean "go one step forward", red-blue-red "turn right", blue-red-green "do not move", etc. Using the created codes, the children would "program" themselves to move. In this case, the children realize that different color combinations represent instructions/commands which could be used to program a machine.

During such formulated activities, children practice plane orientation, learn to realize the sequence of events, practice their combinatorial skills, critical thinking (when revising their solution), creating three-color groups (understanding quantity).

4. In conclusion

The development of computational thinking and realization of logical processes and the sequence of events takes place in all areas of education. Not only does the teacher need to be aware of this fact, they also need to be able to incorporate it into instruction. Considering not only the changes that have already taken place but also those that have yet to take place, it is safe to say that the majority of teachers do not have sufficient knowledge of how to develop computational thinking in their pupils. Activities that take place in preschool institutions should take into account the fact that pupils will need the acquired skills during the first years of school. The activities should be spontaneous and game-based, with emphasis being placed on premeditation and orderliness.

In preschool institutions children learn the basics about the world and rules and are at a particular stage of their cognitive and mental development. The teacher needs to provide enough materials, stimuli and inspirations to help the children learn to recognize and solve problems, be active, creative, think logically, argue, communicate and cooperate.

As has been mentioned in Chapter 2, in the Czech Republic discussions are being held about updating the Framework Educational Program. As a result, a project, in which every single pedagogical department in the country participates has been started which is aimed at implementing the changes. The main goal of the project is to ***change the focus of the subject Informatics from user control of ICT to the basics of informatics as a field of study***. The changes will have an impact on all levels of education, from kindergartens to high schools. The following are the outcomes of the project:

- Updated FEP – from kindergartens to elementary schools to high schools
- New and verified (at some schools) study materials – new Informatics textbooks and methodical guides for teachers
- Training – professional and didactic training of informatics teachers (how to use the textbook, how to use different environments and tools, how to deal with problems)
- Updated teacher education in pedagogical departments – pedagogical departments have agreed that the revised accreditation requirements will include a clause that requires teachers to undergo a training on the use of ICT
- Updated informatics (school subject) – university student competitions, professional didactic conferences, teacher competitions (in which those teachers who create study materials will participate)
- Making informatics more popular

The aim of the paper was to present methods for the development of computational thinking, logical thinking and the problem-solving ability in preschool children. The authors tried to create activity categories which both the present and future teachers could use when incorporating computational thinking into everyday activities.

The created categories and individual tasks are only the beginning. The created activities will have to be verified in a kindergarten environment. Since the authors of the paper participate in the aforementioned project, they will have ample opportunity to do so. Moreover, the authors also participate in creating a new subject which will be included in the revised accreditation – 'Informatics for Kindergarten'. Last but not least, this issue is the topic of several student theses, e.g. 'Developing Algorithmic Thinking in Pre-Primary School Children'.

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Implementing Guided Inquiry Learning and Measuring Engagement Using an Electronic Health Record System in an Online Setting

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Abstract: In many courses, practical hands-on experience is critical for knowledge construction. In the traditional lab setting, this construction is easy to observe through student engagement. But in an online virtual lab, there are some challenges to track student engagement. Given the continuing trend of increased enrollment in online courses, learning sciences need to address these challenges soon. To measure student engagement and actualize a social constructivist approach to team-based learning in the virtual lab setting, we developed a novel monitoring tool in an open-source electronic health records system (EHR). The Process Oriented Guided Inquiry Learning (POGIL) approach is used to engage students in learning. In this paper, we present the practice of POGIL and how the monitoring tool measures student engagement in two online courses in the interdisciplinary field of Health Information Management. To the best of our knowledge, this is the first attempt at integrating POGIL to improve learning sciences in the EHR clinical practice. While clinicians spend over 52% of a patient visit time on computers (called desktop medicine), there is very little focus on learning sciences and pedagogy to train clinicians. Our findings provide an approach to implement learning sciences theory to eHealth use training.

Keywords: inquiry learning, POGIL, online education, health sciences, student engagement

1. Introduction

In 2016, the number of students enrolled in online education at institutions of higher education grew to 5.8 million in the US, continuing the trend of robust growth over the last 13 years. 28% of the higher education students are enrolled in at least one online course. So as online education has gone mainstream, fewer academic leaders have expressed that online education is critical to their long-term strategies, shown by a 7.5% drop from 70.8% to 63.3% (Allen & Seaman, 2016). Many attributes this drop to the observation that many students enrolled in online education were less engaged compared to their peers from face-to-face classes (Dixson et al., 2017; Friðriksdóttir, 2018). Researchers have found that reconstruction of knowledge through team-based learning, particularly in a social constructivist view (Mingfei and Jie, 2010), is harder to achieve in online courses, where space-time factors separate learners. The 66-year old, now fully online, Health Information Management (HIM) undergraduate program at Indiana University-Purdue University Indianapolis (IUPUI) is in a similar dilemma. HIM and Health Informatics is an interdisciplinary field integrating biomedical sciences, information sciences, and computer science, and brings together learners with different backgrounds and disciplines into the same course. We have employed a multitude of online engagement techniques: project-based learning and active learning strategies using virtual labs to engage students, but low engagement and lack of skills, observed when students enroll into graduate education, continues to be a serious issue. In health systems, where these students will be employed, technology use is nearly in every activity. Recent research has shown that over 52% of physician time is spent on recording, reviewing and managing information, which is now referred to as "desktop medicine" (Tai-Seale et al., 2017). The ever-increasing time spent on desktop medicine is frustrating to many healthcare providers because they are not trained in this practice, as much as they are trained on other types of medical practices.

To solve the new challenges of engaging students in an online setting, particularly in interdisciplinary health information management learning, we designed a novel monitoring tool called Student Team-Based Learning Monitor (STLM) on OpenMRS, an open-source electronic health record (EHR) system. In this paper, we start by describing a more nuanced approach to measure student engagement. We then compare the differences in measuring engagement in face-to-face and online courses. We present a review of educational literature related to student engagement, its applicability to the HIM field and then justify our choice to implement a constructivist approach called POGIL. In section 5, we describe our software development methodology used to develop the STLM tool, which tracks user activities in the EHR system. We then describe the features of the STLM tool that helps to measure engagement in team-based knowledge construction, which is central to the POGIL approach.

2. A more nuanced approach to student engagement

Student engagement is one of the primary elements of effective teaching and learning and hence it is important to measure it accurately. It is also a key element to ensure that students are involved in learning (Dixson, 2012). Engagement in online courses, particularly in MOOC (Massive open online courses) is often measured using registration rates, participation rates, and completion rates. Educational psychologists consider these measures too simplistic because engagement in learning sciences is considered to be a multidimensional construct. Engagement in education literature is commonly divided into four constructs – cognitive (regulation), behavioral (effort, participation, rule-following), emotional or affective (positive attitude, interest) and social (Daniels, Adams & McCaffrey, 2016).

Cognitive engagement begins when the learner demonstrates cognitive presence by making an inquiry, which might manifest internally as a structure that the learner creates or externally through discussion. This inquiry results in awareness about new ideas, concepts or problems, and thereby leads to discovering new information, integrating ideas, and eventually to resolving the problem (Akyol & Garrison, 2011). Thus, problem-solving, coping, desire to learn are intrinsic motivations that learner should ideally demonstrate when cognitively engaged with the material and thereby demonstrate self-regulated learning.

Behavioral engagement most commonly includes three ways. (1) Positive conduct, like following the rules, regular attendance and adhering to classroom norms; or negative conduct and undisciplined behaviors, like skipping school and getting in trouble (Appleton, Christenson, & Furlong, 2008). (2) While performing academic tasks demonstrating behaviors, like concentration, persistence, paying attention and asking questions (Birch & Ladd, 1997). (3) Involvement in governance such as participating in student bodies, extra-curricular activities, etc. So behavioral engagement can be seen as a range from simply getting the work done, cooperative participation, and other self-directed academic behaviors. Behavioral engagement is important for achieving academic success or positive outcomes and reducing drop-out rates (Appleton et al., 2008).

Emotional engagement is when learners can express or experience their affective reactions, including interest, boredom, happiness, sadness, and anxiety (Skinner & Belmont, 1993). Emotional engagement in a way is the manifestation of learner's attitudes towards learning and student interest and values (Appleton et al., 2008). For instance, if a learner appears excited about the content, it is considered a positive emotional engagement.

Social engagement can be seen when learners share more than just the facts, but also feel that they can communicate (Kehrwald, 2008). Researchers have stated that social engagement is the effectiveness of using collaborative activities, group discussions, and other forms of student-student interaction (Gaytan & McEwen, 2007). The social constructivism epistemological lens emphasizes the role of constructing knowledge through social interactions. Therefore, when learners can express their social presence, they are emotionally and interpersonally communicating and connecting with others (Garrison & Arbaugh, 2007).

Yet, very little of these well-known engagement metrics have been applied to online education in biomedicine or health/nursing informatics, due to the effort required for such analysis (Gray & Tobin, 2010) or lack of tools that can give quantitative metrics (Russel et al., 2006). It is only recently, that patient engagement with online health information and health portals has caught attention. These concepts of engagement in learning can also be similarly applied to patient's who gain information about their illness and participate in their own care. Thus, the impact of our research can be beyond coursework pedagogy.

3. Measuring the four constructs of engagement in face-to-face or online

In traditional classroom settings, we might observe that when a student asks a question in class (cognitive), completes assignment (behavioral), appears excited about the content (emotional) and shares information with their peers (social) as useful measures for engagement. In an online setting, when a student starts a debate or asks a question (cognitive), regularly logs in and watches full video segments (behavioral), expresses that the content is useful (emotional) and participates in discussions and collaboration with other students (social), as some points to measure engagement. So, it is easy to see how engagement can be measured and possibly compared to the classroom and online settings.

In the face-to-face classroom, when teachers observe low engagement among students, they often use pop quizzes, case studies or example situations to create an inquiry structure within the learner. However, in the case of online learning environments, replicating pop quizzes or other inquiry methods might not yield the same engagement due to space-time differences. In particular, observing, assessing and measuring the inquiry structure is harder, since the teacher will never know for sure about the sources that were used by the learner to create the inquiry structure if they came from the teacher's instructions or elsewhere.

Social engagement in face-to-face or online settings is often measured by the quantity and quality of the interactions. The differences between verbal and written communication are well known, and with modern e-learning technology, the space-time synchronicity provides rich and lifelike experiences. Yet, where the online and face-to-face learning environments vastly differ are in the experiences of the learner. The experience mainly depends on technology affordance, which might be a function of how much or how often technology is used or is available. Often this technology affordance is simplistically correlated to the age of the learner. Instead, we suggest that more granular measurements be made by using structured observations of behavior within the e-learning technology. For example, students can complete an assignment either by paying attention and staying on-task or using superficial learning strategies to memorize, rather than deeper strategies to understand what is being taught. This difference in student behavior can be measured by observing the steps that a learner takes to complete the assignment. This is done quite often in the case of viva voce in medical education, but rarely in e-learning environments (Purkayastha et al., 2015). Many studies demonstrate a link between behavioral engagement and achievement (Connell & Wellborn, 1991).

Emotional engagement is often the hardest to measure or capture in both face-to-face or online settings because it depends on whether the learner expresses or experiences those emotions. Much of the emotional response to a subject or topic might also be outside the face-to-face classroom. Thus, we need to use surveys and interviews to measure emotional engagement.

4. Review of pedagogical approaches to engage students

As part of our HIM program, multiple approaches have been taken to involve the undergraduate students in the learning process - using active learning, problem-based learning, experiential learning and inquiry learning. All these teaching and learning methods try to move away from didactic learning and engage students in their own learning process.

Experiential learning requires self-initiative, an intention to learn and an active phase of learning (Moon, 2013). David Kolb's 4-step experiential learning model (ELM) that built on the work of Dewey, Lewin, and Piaget is probably the most popular model to explain experiential learning (Dixon, Adams, & Cullins, 1997). But with the challenge of self-initiative, particularly in the undergraduate and online classroom, we saw limited approaches to implement ELM. Problem-based learning (PBL) is another approach commonly used in STEM education, due to the constructivist philosophy and positivist epistemological base of many natural sciences. Wood et al. (2010) expressed that utilization of resources and tutor facilitation are the main problems of PBL methods. Students have also reported information overload and unable to determine the amount of study required to be able to solve a problem. On the other hand, another method influenced by constructivist teaching philosophy called inquiry learning can be applied to active learning and group-based learning strategies without student overload. In the 1960s, Schwab articulated 4-levels of inquiry – confirmation inquiry, structured inquiry, guided inquiry and open/true inquiry (Schwab, 1960). These levels of learning might be thought of as hierarchical and form a chain of discovery where student traverses the different levels of inquiry. For undergraduate education, guided inquiry learning has been founded to be appropriate, given the amount of work that students need to put in a traditional, single semester course (Kuhlthau, Maniotes, & Caspari, 2015). Furthermore, to facilitate early or introductory courses, making students walk through a process also helps in inquiry learning. This is what is referred to as process oriented guided inquiry learning (POGIL) (Brown, 2010). Although POGIL started in chemistry, it has been customized to other fields such as Computer Science, Nursing, Medicine, and Pharmacology. POGIL has been shown to improve student engagement, improved performance in assessments, particularly among women, minority and low-income student groups (H. Hu & Avery, 2015). Thus, POGIL is the theory that we have put into practice using STLM in the two HIM courses.

5. Our implementation context and methodology

Our intervention is based on a practical application of the theory of Process Oriented Guided Inquiry Learning (POGIL). We selected two courses from the HIM program for implementation, M200 - Database Design for HIM and M220 – Health informatics for Decision Support. The main learning outcomes of the two courses are for students to acquire process skills in the use of technologies such as electronic health record systems and health databases. POGIL practices, which we describe in the next paragraph, were integrated into the curriculum redesign of these HIM courses. We implemented the core philosophy of POGIL in the two courses - students learn through the process of performing activities that aid in developing critical thinking skills, as in such scenarios, learning is by doing, and the teacher does not instruct, he/she facilitates guided learning. Before our modifications, the courses used active learning strategies such as group discussion on database-related work, and virtual labs, where students critically review decision support tools in an EHR system. Based on the HIM plan of study, these courses are taken by students in the 2nd year of their BS in HIM. The HIM M200 is a general education course, which can be taken by students from different programs. Approximately 40 students enroll in these courses each semester.

We currently use OpenMRS, an open-source electronic health records system in the Health Information Management and the graduate Health Informatics program at IUPUI. OpenMRS is widely deployed in more than 350 sites in over 42 countries, mainly in clinics in low-and-middle income countries, but also in some academic sites such as medical schools and schools of informatics in high-income countries. Students enrolled in the online program are given lecture material (slides, documentation or videos) suited for POGIL pedagogy. We divided the students into small groups of 3-4, which is the appropriate size for the tasks from these courses. As part of the POGIL implementation, each student of a group can play two roles - iTrainee and rTrainee. The "inquiring student" called the iTrainee is asked to create a set of tasks based on the concept that was explained in the lecture material and instructions from the teacher. The iTrainee is not aware of the most efficient way to perform the task but tries to perform the task on their own, based on the concepts explained in the lecture slides. See Figure 1 below for an example. After performing the task, the iTrainee requests the other students of their group (rTrainees) to perform the same task.

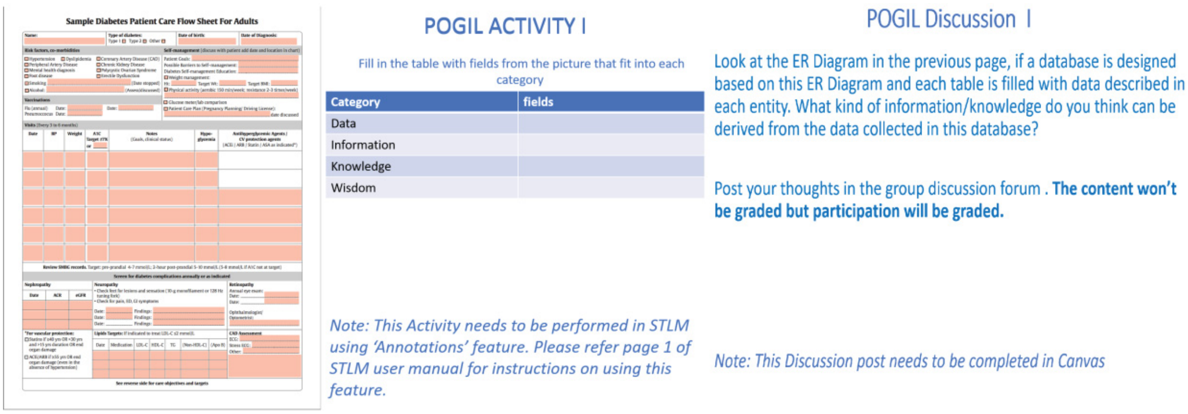

Figure 1: A comparison of slide material (right), STLM (left), and the Canvas discussion

This is written by the student on the Canvas learning management system used at IUPUI. The rest of the group members are notified of this request. Other "responding students" called rTrainee now attempt to complete the task that is put forth by the question of the iTrainee. The rTrainees attempt to complete the task, without knowing the way in which the iTrainee completed or could not complete the task. After completion of the given task, the rTrainees and iTrainee will be able to compare their work with other members of the group. The iTrainee will also similarly have to play the role of a rTrainee when other members of his/her group make inquiries and propose new tasks to the group. We found that with each attempt as a rTrainee, there is improved student learning of the concept, followed by knowledge reconstruction that occurs by observing the comparison of the tasks performed by different students.

Let us look at the example POGIL activity from Figure 1. The HIM M220 course has an assignment, which requires all the students to identify data/metadata, information, and knowledge from the EHR data, shown in the patient dashboard, such that they can be used to create clinical decision support rules. We modified the assignment in such a way, where iTrainee is given a set of instructions to search for a patient in the EHR system and tag the elements and values as data or information or knowledge. The STLM tool enables selecting or typing text in the EHR forms and tag them as data/metadata, information or knowledge. Figure 2. shows how this task is performed by the student in the EHR and monitored by the STLM. The iTrainee then posts instructions in the discussion forum for other members of the group, who will now have to play the role of rTrainees. The iTrainee instructs the rTrainees with the specific name of the patient to search, the form that needs to be opened and the type of concept or form that should be filled to complete the task. After completion of the task, students can compare their methods to attempt the task with other members of the group, this is facilitated by the STLM tool, which is discussed in the next section. Our implementation involves students in the learning process, through inquiry and activities of the constructivist learning cycle. Due to the use of the POGIL approach, students discover different ways to complete the tasks in the EHR system. This is difficult in a didactic setting since all possible ways to solve the problem are hard to demonstrate. Whereas in a POGIL approach environment, the students will work with/against (in a competitive way) to solve the problem and discover efficient ways to complete a task.

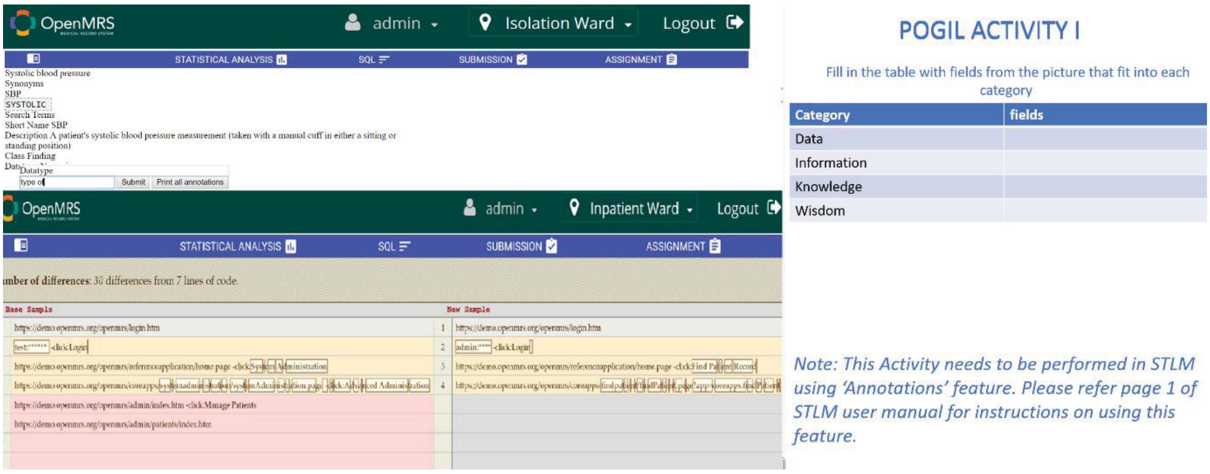

Figure 2: Screenshot showing STLM tool with annotation and compare feature (left) and POGIL task (right)

We measured the student engagement using survey instrument and learning analytics from the Canvas learning management system and the STLM tool. The survey questionnaire is based on the National Survey of Student Engagement (Kuh, 2003) and the Student Engagement Instrument (Appleton, 2012). This survey contained 22 questions related to four engagement components (cognitive, behavioral, emotional and social) and took about 15 minutes to complete. A semi-structured interview was then conducted by an undergraduate researcher (who has already taken the course). The interview lasted between 30-45 minutes and included questions about student's experiences on the POGIL and the STLM tool. The results of the analysis of the survey and interview data have been reported elsewhere.

6. Features of STLM

We developed the STLM tool as a module on the OpenMRS EHR system platform, because it is flexible, and used in many Health Informatics and Health Information Management courses (Purkayastha et al., 2017). Using the role-based permission scheme in OpenMRS, we assigned trainee roles to students. The students are sub-divided as one iTrainee or multiple rTrainee roles in a round-robin fashion for each week's assignments. The teaching assistants or course instructors use the EHR administrator role to manage the trainees, grade and provide answer keys for the tasks that are completed each week in the EHR system, under the observation of the STLM.

The STLM provides a generic assignment task list to be completed by the trainees each week. The iTrainee is the only student who sees this tasklist and creates a specific question out of each task for their student group. Along with creating the question, the iTrainee applies the concepts learned from the slides and attempts to answer the question. As shown in Figure 3, the iTrainee clicks the "Start recording" button to record their answer, navigates through the EHR performing actions to complete the task, and then answer the question that they originally asked. The "Stop recording" button is activated once the recording is started and the iTrainee needs to press it to complete registering the answer. By doing so, the STLM tool has captured all the actions that were performed by the iTrainee. After performing the task, the iTrainee will have to request the other students of their group (rTrainees) to perform the same task. The rest of the group members will be notified of this request. rTrainees will then attempt to complete the task that is put forth by the iTrainee for the given week. As the rTrainees attempt to complete the task, without knowing the way or approach in which the iTrainee completed the task. After completion of the given task, the rTrainees and iTrainee will be able to compare their work with other members of the group using the compare feature in the STLM tool as shown in Figure 3. The STLM tool captures the different types of actions performed on the EHR. The user fully controls the STLM recordings and as such avoids privacy or security issues during deployment. The following are actions captured by STLM:

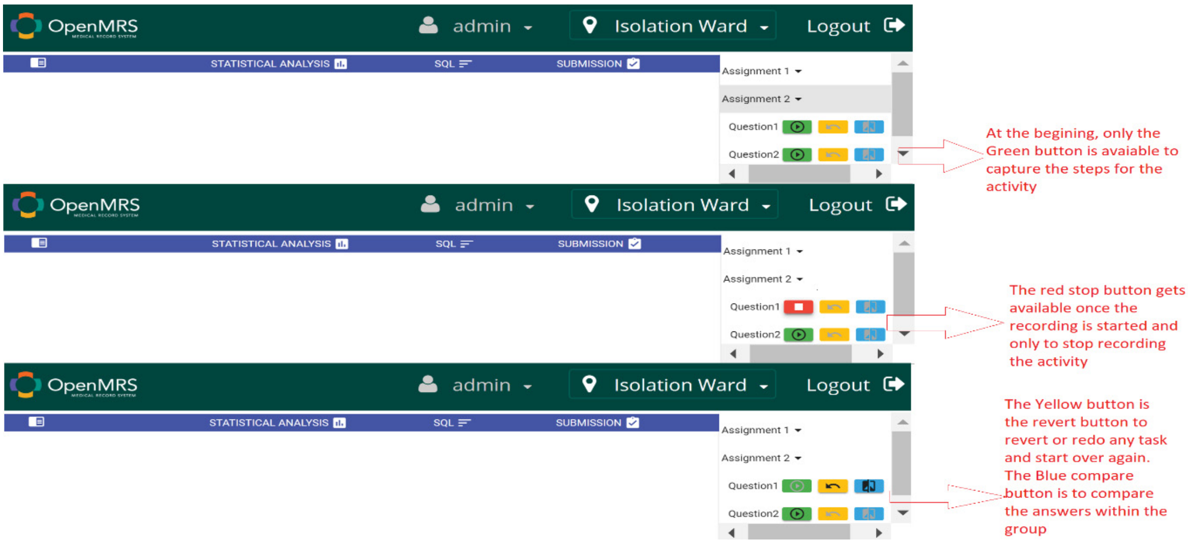

Figure 3: Steps involved in capturing the task performed in STLM

- 1. Page navigation: This is the most basic data captured by the STLM. The STLM captures all the pages where the EHR user (iTrainee or rTrainee) navigates, clicks and types on text fields. The users then have the option to compare the navigation to complete a task with other trainees.
- 2. Onscreen annotations: The user can select parts of the screen text and annotate them with tags. E.g., in M200 course, while studying Database Design for HIM the students are given the task to annotate a few data points based on their slides. This task needs to be completed using the 'Annotation' feature. For better understanding as shown in Figure 2 the students are expected to annotate words or fields based on their understanding from the uploaded patient care sheet, which will be made available to the students by uploading in the tool where they can directly select the field or word that corresponds to 'Data', 'Information', 'Knowledge; or Wisdom' and annotate it. Each step performed to complete this activity will be captured into the STLM tool. In this way, they can perform an information management assignment. The trainees can then compare the annotations with other trainees within the STLM.
- 3. Diagram comparison: Block diagrams, entity diagrams, and workflow design are an important part of information management and for the design of EHR systems. Trainees can create flowcharts, block diagrams using entities as shown in Figure 4. The STLM will compare the diagrams that are created by the trainees. The STLM does not evaluate the exact contents of the diagrams but can compare the number of entities, number of connectors between entities, as well as the layout and arrangement of the entities.

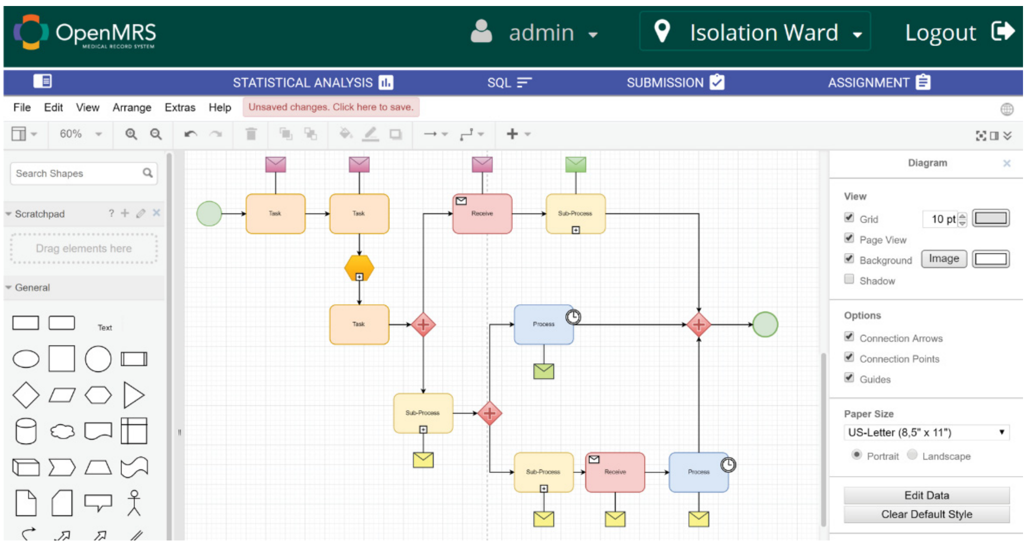

Figure 4: Screenshot showing drawing feature to capture various steps

- 4. SQL execution: This allows the user to execute SELECT queries on the database to retrieve data from the EHR and compare those between students, this feature can be referred in Figure 5. The STLM can compare the text of the queries themselves, as well as the output that is generated from it.
- 5. Cohort export: As shown in Figure 5, while the SQL execution results in some data that is shown on screen, it can be combined with previous run queries and trainees can compare the exported cohort between their extracted data and data that is extracted by other trainees.

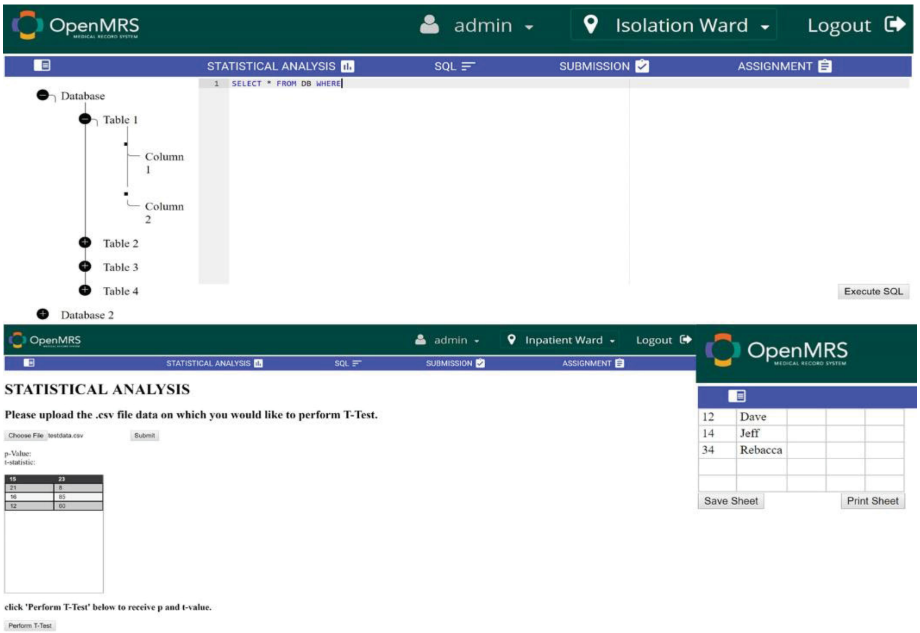

Figure 5: Screenshot showing feature for SQL query execution (top) and Cohort export (bottom)

STLM supports inter-disciplinary learning by involving trainees with different skills in groups. Health informatics and health information management are inherently interdisciplinary fields where individuals with a background in biomedical sciences, information sciences, and computer science collaborate with each other. The STLM use-cases support interdisciplinary collaboration, as trainees with different backgrounds can observe how each person from their group performs the same action in different ways and can engage in learning from each other.

7. Conclusion

Through our study and development of the STLM module, we can capture more granular information about student engagement, instead of just time spent on a task, which is what is usually available in learning management systems. Using STLM, instructors, learning science researchers, clinic administrators and students can review more detailed information about how students perform tasks and how they convert conceptual learning into practical implementation of process-oriented inquiry learning, particularly in interdisciplinary settings and e-learning environments.

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Gamification in Education: Real Benefits or Edutainment?

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Abstract: Gamification of learning—the application of game design elements to learning activities—is currently a hot, if controversial, trend in education. Proponents of gamification, on the one hand, claim that gamification leads to learning gains. They assert that gamification reinforces important skills in education, such as problem-solving, collaboration, and communication. Furthermore, they maintain that need for interaction in a gamified approach to education encourages students to play an active role in the learning process, thereby increasing student engagement in online forums, projects, and other learning activities. Detractors of gamification, meanwhile, argue that it derails learning with aimless distractions, adds unnecessary competition stress, and fails to take into account certain learners' pedagogical needs. Research on gamification is gathering momentum and promises to help adjudicate many of the issues raised in this controversy. We therefore conducted a second-order review to examine the evidence-based discourse on this aspect of gamification. We found that while the review literature adequately summarizes evidence in support of effectiveness in terms of cognitive, emotional/motivational, and behavioural outcomes, certain design issues remain unaddressed. When addressing effectiveness, a concern for how the nature of learning objectives and the quality of learning activities that are gamified is noticeably absent in the field. Furthermore, a contextual bias towards STEM courses limits the generalizability of evidence to other contexts. The review literature further suggests a publication bias and an over-emphasis on positive effects. Nevertheless, recognising the general scope of the research, its theory, and evidence, will help instructors and curriculum designers interested in gamifying courses decide how to approach gamified course designs to use in a specific context. Highlighting current limitations in the evidence-based discourse may benefit the design of future research by drawing attention to the types of evidence that will help advance gamification in educational settings.

Keywords: gamification in education, game design elements, learning design elements, game design principles, game mechanics, learning outcomes

1. Introduction

Gamification has been applied in several domains, including education, business, fitness and health domains, but the research field of gamification in education is still in its emergent stages. Despite Piaget's early advocacy of games as a way for children to meaningfully interact with and learn from their environments, it was not until recently that research on games in education gained momentum. Indeed, as of 2013, only 26% of scientific publications in gamification were about its practical application in education (Seaborn and Fels, 2013), with the first seminal framework of gamification published only a few years ago (Deterding et al, 2011).

Despite its late arrival, its popularity has grown rapidly, largely due to expectations around its ability to solve a perennial challenge of traditional learning environments: making learning interesting and engaging. With the advancement of social media and online gaming, as well as the widespread use of smart devices, the task of keeping students motivated to learn has become even more challenging. The introduction of gamification into the classroom stems from the premise that the nature of games and what makes them fun increases students' intrinsic motivation to engage in learning activities (Adams and Dormans, 2012). The inherent interactivity of games is also thought to maximize students' involvement in the learning process, thereby supporting active learning, problem-based learning, and experiential learning (Oblinger, 2004).

Many educators hope that gamification will not only increase students' motivation to learn but also make participation in schoolwork more effective and meaningful. The emerging literature seems to uphold this view, with evidence that gamification may be linked to higher numbers of passing students (de Marcos et al, 2017). Gamification of learning environments may constitute a powerful tool for the acquisition of knowledge, and might enhance important skills such as problem-solving, collaboration, and communication (Dicheva et al, 2015). Critics, however, argue that gamification derails learning with aimless distractions, adds unnecessary competition stress, and fails to take into account certain learners' pedagogical needs. The value of gamification in education remains controversial, despite an increasing number of empirical studies and literature reviews that may inform this controversy. The present study aims to ascertain the extent to which literature reviews in the field of gamification are adequately addressing relevant issues to inform this debate.

1.1 Definition(s) of gamification in education

In defining the scope of our study, we build on the definitions of *gaming*, *game design elements* and *gamification* set out by Deterding et al (2011). First is the differentiation between 'gaming' and 'playing'. While playing is a freeform, creative and open-ended process, *gaming* is a highly structured process oriented toward discrete, clearly defined goals. *Gamification*, then is defined as "the use of *game design elements* characteristic for games (rather than play or playfulness) in non-game contexts"(p. 13).

Game design elements are more difficult to define, owing to the multiple theoretical frameworks that have been produced, each with idiosyncratic classification systems and levels of abstraction. Useful for the current study is the synthesis by Dicheva et al (2015) of the more prominent frameworks found in the literature (*e.g.*, Deterding et al, 2011; Zichermann and Cunningham, 2011). Table 1 summarizes the synthesized framework, which classifies game design elements into two levels of abstraction -- game design principles and game mechanics -- with exemplars of each.

Table 1: Game design elements: Classification framework

Design principles	Mechanics
Visible status Social engagement competition cooperation collaboration Freedom of choice Freedom to fail Rapid feedback Goals & challenges Customization Access, unlock content	Badges Points Levels Rewards Leaderboards Progress bars Currency Avatars Countdown clock

Common *game design principles* are those of visible status, social engagement, freedom of choice, freedom to fail, and rapid feedback (Dicheva et al, 2015). *Visible status*, informs students about a task's completion status or else shows students how they are progressing. *Social engagement* feeds into purported needs for competition against individuals or teams (O'Donovan et al, 2013) but may include team projects and group learning opportunities (Mak, 2013), as well as cooperation and interaction with classroom peers (Landers and Callan, 2011). *Freedom of choice* implies that students are free to choose whichever task(s) they want to complete. For instance, in Holman, Aguilar, and Fishman (2013), students could choose between writing an essay, a class blog, a group project, or an individual project, while in DeShutter and Abeele (2014) options included making a YouTube video, designing an educational game, or writing academic essays. The *freedom to fail* principle is exemplified in contexts where students were given the chance to submit assignments again and to revise their work without a penalty (Hentenryck and Coffrin, 2014). *Rapid feedback* refers to the gaming context enabling students to receive feedback on their learning performance.

Commonly studies *game mechanics* are badges, points, levels and rewards. As the more concrete level of elements, game mechanics are more contextualized than design principles, more adapted to the specifics of a given learning environment. Badges generally are icons associated with a learner's profile that signal accomplishment and can be linked to several design principle, such as visible status, goals and challenges. Points are generally accrued for performance or participation and are given to reward desired learning behaviours. Again, they can be linked to and promote several design principles (*e.g.*, visible status, rapid feedback, competition, etc). Mechanics generally represent an instantiation of a game design principle. For example, the principle of visible status can be instantiated through the use of a leaderboard, badges, etc. A single principle may be operationalized by more than one mechanic. By the same token, a single mechanic can operationalize multiple principles. For example, a leaderboard can operationalize visible status and social engagement. The combinatorial relations among principles and mechanics raises an important caution in interpreting the effectiveness of a mechanic without considering which principle(s) it is used to instantiate, and vice versa.

Gamification, then, is defined as "the use of design elements characteristic for games (rather than play or playfulness) in non-game contexts"(Deterding et al, 2011, p 13). The focus on game design elements intentionally excludes the consideration of 'serious games' or whole educational games when referring to gamification, as these types of games are so idiosyncratic to context as to not be generalizable and are prohibitively resource-intensive to produce; they are exceedingly rare in educational contexts and out of scope for the current study. Gamification in education therefore is defined as the use of game design elements in in the context of formal higher education and with the intention of supporting the acquisition of course-specific learning objectives. Our study aims to characterize the current state of discourse in the educational gamification field by examining the literature review articles, each summarizing the field's evaluation of gamification in education.

2. Objective and methodology

The overall objective of this study is to describe the extant corpus of relevant literature reviews in order to characterize the discourse over effectiveness of gamification of learning in higher education. The assumption driving this second-order review is that literature reviews and meta-analyses most effectively inform evidence-based discourse over issues of effectiveness of educational innovations, but can unwittingly introduce blindspots into the discourse. A careful characterization of the review literature therefore will allow us to present a current snapshot of the 'state of the evidence' as well as identify any blind spots or gaps that may limit the utility of that evidence in adjudicating debates over the effectiveness of gamification. A clear understanding of the gamification in education research field would likely help researchers and educators marshal and qualify relevant evidence in discussions over the usefulness and impact of gamification.

Our second-order review focuses on the evidence for effectiveness of gamification in education, framed by three specific questions:

- What are the types of outcomes currently used to decide effectiveness?
- What are the types of game design elements used to decide effectiveness?
- What limitations can be addressed to better inform discourse over effectiveness?

We present here a second-order review -- a qualitative analysis of the review literature on gamification in education, published in the past 5 years (2014–2018). We conducted systematic searches using specific keywords to identify relevant reviews in the field of gamification in education and targeting higher education populations in particular. First, we performed a Boolean AND search of key terms on the Google Scholar and Educational Research Information Center (ERIC) databases. The terms were: review, gamification, learning, higher education. We followed up this search with a set of inclusion/exclusion criteria where the final articles included in this study had to satisfy the following criteria: published in the last five years, pertained to higher education settings, used a form of gamification for education, and did not use serious games or whole educational games when referring to gamification.

Our search yielded 54 reviews, 10 of which met our inclusion criteria and were analyzed in-depth. (Included reviews are marked with an asterisk in the References section). Our review is descriptive in nature, synthesizing findings around what the literature reviews uncovered with regards to patterns and interpreted findings, theories, or recommendations on the area of gamification in education.

3. Findings

Our examination of the relevant reviews allows us to summarize the core activities, nature of evidence and interpretations currently informing discourse in the field of gamified education.

3.1 What outcomes are currently used to decide effectiveness?

Effectiveness of gamification is often dealt with in the research literature, yet it is broadly construed around various outcomes. For example, Martí-Parreño et al (2016) describe a theme in the literature, termed 'effectiveness', that includes cognitive outcomes as well as various attitudes and emotions about the gamification experience. The authors also include a separate theme, 'engagement', which is also considered a relevant outcome to decide effectiveness in a broader sense. Indeed, in addition to cognitive learning gains, the outcomes most commonly considered for effectiveness of gamification in education are motivation and engagement (Bell, 2017; Faiella et al, 2015; Hamari et al, 2014). We consider these outcomes in turn.

3.1.1 Cognitive learning outcomes

When considered, reviews generally reported that gamification had positive effects on cognitive learning outcomes (Bevins and Howard, 2018; Hamari et al, 2014; Kim et al, 2018). Scholars reported that learning achievement, procedural and declarative knowledge, higher order thinking skills were enriched by adding a gamification layer (Kim et al, 2018). Gamification, does appear to improve learning outcomes on lower-risk assignments (e.g., quizzes and practical activities) and overall course marks but does not appear to significantly influence performance on final exams (Bevins and Howard, 2018). In summary, the review literature supports the claim that well-designed, properly deployed gamification can improve learning outcomes in different conditions.

Though effectiveness in terms of cognitive learning outcomes is most closely aligned with the objectives of higher education courses, literature reviews found a disproportionately low emphasis on this outcome. We suggest several reasons for this discrepancy. First, the effectiveness of gamification on learning outcomes may depend on the nature of the learning outcomes targeted (there are many frameworks to provide texture and nuance to these, such as taxonomies elaborated by Bloom, Fink, Biggs, and others). Also critical are the nature and design of the learning activities that are gamified to achieve these outcomes. Motivation for and engagement with effective learning activities will more likely lead to improved learning outcomes, while ineffective learning activities may not, no matter how much motivation and engagement is mustered. A layer of complexity therefore arises in that the effect of gamification of learning outcomes requires contextualization with respect to learning outcomes and is probably mediated by the effectiveness of gamified learning activities on achieving those outcomes. Nevertheless, the most obvious reason for the lack of emphasis on cognitive outcomes is a pervasive perception that the primary affordance of gamification is motivation and engagement.

3.1.2 Motivation and emotion

A majority of the literature reviews showed positive effects of gamification on motivation (Alsawaeir, 2018; Bell, 2017; Bevins and Howard, 2018; Dicheva, 2015; Faiella, 2015). Students perceived gamified courses to be more motivating, interesting, and conducive to learning than other courses (Dicheva et al, 2015). Particularly, gamification elements transform boring tasks into interesting ones (Faiella et al, 2015). Emotional outcomes generally focused on constructs such as motivation, attitude, and enjoyment, which were investigated via interviews or questionnaires (Alsawaeir, 2018; Hamari et al, 2014). Scholars in the field recommend further research on the impact of gamification on motivation. To better grasp the effect of gamification on motivation effectively, researchers need to conduct longitudinal studies or at least identify which combinations of game design elements are most likely to stimulate intrinsic motivation (Alsawaier, 2018).

3.1.3 Engagement and behaviour

With regards to gamification and its effect on learners' engagement, literature reviews generally target engagement as an outcome in itself (Alsawaier, 2018; Bell, 2017; Bevins and Howard, 2018; Dicheva et al, 2015; Faiella et al, 2015; Martí-Parreño et al, 2016; Ortiz et al, 2016). Studies examining effects of engagement revealed, again, mostly positive results. These included significantly greater student engagement in forums and projects; higher rates of attendance, participation, and material downloads; increased quantity (and continued quality) of student contributions/answers, higher passing rates, increased volunteering, and undertaking of difficult assignments; as well as a reduction in student achievement gaps (Dicheva et al, 2015). Interestingly, participation results in greater student engagement, particularly if individuals are free to select a preferred mode of learning (Faiella et al, 2015). In addition, the better the alignment of coursework, core content, and game elements, the greater the positive the effect on gamification and engagement. This is especially true if such aspects are linked to a central narrative (Bell, 2017).

3.1.4 Relations among outcomes:

The relations among the cognitive, emotional and behavioural outcomes are likely complex and nuanced. For example, learning gains resulting from gamification show that results are not tied to motivation and engagement only. In fact, Sitzmann et al (2011) disclosed that gamification in education also helps self-efficacy and boosts knowledge retention. Faiella et al (2015) revealed that gamification helps lower anxiety or worry over the consequences of not doing well. In addition, gamification aids in building communities, where participants share tips and celebrate accomplishments on a whole class level, not only academic high-achievers (Faiella et al, 2015).

Meta-analytic studies demonstrate that gamification might be quite beneficial and help students achieve better outcomes when certain elements are present (Garland, 2015). These include applying a gamification layer to courses that last shorter time periods, such as short-term courses or modules within courses (Garland, 2015). Gamified courses should include elements that demonstrate time spent on tasks since poor time management is inversely related to positive results (Garland, 2015). Last but not least, feedback that is ongoing, immediate, and meaningful can have a positive effect on learning outcomes (Faiella et al, 2015).

3.2 What are the types of game design elements used to decide effectiveness?

3.2.1 Game mechanics

The literature reviews reveal that the most typically used game mechanics were points, badges, and leaderboards, (Bevins and Howard, 2018; Hamari et al; 2014; Ortiz et al, 2016). However, gamification is not only about using game mechanics in courses, but rather using them to overcome challenges in education and meeting objectives (Kim et al, 2018), a function that falls closer to the game design principles level in Table1. In light of that, to better grasp the effect of gamification mechanics on engagement and motivation, researchers need to study how game mechanics interact with design principles (see Figure 1), and which couplings work well together, in what contexts (Alsawaier, 2018). Furthermore, these game design elements should be considered also in light of their coupling to 'learning design elements', what we introduce here as the analogical counterparts to game design elements: 'learning design principles' and 'learning mechanics'. To properly inform discourse on effectiveness of gamification in learning, the design principles and mechanics of both gamification and learning must be considered together.

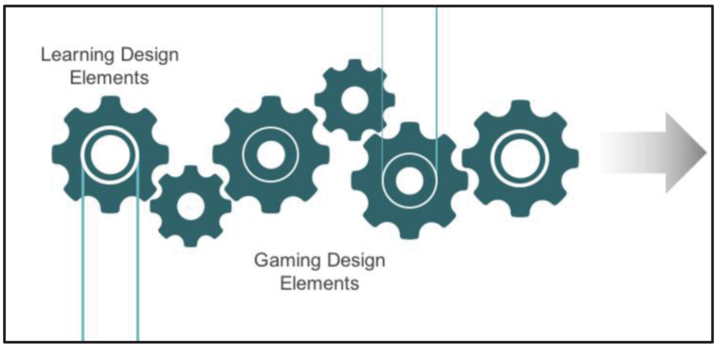

Figure 1: Illustration of the Interaction

3.3 What limitations can be addressed in order to better inform discourse over effectiveness?

3.3.1 Context

The literature reviews synthesized here show that context plays an important role in gamification (Alsawaier, 2018; Dicheva et al, 2015; Faiella et al, 2015). Gamified designs and hence their impacts differ depending on the nature of the learning site, the subject matter, the instructor, and how gamification is to be implemented (Alsawaier, 2018). These contextual effects make the effectiveness of gamified learning hard to synthesize (Dicheva et al, 2015). Furthermore, the descriptive nature of most studies precludes inferential claims about the effectiveness of gamification despite the many reports of successful implementations (Hamari et al, 2014). In addition, gamification cannot be successfully implemented into the classroom without the support of a solid technological infrastructure and suitable pedagogical framework (*i.e.*, 'learning design elements'). A generalized description of effective gamification of learning is therefore elusive (Dicheva et al, 2015).

3.3.2 Learner characteristics

Another common aspect of the studies was that learner and content characteristics clearly determine the impact of gamification in education (Faiella et al, 2015; Kim et al, 2018). For example, student engagement has been found to be particularly improved if individuals are free to select a preferred mode of learning (Faiella et al, 2015). Additionally, students' previous exposure to video game elements, the number of games played, prior knowledge of, and exposure to gaming play an important role on the success of gamified experiences (Alsawaier, 2018; Garland, 2018; Kim et al, 2018; Martí-Parreño et al 2016). Despite some reports, effectiveness research has not been properly contextualized with regards to how particular kinds of learners are motivated in different gamified contexts or how personality traits like extroversion or introversion may impact the social aspects of a gamified experience.

In sum, gamification studies tend to overlook critical contextual moderators that help explain mixed results on effectiveness. For example, social dynamics may be moderated by personality traits like extroversion and responses to gamified instruction may vary as a result of students' preferences (Martí-Parreño et al, 2016). In light of the above, evidence is needed to corroborate practitioners' claims that newer, innovative formats can lead to better results with different demographics (Bell, 2017; Ortiz et al, 2016). To properly assess the impact of gamification, therefore, the field is in need of richer predictive models that include contextual variables as mediating or moderating variables, such as students' levels of motivation, personalities, and game preferences (Ortiz et al, 2016).

3.3.3 Biases

Literature reviews also make evident certain biases in the corpus of primary literature. Most notable and problematic is the evidence for a disproportionate interest in the benefits of gamification. Though not explicitly confirmed, this may indicate a publication bias, where only positive results are reported, either due to a disproportionate search for positive outcomes while ignoring negative outcomes, or due to the lack of interest in publishing negative results (file drawer bias). More studies should, therefore, include a focus on the possible negative outcomes of gamification, particularly with regard to students' emotions. Martí-Parreño et al (2016) found that studies largely fail to explore how gamification might cause frustration, anxiety, or negative social comparison. Similarly, de Marcos et al's (2017) study on social gamification reported decreased motivation and participation as the course progressed, probably due to the fact that the duration and timing were not taken into account during the design phase of the course.

Another contextual bias is evident in the preponderance of research focusing on computer science and IT (STEM) courses as opposed to other fields (Dicheva et al, 2015; Ortiz et al, 2016; Kim et al; 2018). This bias might be because implementation of gamification requires the set-up needed to integrate and envision game mechanisms and dynamics, which are usually found the computer science and IT department faculty (Dicheva et al, 2015). On the background of this bias, studies reveal that gamification produced better effects in these STEM subjects than the humanities (Kim et al, 2018). It is unclear if the application of gamification in other fields would result in the same findings.

4. Conclusions

Based on our second-order review, we offer recommendations for further research in the field, with the objective of better informing debates on the effectiveness of gamification in learning.

- The relation between game design principles and game mechanics is important. Research studies and reviews would benefit from unpacking game design elements and explicitly considering which game mechanics are employed and in service of which game design principles.
- The relation between game design elements and learning design elements is important. In addition to a clearer analysis of the game design elements employed in research studies, equally important in terms of outcomes is the consideration of 'learning design elements', or the pedagogical principles, learning objectives and learning activities that are gamified. Noticeable are the potential overlaps between the two sets of principles. For example, 'rapid feedback' is a both principle of game design and pedagogy, while 'levels' and 'access' align well with 'mastery learning' (see *e.g.*, Hattie, 2015), but mechanics do not overlap. This raises the enticing suggestion that gamification of learning is most effective when the principles of gaming and learning are shared, aligned or even equivalent and operationalized through game mechanics. Furthermore, the effectiveness of the learning activities that are gamified seems a clear prerequisite to effectiveness of the gamification. Finally, not all types of learning objectives may be equally effectively gamified. More careful analysis of these factors will help understand what types of learning are effectively gamified.
- Contextual variables are important. With a clearer view of the 'intervention' as defined in recommendations 1 and 2, a clearer view of the contextual models is called for.

- Richer predictive models will help. Summing up the previous recommendations, predictive models that include the relations among game design elements, learning design elements and contextual variables will benefit our understanding of what is best gamified, how, for whom and to what end.

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Educational Audio Gamification: Theory and Practice

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Abstract: Electronic computer games used for educational purposes currently constitute an essential component of the learning process. By combining entertaining elements with interactive technologies to deliver the respective curricula they can enhance the development of various skills, as well as serve as platforms for the application of modern educational theories. Audio Games (AG) are a particular genre of electronic games, in which all information is conveyed mainly or exclusively through sound. Thus, players need to employ their sense of hearing to understand and accomplish the necessary tasks, a process that promotes their concentration, memory, fantasy, emotion, perception, data management and cooperation. Even though research findings have shown that both game and audio interaction have positive effects on the user, there has been no systematic approach in designing educational AG and implementing them in the learning process. In this paper the authors attempt to establish the theoretical frame for the design of educational AG by arguing that their features comply with the goals of music education, as these are formulated in the official Program of Music Studies by the Greek Ministry of Education, and in the Primary Years Program on learning Arts by the International Baccalaureate Institution, on local and global level respectively. In that context, three different audio gamification approaches developed by the authors are discussed as suggestions for incorporation into formal education. The first one aims at raising users' awareness about the harmful impact of noize on the acoustic environment, the second one introduces players to concepts and techniques of electronic music composition, whereas the third one informs them about the layers of Earth's atmosphere. All three approaches employ similar mechanics, but each one addresses a different topic: acoustics, music, and even non-music respectively, suggesting that the application of educational AG can extend to a variety of subject matters.

Keywords: educational audio games, gamification, music education, audio interaction, audio games, educational games

1. Introduction

Electronic computer games are being used for educational purposes for almost half a century now and have from the start exhibited positive results in both generally developing students' skills and specifically improving their knowledge on targeted curricula. Early research has consistently shown that educational computer games have considerable success in raising players' self-esteem, improving their hand-eye co-ordination and reducing their reaction time. After examining many of their features, such as interactivity elements, performance measurement capabilities, diversity and novelty, the author argues that they make the genre a suitable medium for addressing a specific problem or teaching a certain skill. (Griffiths, 2002) In another paper reviewing multiple studies over a period of 28 years to compare the instructional effectiveness of games to conventional classrom instruction, educational computer games are reported very effective in improving students' ability to solve mathematics, physics and biology problems, while exciting their interest and enhancing the absorption and retention of knowledge. (Randel et al, 1992)

Since then, utilizing technological advances in audiovisual effects, interactivity, connectivity and processing speeds have made educational computer games into valid platforms for the application of modern learning theories, including Problem Based Learning, Constructivism, Experiential Learning and the Flow Theory. Students are no longer passive, but active participants in the learning process; they are required to cope with challenges, explore their environment to correlate new with previous knowledge, which makes it easier to be integrated into their cognitive structures, observe and analyze the results of their actions to draw further conclusions, as well as immerse into a timeless experience, which will enhance their perceptual receptiveness. (Stapleton, 2004; Kiili, 2005; Kafai, 2006; Sancho et al, 2009) Furthermore, playing computer games enhances decision-making, short and long-term memory, and analytical thought, while reducing negativity and promoting collaboration among the team members. (Susi, Johannesson and Backlund, 2007)

On the other hand, Audio Games (AG) constitute a particular genre of electronic games, in which all information is conveyed mainly or even exclusively through sound. Players need to concentrate on their sense of hearing to interact with the game-system, including navigating through the game's space, understanding and executing the required gameplay actions, and interpreting the respective feedback. Due to the lack of visual stimuli the genre has traditionally been addressed to players with visual impairment. Recently, however, there has been a rising interest in targeting the broader public, a trend mostly accounted for by the development of mobile technologies, which take advantage of AG' inherent feature that actions are not restricted within the dimensions of a screen, but can take place in a 360 degree acoustic field around the user.

As a sub-genre of electronic games, AG have inherited many of the aforementioned educational properties of game interaction, yet it is audio interaction that lies at the core of their mechanics. It will be shown that to the extent that it has been documented in current literature, the educational potential of this sound-driven medium seems quite promising. Nevertheless, there has been no systematic approach in designing educational AG and implementing them in the learning process. This paper aims at establishing a strong theoretical framework for the use of AG in formal education. To do so, the educational aspects of AG will be investigated from two perspectives: a) the effects of audio interaction on the user, and b) the standards to be met in terms of officially-stated educational goals. Then, three different audio gamification approaches developed by the authors will be presented; they serve as suggestions for the incorporation of specially designed AG into formal education.

2. Educational aspects of audio interaction

To answer whether audio interaction can enhance the learning process, the research was based on the axis, whose one end examines the systematic use of sound in educational computer applications and the other the impact of interacting with sound in an AG environment.

In terms of closed-loop sonic interactions that require users to actively employ an interface through auditory feedback one research suggests that there is a great potential to help users become more proficient at fine movements and the complicated manipulation of tools. (Franinovic and Serafin, 2013) Sonic stimuli may be arbitrary or causal ; in both cases the richness of the sonic information has the potential to promote the exploration of complex patterns and let users decode how their actions modulate the sound. In that context M.J.Bishop and her associates argue that sound should be incorporated into learning environments not only for literal information conveyance, but to help learners process the material under study more deeply. (Bishop, Amankwatia and Cates, 2008) A multitude of researches is provided supporting that sounds can gain learners' attention and retain it over time, while reducing the distraction of competing stimuli. Furthermore, learners are facilitated to organize complex data in detail, as well as intercorrelate new pieces of information with older ones. This can be applied on many subject areas, such as sports, medicine, engineering and art. As far as music education is concerned, it has been suggested that interactive learning environments realized through computer technology can make music composition possible for learners without any training prerequisites by providing them with tools for experimentation within the familiarity of a modern culture medium, and adjusting to their special needs in real-time. (Wishart, 1992 ; Seddon, 2007) Thus, interacting with sonic stimuli ranging from musically primitive events to high-level structures can turn musical games into platforms, on which all users, regardless of musical background, will be introduced to acoustic and musical concepts and guided to experiment and realize their ideas. (Berndt, 2011)

Another approach focuses on the emotional content conveyed through sound. After examining different audio modes of operation, such as recalling tonal or rhythmic patterns, tracking the position of sounds in the acoustic field, synchronizing to periodic events, and identifying tonal qualities, the authors suggest that AG are often designed in a too-visual way of thinking overlooking the fact that sound carries with it more emotional content than any other part of the game. (Parker and Heerema, 2008) They argue that aural stimuli trigger feelings and memories in ways not possible by visual observation. In that context, other testings suggest that playing AG could assist in boosting memory and increasing the ability to concentrate. (Targett & Fernström, 2003) Thus, entertaining computer games that use only non-speech aural feedback show potential for both skills acquisition and therapeutic applications. Excluding the sense of seeing causes more freedom for interpretation. A computer gaming system based on audio rather than graphics will make the experience less dictatorial and create the conditions for players' fantasy to develop. (Liljedahl & Papworth, 2008) This inherent feature of audio interaction to exclude other distractions and focus on sound acts upon not only the conceptual, but also the physical level, in that players gain an increased degree of spatial freedom, as looking into a screen is no longer necessary. Thus, gameplays allowing a 360° field of interaction around the player result in an increased level of immersion. (Röber & Masuch, 2005) By finding the balance between functionality and aesthetics, as well as instruction and dramaturgy, AG can become immersive interactive environments in compliance with both modern educational theories, which require immersion to enhance the delivery of the curriculum, and state-of-the-art technologies, such as mobile and wearable devices or even virtual and augmented reality settings, which rely on immersion to efficiently convey the intended content.

At this point it would be useful to draw some intermediate conclusions. First, there has been no systematic approach in designing educational AG and implementing them in the learning process. A categorization of the few directions, in which AG and audio interactive systems have been linked to the learning process, has been formulated by the authors in (Rovithis and Floros, 2018). Second, there is a strong suggestion by many researchers that such systems, which would exploit the benefits of audio interaction, be designed and tested on their educational efficiency. Third, research findings support this notion; they have shown that both game and audio interaction in computer applications in general and in AG specifically, have a positive impact on the user. But is this impact in compliance with the actual learning needs of modern education? To further elaborate upon this question one has to delve into the officially formulated goals of valid educational systems and institutions.

3. Convergence of AG features and official educational goals

Two sources were investigated, from which clearly defined learning objectives were derived and juxtaposed with the characteristics of game and audio interaction, as the latter were discussed in the previous sections. The first source is the Program of Music Studies formulated by the Greek Ministry of Education and issued online in its official guide. (Pedagogical Institute, 2018) This source reflects the current situation in Greece by stating explicit directives on teaching and learning music. The second source is the Primary Years Program on learning Arts formulated by the International Baccalaureate Institution and issued on its website. (International Baccalaureate, 2018) This source aims at expanding the research material out of Greece's borders onto global level as a first holistic approach in suggesting that AG be incorporated into formal education based on their compliance with global standards.

3.1 Goals of music education by the Greek Ministry of Education

The official guide of the Greek Ministry is organized in three sections, each one defining the desired goals of music education on cross-curricular, primary and secondary level respectively. A detailed frame is given for each section including sub-level, cognitive content, goals in terms of knowledge, dexterities, stance and values, elements from the respective curriculum, and suggested activities. It is designed to develop spirally, from known and simple concepts to unknown and complicated ones, adapting to the students' kinetic, perceptive, expressive and communicative skills.

In the scope of this paper, all sections were examined, in order to extract the educational goals defined. The results were juxtaposed with the research findings in literature regarding the effects of game and audio interaction. It was found that at a large extent they agree with each other. For many of the learning objectives stated by the Greek Ministry there is a research finding showing that the respective skill is enhanced through AG interaction. More specifically:

According to the greek official Program of Music Studies, students are to

- Acquire a positive stance and love towards music
- Develop their acoustic ability
- Observe and discuss about how sounds are produced
- Identify sounds of the natural and urban environment
- Identify and organize simple sonic properties, including amplitude, pitch, timbre, duration, melody, rhythm and structure
- Combine sounds into simple compositions
- Perform simpe rhythmic and melodic progressions
- Perform on rhythmic and melodic instruments
- Concentrate on and internalize sounds
- Memorize patterns to develop their acoustic memory
- Explore, select and organize acoustic sources

- Experiment and improvise creatively
- Design sounds to implement them in complex structures
- Elaborate music composition techniques
- Correlate music and sound with other arts and cognitive subjects
- Cooperate and communicate with responsbility and discipline
- Develop their self-esteem

3.2 Goals of music education by the International Baccalaureate

The International Baccalaureate (IB) is an educational program followed by almost 5000 schools in over 150 countries around the world. It is organised in 4 parts covering the range from primary to career-related years (3 - 19 years old). It was founded on the principle that people need an education that crosses disciplinary, cultural, national and geographical boundaries. More than one million students are taught the IB program, a curriculum that encourages them to consider not only local, but also global contexts, think critically and challenge assumptions, incorporate practices from a global research and school community, and develop multilingual skills. Currently, 16 schools in Greece offer one or more IB programmes.

In the scope of this paper, the IB Primary Years Program (PYP) about learning Arts in general and particularly Music was examined, in order to extract the underlying educational goals. To IB, arts constitute a powerful mode of communication towards constructing one's self and understanding the world around them. The results of this investigation were juxtaposed with the effects of AG interaction. It was again found that the two juxtaposed parts strongly coincide. More specifically:

According to the IB program of learning Arts, IB students strive to:

- Develop their natural curiosity and become stimulated for challenges
- Understand that arts communicate feelings, ideas and experiences
- Consider works of art from different perspectives
- Explore new roles, ideas, strategies and artistic presentations
- Critically interpret works of art
- Articulate their thought through a variety of new media and technologies
- Engage their imagination for creative exploration
- Develop their conceptual understanding
- Develop their listening skills
- Describe differences in music
- Synchronize with rhythm
- Classify and analyze sounds
- Play musical instruments
- Create simple compositions
- Participate in collaborative live performances

3.3 Overview of the results

Table 1 summarizes the findings by presenting the matching learning objectives of the Greek Ministry of Education and the International Baccalaureate with the respective AG features:

Table 1: Summary

Educational Goals – Greek Ministry of Education	Educational Goals – International Baccalaureate	Features of AG Interaction
Positive stance towards music	Stimulation for challenges, Development of curiosity	Exciting players' interest, Motivating towards knowledge,

Educational Goals – Greek Ministry of Education	Educational Goals – International Baccalaureate	Features of AG Interaction
		Applying modern learning theories
Development of self-esteem		Raising players' self-esteem, Reducing negativity
Experimentation, Creative improvisation, Combination of sounds into simple compositions, Elaboration of techniques	Creation of simple compositions, Exploration of artistic ideas and strategies	Guiding players to experiment and realize their musical ideas, Creating platform for music composition and improvisation
Development of acoustic ability, Identification of sounds, Identification of sonic properties, Observation of sound production	Development of listening skills, Ability to discern musical differences	Introducing players to musical concepts without prerequisites, Guiding players to identify sonic properties, Employing mechanics that target specific musical skills
Concentration, Internalization of sounds		Focusing on the sense of hearing, Excluding distractions, Gaining players' attention and retaining it over time, Increasing concentration, Enhancing immersion
Cooperation, Communication	Participation in collaborative performances	Promoting collaboration among team members
Correlation of music and sound with other arts and subjects	Consideration of art from different perspectives	Sonifying non-musical data
Sound design into complex structures, Organization of acoustic sources	Classification and analysis of sounds	Facilitating the exploration of compex patterns, Enhancing analytical thought, Managing complex sets of data
Pattern memorization, Development of acoustic memory		Enhancing memory
Performance of rhythmic and melodic progressions on respective musical instruments	Playing musical instruments, Synchronization with rhythm	Enhancing dexterity at fine movements and manipulation of complex tools Improving hand-eye coordination
	Engagement of imagination for creative exploration, Development of conceptual understanding, Critical interpretation of artistic works	Allowing freedom for interpretation, Releasing fantasy
	Articulation of thought through new media and technologies	Employing a familiar technological medium of modern culture
	Understanding that arts communicate feelings, ideas and experiences	Carrying emotional content

4. Audio gamification approaches

In this section three different audio gamification approaches are presented and discussed, each with a slightly different educational scope. The first one, "Noize Games", aims at raising awareness about a specific matter through a one-time gaming experience. The second one, "Kronos" sets off to educate on a complicated field, as well as to provide an environment for creative practice on that delivered information through a series of gaming sessions. The third one, "AstroSonic" is a work-in-progress that attempts to communicate scientific information. The differentiated specifications of those projects suggest that, when designed accordingly, AG can cover a wide range of educational scopes.

All three games employ partially the same mechanics. This limited similarity implies that the same gameplay, including the game's goal, the appropriate actions and the rules evaluating those actions towards that goal, can be adjusted through sound design to express different content in terms of dramaturgy and narration. An important factor, in which the games differ though is the subject matter. The curriculum to be delivered can impose considerable differences in content and approach. "Noize Games" deals with acoustics, which is the nearest subject to audio interaction in terms of directly perceiving and interpreting sound. "Kronos" is based on the curriculum of electronic music composition: partially audio engineering and partially music. “AstroSonic” expands the traditional acoustic and musical AG thematology to scientific, non-audio data from the subject of astronomy. Thus, as far as the curriculum is concerned, these three different approaches suggest that educational AG can address a variety of subject matters.

In terms of sound design the following sonification techniques were used: a) auditory icons, which are sounds with a clear, realistic reference to the process they describe. (Gaver, 1986) For example, the sound of a document sent to the computer’s recycle bin creates a clear reference to that real-world process, b) earcons, which are arbitrary auditory icons acting on a symbolic level that the user must decode, in order to perceive the intended message. (Blattner, Sumikawa and Greenberg, 1989; Mc Gookin and Brooster, 2011) For example, a melody playing, when starting up the computer, is an earcon, c) parameter mapping sonification, which takes place when assigning different qualities of the represented information to respective properties of a sonic event. (Grond and Berger, 2011) For example, a chart with two different functions can be sonified by assigning one function to the sound’s timbre and the other to its pitch, and d) spatialized sound, which occurs, when placing sounds to specific coordinates in the acoustic field. (Röber and Masuch, 2004) Thus, listeners can perceive the position and movement of the sounds, as well as of themselves, in the game space. For example, a sound gives the impression of coming near, when becoming louder, and drifting away, when becoming quieter.

The following gamification approaches are discussed in terms of educational scope, gameplay mechanics and sound design:

4.1 Noize Games

The “Noize Games” (2014) was developed in collaboration with the Department of Audio & Visual Arts of the Ionian University and the Hellenic Institute of Acoustics and was presented to primary and secondary education pupils in Corfu, Greece, within the context of the International Noize Awareness Day 2014. Its aim was to a) inform about the nature of noize as an acoustic phenomenon, and b) raise awareness about the harmful impact of noize on the acoustic ecology. Two AG were designed, one for each of these educational scopes: “Match Noize” and “Escape Noize” respectively.

“Match Noize” mainly deals with introducing players to the broad range of sounds that can be characterized as noize. After playing the game, players should be able to discern noizy sounds in their environment, as well as have acquired a clear understanding of the specific features that account for this particular sonic property. Therefore, the game’s gameplay must create the necessary conditions for carefully concentrating on each separate sound and playing it back repeatedly. Essentially, what was needed was the gamification of a drill exercise, aiming to excite students’interest more than if they were simply identifying timbres. Furthermore, all different contexts, in which noizy sounds may appear, should be demonstrated. In that way, players will become aware of the abundance of noize in everyday life, and ultimately its strong correlation to the human experience.

The gameplay mechanic that was chosen is an aural interpretation of the classic memory cards game, in which players flip cards two by two from a given set trying to match them in pairs in terms of their similarity. In “Match Noize” the available cards disclose auditory icons. Thus, players need to flip the cards and listen carefully to the respective sounds, in order to link them in pairs. In terms of noizy features, the following categories were included: a) timbre, for example air humming, b) distortion, for example buzzing lights, and c) overload, for example too many phones ringing simultaneously. In terms of different contexts, in which noizy sounds can be found, the following environments were selected: a) domestic, for example the buzz of the refrigerator, b) urban, for example horns tooting in a traffic jam, and c) natural, for example waves clashing on the shore.

The second game, “Escape Noize”, aims at raising the awareness of the harmful impact of noize on the acoustic environment. In this case, a more emotional approach was followed. The core idea was to make players feel anxious and put them in a situation, from which they would want to escape. Thus, stressing soundscapes were designed by putting layers of noize on top of each other. Again, those soundscapes ought to reflect the aforementioned idea of different contexts –domestic, urban, natural–, only this time they are to be dominated by noize. Each soundscape is comprised of four noizy layers ranging from outmost intense ones, which cause discomfort, to quite subtle ones, which people usually have become accustomed to. For instance, a domestic soundscape is comprised of the following noizy layers: a) white noize of TV, b) buzzing noize from speakers, c) hissing noize from pc, and d) hissing noize from air conditioner. It is exactly that essence that had to be grasped:

the relief, when the loud TV is switched off and one can finally relax or when the pc is switched off and one becomes suddenly aware of silence.

To create the experience of escaping noize an audio interpretation of the point-and-click escape game mechanics was designed. Traditionally in escape games, players scan the screen with the mouse cursor for objects to interact with and ultimately find their way out. In “Escape Noize”, players need to deactivate all noize layers one by one to achieve silence and defeat the harmful impact of noize. To do so, they need to look for specific points on the screen, where the layers become silenced. Once they have deactivated all layers one by one, they are free.

4.2 Kronos

“Kronos” (2015) is the prototype of the author’s thesis that an audio game, an educational tool and a music instrument can be combined into one interactive platform. (Rovithis, 2015) The game follows the structure of role-playing games, in which players accomplish various tasks, in order to evolve, i.e. gain and develop specific abilities. They are also provided with an increased degree of freedom regarding the choices they can make ; from critical ones, for example their role within a group, to simple ones, like the way, in which they will explore the game’s environment. Thus, they are responsible for their in-game hero’s behavior, including the acquisition of attributes and how these will be customized. In “Kronos”, the tasks to be accomplished are audio interaction challenges, ‘audio mini-games’, that exercise different musical skills, and, when successfully completed, reward with relevant sound production modules. In that way, the in-game hero to be created and developed is itself a musical instrument, a sound design and performance system, which can be modularly constructed and expanded by following the games’ narration and participating in the game’s action. Depending on the path the players follow, they choose to focus on specific parts of the curriculum and gain the respective modules, which will facilitate the customization of their instrument and the specialization on targeted concepts and techniques of electroacoustic synthesis.

To achieve the necessary immersion into the game-world for maximizing the learning process, a system of correlations between the storyline and the curriculum ought to be created. The more connections are designed between agents of the game’s plot and action with the involved musical elements, the better chances players have to perceive the game world as a fictional, yet solid, detailled and, ultimately, convincing structure that can turn the learning process into a serious, but also fun gaming experience. This mapping between narrative and sound took place on the symbolic level and was critical for the game to fulfill its triple role. The main sonification technique used was parameter mapping on a multitude of earcons, auditory icons, as well as gameplay features. Let’s name all those agents “sonic symbolisms” and clarify the process through the following example:

All Human avatars – players may also become Ghosts or Spirits – have a body. The sonic symbolism for the body is a 1-second long buffer on the ground that it is a sound source, which, unlike noize or oscillators, is not created within the internal mechanisms of the computer, but only played back, after inserted. Players, who choose to become Humans, can upload any sound that was designed, recorded or in any way captured as an audio file in the outside, “mortal world” into their buffer as their body. Let’s now suppose that this Human needs to go to the lake and fetch some water. First things first: one needs to be able to move. The sonic symbolism for moving is that a piece of the body, thus a part of the buffer, is played back at a randomly variable speed. Finding the lake means pointing the cursor at a certain direction, while moving, until the sound of the lake becomes loud and clear. Once there, this Human would have to use the mouse again, this time without moving, to find the right spot, on which the sound of running water appears. Once collected, the water belongs to the Human, who can now modify its spectral properties at will with the use of filters; thus the sonic symbolism for ownership is filtering.

Through this example it becomes clear that the notion of sonic symbolism may refer to auditory icons (the actual sound of water as itself), earcons (speed-altered samples as steps), processes (spectral filtering as ownership), and concepts (buffer as body). It is also demonstrated, how players can be introduced to such music/audio concepts, while participating in a game, whose narrative refers to a different, non-musical context. To broaden the targeted curriculum “Kronos” includes challenges implementing a wide range of audio interaction mechanics. In total, players need to identify sonic properties, including timbre and pitch, describe the tonal progression of a melody, mimic rhythmic patterns, explore soundscapes, search for dis/appearing sounds, and aim at sonic objects through ear-hand synchronization.

4.3 AstroSonic

"AstroSonic" (2018 – ongoing) is a work-in-progress that applies audio game mechanics on information relevant to the subject of astronomy. From a research point of view, it can serve as testing grounds to investigate the extent, in which interaction with sound in an AG environment can deliver not music-related, but scientific curricula. At the moment it consists of only one stage, in which players guide their rocket spaceship into low-Earth's orbit. It is the authors' intention to expand the game through more stages, in which players will collect space debris, build bases on the Moon and Mars, and mine asteroids. In the scope of this paper, a brief overview of "AstroSonic" is presented. As in the previous two audio games, the design process evolved around two axes: a) sound design, i.e. the sonification of targeted pieces of information, and b) mechanics design, i.e. the interconnection of those elements through gameplay rules. In that context, sound ought to carry as many aspects of the scientific curriculum as possible.

To travel to low-Earth orbit players must cross the four layers of Earth's atmosphere: Troposphere, Stratosphere, Mesosphere and Thermosphere. In terms of sound design, the layers were assigned to four earcons respectively: filtered noize-based spectra. The lowest layer was assigned to the spectrum with the lowest pitch, whereas the highest layer is represented by the highest-pitch spectrum. To provide more information about the layers, additional earcons and auditory icons were used. For example, when players are crossing through the Troposphere, where airflights are frequent, there is a big chance to listen to the auditory icon of an airplane, whereas in the Stratosphere, one might come across the earcon of the ozone layer.

In terms of gameplay design, the aforementioned one-click audio escape mechanic was used, in which sounds are deactivated, when clicking on specific points on the screen. Players control a rocket spaceship and, as it takes off and rises towards space, they have to find a way to guide it through the layers of the atmosphere by selecting the correct spots and thinning the rich noizy spectrum. When a layer is completely silenced, they move on to the next one, which is also comprised of more mini-layers, but as a whole occupies a different frequency range and is therefore quite discernible from the others. The mini-layers of each atmospheric layer amount to the number of steps, in which the layer becomes thinner and silenced, and are essentially proportionate to the actual size of each layer. Another twist in the mechanic, apart from the existence of mini-layers, is that a deactivated step/layer will be re-activated, if the player takes too long to successfully deactivate the next ones, implying that the spaceship lost height.

5. Conclusions

This paper has discussed the educational aspects of AG in terms of game and audio interaction within a computer game environment. Then it has juxtaposed those features with officially formulated educational goals on a national (Greece) and global scale. It was found that many of the official learning objectives coincide with the inherent features, as well as with the beneficial impact of audio interaction. Thus, the conclusion can be drawn, at least on a theoretical level, that AG can be valid means to deliver curricula related but not restricted to acoustics and music, and should therefore be incorporated into formal education. Three such AG developed by the authors were discussed. Their subject matters extend from the field of acoustics and electronic music to the non-musical scientific field of astronomy. Sonification techniques and audio gameplay mechanics in compliance with the aforementioned learning objectives were employed for their development. In the near future, those prototypes should be tested and their educational efficiency measured, in order to investigate, whether the suggested theoretical frame can be empirically verified.

At this point two things should be mentioned. First, this research was based on current literature. Apart from that, there is great potential to realize innovative mechanisms of audio interaction, which will further support the AG educational aspects. For example, IB suggests that the students create their own basic musical instruments. Even though some AG offer music creation capabilities, there is no documented example of an AG that guides players to construct such an interactive tool that can be characterized as a musical instrument. But this is exactly the innovation of "Kronos": the fact that players construct a modular music production and performance engine, while participating in the narration of a game. This shows that AG designers are not restricted but only by their fantasy, in order to creatively transcend borders into uncharted territory.

Second, AG should be used as means to complement the learning process and not to overshadow the traditional role of the tutor. According to the Greek Ministry the official specifications of Music Education are intentionally less descriptive than in other subjects, so that teachers plan the lesson in their own way according to the special needs of the learning group. Music is to be taught through a series of activities that will excite and motivate students; in that context, AG can play a vital role.

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The Emergence of Socio-Material Assemblages in a University, Company, and Municipality Collaboration

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Abstract: In this paper we report on an attempt to let students, companies, and organisations themselves discover the kinds of technologies that could be useful when co-producing knowledge in a Master's-level course in innovation and design. Traditionally, and for various good reasons such as security and stability, universities have had certain online tools and systems for collaboration, while companies and municipalities have had others. These systems support internal communication within organisations but do not necessarily enhance communication with external contacts. This use of different systems creates barriers to the iterative, recurring, convenient, non-hierarchical, and open online collaboration needed in an innovative design process involving multiple stakeholders. During a ten-week Master's-level course in innovation and design in 2016 and 2017 the 38 students divided into five project groups established contact with five companies and organisations and could choose their own online tools in dialogue with them. This paper presents the students' and organisations' emerging practices during the process based on observations and reflective evaluations conducted during and after the course. The results are discussed in light of how socio-material assemblages formed in this special setting and how the results might be used to improve the teaching of online literacy in design collaboration. The result indicates that for co-production of knowledge in innovation and design projects, three new social media literacies would be useful: *meta communication*, *peak performance*, and *design awareness.*

Keywords: socio-material assemblages, online literacy, design collaboration, blended learning

1. Introduction

Teachers of design and innovation in higher education have many opportunities to improve and develop the teaching situation, to provide an education that is relevant to students and society and that meets the academic course criteria (Mossböck et al 2017, Schaeffer and Palmgren 2017).

With the possibility of worldwide collaboration in the area of innovation and design and the growing use of social media in product development, B2B collaboration, and human-centred design projects in multinational and small and medium-sized enterprises (SMEs) (Bashir et al 2017, Brink 2017, Heafliger et al 2011), social media communication has become part of the design or innovation project leader's communication competence. It consequently has become part of the teacher's competence to know how to train students in social media competence for collaboration in a reflective way. The empirical study presented here arose out of the authors' previous experience of co-production in courses (up to 10 years of designing tasks, courses and programs together with companies and organisations) and out of curiosity to try out new ways of working. The study involved a course, Project Management in Innovation and Design, in which students learned about and reflected on project management in both theory and in practice (undertaken through 5 joint projects with organizations).

We had previously successfully taught through co-design projects with invited organisations, but based on extensive face-to-face (F2F) communication, which was time consuming for the companies and to some extent limited the choice to local organisations. We had also introduced blended learning in Master's-level courses by using Blackboard and Yammer for microblogging, video tutorials, chat groups, etc. In these online efforts, we directed students towards certain platforms and strove to enhance communication between students and between teachers and students. One obstacle to encouraging students and companies to collaborate online was that the companies did not have the tools that we used and were not all allowed to use their systems in external collaboration. Traditionally, universities have had certain online tools and systems for collaboration, while companies and municipalities have had others. The systems in the companies were not designed to be used jointly with or by external contacts, i.e., there was a misalignment between what we wanted the technology to support and what it actually could support. The systems supported internal communication within the organisations but did not necessarily enhance communication with external contacts. This use of different systems therefore created barriers to the iterative, non-hierarchical, and open online collaboration needed in an innovative design process involving several stakeholders.

Since we needed to develop adaptable practices that could be responsive to the rapidly changing needs of a design project, we became interested in relinquishing control and letting the students and organisations themselves choose how to communicate and co-produce knowledge. We assumed that this way of working would introduce new practices into the students' work, posing new questions to us as teachers. We were interested in learning about the new practices and emerging questions. In this paper, we report on this attempt to let students, companies, and organisations themselves discover the kinds of technology that could be useful when co-producing knowledge and developing conversational prototypes; we also examine the practices and questions that arose from that attempt.

1.1 Previous research

Blankenship (2011) observed that Skype was part of the rapidly expanding use of social media in higher education; described the use of Skype, Twitter, Blackboard, Facebook, YouTube, and blogs in academic classrooms. He asserted that 80% of universities in the USA used social media to some extent in education to produce engaged, interested students who take control of and responsibility for their learning (Blankenship 2011). Online learning and F2F interaction are combined in higher education to increase accessibility and flexibility (Graham, Allen, and Ure 2006). Studies of distance university courses have demonstrated that asynchronous courses that offer control over where and when to learn tend to work better than synchronous courses, and that the more control participants have over their milieu in distance courses, the more successful they tend to be (Kaplan and Haenlein 2016). The use of social media creates opportunities for interaction and collaboration (Doolan and Guiza 2015, Doolan and Gilbert 2016), but it has also been found that frustrations arise when institutional support or training are lacking (Gikas and Grant 2013). Since it is important to train innovation and design students in the flexibility, engagement, and emancipatory aspects of social media, we were encouraged by those earlier studies even though they, in contrast to our attempt, did not examine blended learning (a combination of online digital media with traditional classroom methods) in co-production with organisations.

Blankenship (2011) interviewed Howard Rheingold, a central figure in the social media revolution since the early 1980s, and they discussed the various competences, or "literacies", students need in order to engage with social media. The first is *attention*, which concerns where and when to direct one's attention when navigating among various media and between online media and real life. Students need to be trained in how to decide what deserves attention. The second is *participation*, which concerns knowing both the appropriate content to post as well as when and how to post it (e.g., a comment on a blog). The third is *collaboration*, which concerns avoiding being a lone wolf and instead knowing how to collaborate both in online communities (e.g., Wikipedia), which thrive by collaboration, and in the real world. The fourth is *network awareness*, which concerns understanding how online media networks operate; for example, understanding the privacy settings in Facebook. The last literacy, *critical consumption*, is the ability to evaluate what we are seeing and hearing and is also called "crap detection" (Blankenship 2011). In a wider sense the literacy is not limited to the technology and the use of it as the last literacy, critical consumption, above touches upon. Media literacy also involves the knowledge of the content and form in the societal context." To be truly literate means being able to use the dominant symbol systems of the culture for personal, aesthetic, cultural, social, *and* political goals-and as a result, respect for personal autonomy becomes paramount within a pluralistic understanding of media literacy education (Masterman, 1985).

1.2 Socio-material practices

"There is no social that is not also material, and no material that is not also social" (Orlikowski 2007, p 1437). Our organising of work, for example, our everyday work as university teachers or our students' everyday work in their courses, is bound up with material forms and spaces. It is therefore not useful to study technology in isolation; rather, we should study the varied mixtures or assemblages of technological and social practices arising in various contexts and situations (see Orlikowski 2007).

From the perspective of socio-material practices, social practice and technology are not considered separate entities. Human beings affect technology just as technology affects our social practice. Instead of focusing on technology alone, the ontological perspective of the socio-material viewpoint does not separate the world into isolated entities but considers mutually influential interrelations, including the historical and cultural influences of technology use. The temporary entanglement of the social and the material can be called a socio-material assemblage (Suchman 2007), giving us perspective on how the intra-action among students, organisations, and technology gives rise to an additional layer within pre-existing structures and norms, or even gives rise to new organisational structures (Leonardi 2009).

2. Case description

Planning of a ten-week Master's-level course, Project Management in Innovation and Design, started in the spring of 2016 and continued during autumn 2016 and 2017, but was preceded by considerable preparation. (This course planning was interspersed with the planning of the first course in the Master's programme.) Four companies (anonymised as Innovatio, Manufactio, Big Electric, Vatero, two municipal organisations (anonymised as the Planning Department and Leisure department), one research institute (anonymised as Researchinst) and one county organisation (anonymised as InnoHealth) involved in the planning. In this course, the companies and organisations presented their current challenges in the area of innovation and design. One of challenges from the municipality was: *How can we design our city and our communication so the citizens will be less car dependent*? A challenge from the manufacturing company Manufactio was: *How can we change the way we work to create a radically innovative organisation?* Two teachers, the students, and the involved companies and organisations also talked about co-producing knowledge in one of the presentations, encouraging the companies, organisations, and students to find their own methods of online communication in the next course as a part of a blended learning project at the University (see Figure 1 for an overview of the process). When the course Project Management in Innovation and Design started both 2016 and 2017, the students (19 students each year) were divided into five project groups based on their interest in the various challenges presented by the companies and organisations that had established contact with them. The teachers monitored the students' classroom work during lectures and supervision and also monitored the students' group reflections on questions concerning communication, emotional experience, and the content of written evaluations twice during the course (see below). Questions 2, 3, and 5 were adapted to be relevant to the companies/organisations and were posed to them after the course.

- Which company/organisation did you contact?
- What communication platform did you choose and why?
- Describe your experience of the conversation with the company from the technical, content and emotional perspectives.
- What ideas, strategies, and knowledge did you present to the company/organisation?
- How did you learn new things from the company/organisation about the ideas, strategies, and knowledge that you presented? What did you learn?

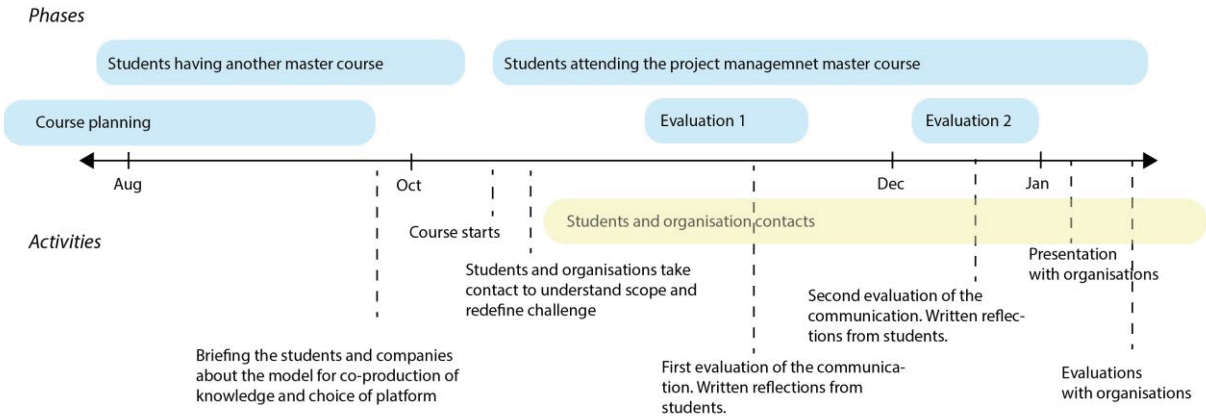

Figure 1: Visualisation of the phases and activities involving online tools in the Master's-level course.

The questions above were answered by the students two times online during the 10 weeks, the companies and organisations one time after course ended. The material was analysed from the perspective of finding descriptions of the emerging interrelations among the students, organisations/companies, and technology used and presented thematically below. The results are discussed from the perspective of how emergent socio-material assemblages form and how we from that knowledge can learn about improving the training of the students.

3. Results

3.1 Holidays, need for safety, and asynchronous e-mail conversation

Group A first contacted InnoHealth via e-mail in order to share information among all group members and to document the conversation if needed. The first e-mail conversation was experienced as flexible without long waits for answers, which helped the students initiate their projects with confidence. They found it fast and convenient to exchange e-mails, making it a reassuring method to use.

Later, the students decided to meet F2F with the key person at InnoHealth, anonymised as Anna, so they could get to know each other better and discuss their common challenge. The students thought that the F2F meeting was useful in that it brought them together more closely and let them see the environment in which Anna worked. Anna helped them refine their concept and stressed the importance of co-operation between the students and the actual end users.

The F2F meeting helped both sides resolve questions. For the students it clarified questions on how work was organised, how they have attempted to solve the challenge before, for Anna understanding more about the students' competences and their view on innovation and design, as well as get a concrete sense of what both parties wanted to achieve with the project and what the next steps should be. The students thought that it was useful to have met Anna, and said that this made it easier to exercise trust and forbearance during later e-mail conversations. The e-mail/F2F conversation also allowed the students to hold longer conversations and avoid the interruptions and unforeseen technical problems they suspected might occur had Skype, for example, been used.

Later in the process, the choice of asynchronous conversation via e-mail posed certain challenges. Since their first contact was an F2F meeting that established their relationship in a positive way, the students said that they agreed to get Anna's feedback by e-mail. However, since the Christmas and New Year's holidays occurred at this time, there were some unanticipated delays in receiving feedback from Anna. When they phoned Anna immediately before the Christmas holiday to remind her, she told them of her intention to show the prototype to multiple colleagues. The students said that they reached a mutual understanding that the feedback could be delayed several days (Conversation evaluation, group A).

When the students finally received the e-mail, it contained substantial feedback and was easy to interpret and understand. However, the students thought that receiving the feedback by e-mail limited their opportunities to ask direct questions about the feedback or start discussion for further analysis (Conversation evaluation, group A).

Using e-mail for further conversation was a time-saving option given the uncertainty around the holidays. The students could also phone Anna, which they did on occasion. They said that Anna was always very accommodating and open to conversation, which made the students feel comfortable with conversation by e-mail, as they trusted Anna to answer in due time. Anna's commitment was valuable to the students, who interpreted it as willingness to engage in their co-operative project. However, the students also said that oral conversation via Skype instead of written conversation by e-mail might have opened more doors when receiving feedback from Anna, since they would have been able to respond in real time. This group and Anna at InnoHeath both seemed to have a degree of *attention* literacy, knowing where and when to direct their attention when navigating among various kinds of media and between online and real-life interactions. The F2F meeting seemed to "boost" the trust the students needed in order to feel comfortable when using e-mails to present their prototype. The students strove for safety, which made them avoid using Skype, for example, which would have created an opportunity for temporally synchronous conversation. The time of year also affected the collaboration, since it led to asynchronous e-mail conversation, and what can be called resistance in a socio-material assemblage caused delays on the students' side of the design process. This project continued after the course ended.

3.2 Use of private computer was key

Group B chose to work with a municipal department, the Planning Department (PD). The group's first few weeks were problematic because its members were attending different courses and could not synchronise their work. They tried to arrange an F2F meeting with the PD in the second week, so the contact person could explain their problem in detail, but they then decided on a Skype meeting. At the time scheduled for the meeting, Skype did not work because each party had different versions of the app. The PD contact person, anonymised as Johan, explained that they would have to reschedule the Skype meeting because of technical difficulties; the problems were resolved at the second meeting when he used his private computer. Johan found the students somewhat insecure, but he thought that this was probably natural given that they were presenting ideas in an area where they were not completely comfortable. The students, on the other hand, expressed real frustration and noted a deterioration in their group process after the first unsuccessful Skype meeting. For this reason, time was lost in the project.

This group, whose members were part of the "Net Generation" (Gerbic 2011), judging by their age, apparently struggled to align the content they wanted to address with the social media literacy necessary to make the communication succeed on first attempt. Neither the municipal representative nor the students had sufficient *network awareness.* The resistance caused by Skype provoked diverse reactions: Johan had relevant practical experience, and noted that "with this kind of online meeting, you need to try again", talking about the first attempt in a positive tone; the students, in contrast, felt lost (Conversation evaluation, Group B). The same for group G in the following year that worked with the Leisure department at the municipality. Their experience of using Skype for a meeting with the stakeholder was somewhat ambiguous, they expressed in the evaluation. They expressed that the municipality was using Skype for business, which does not work with normal Skype. It therefore took a while to get connected and the solution involved private computers (Conversation evaluation, Group G).

3.3 Company and students well versed in social media literacy

The Big Electric representative, anonymised as Klara, and the students were all conversant with Skype. The students were able to arrange short Skype conversations with Klara throughout the process. She was very busy and needed to use her time efficiently, so the students prepared themselves well and adapted their presentations to work optimally with the medium. "The conversation was well and clearly structured because of the work we did in advance. We printed out our questions and drew mind maps for a better grasp of the area and the company. The purpose of the meetings was to increase knowledge of the problem, what the problem is, why it arose, and how they have already tried to work around the problem" (Conversation evaluation, Group C).

They prepared thoroughly for the conversations, submitting the material, images of prototypes, and animations beforehand. Here, their literacy in social media use resulted in conversations that were meaningful and effective. "The Skype conversation was smooth and relaxed. Klara gave us a lot of good and useful information, which built on our thoughts from before. Klara gave us the feeling that she really had time to talk to us, and the first meeting lasted almost half an hour, with no stress or interruptions" (Conversation evaluation, Group C). The students knew how to participate and keep Klara engaged, i.e., they knew something about *participation*, understanding both what was appropriate content to present as well as when and how to do so. They had *network awareness*, displayed by knowing how Skype operates. They used visualisation techniques and found technologies that presented their work in an interesting way, and could negotiate what they needed to use to share their knowledge.

3.4 The lone wolf emerges

Group D struggled to make contact with this SME and to forge functional communication with each other. They used e-mail to contact Manufactio but got little response. They finally had an F2F meeting at Manufactio premises late in the project, when they discovered that Manufactio had already implemented an advanced version of what they were proposing as a prototype. *Collaboration* illiteracy was evident in this group, which had difficulties finding both ways and time to communicate. Internally, the group used emails to communicate and did not try alternative means such as Skype; they did not stay after class to talk or use the scheduled time for collaboration and supervision. When one group member emailed suggestions to others in the group and they did not respond, the alternative of more synchronous communication was not tested. Despite suggestions to find appropriate online tools for collaboration, this option was little discussed. One group member assumed it was understood that the others should respond, but they did not have an explicit agreement about this. Almost the same pattern appeared in relation to the company: how to communicate was not discussed, and the group and the company had difficulties contacting each other. Due to this one-way communication, mostly by email, a lone wolf emerged, working separately in the group. In the end, the group presented two different ideas, both loosely connected to the knowledge and needs of the company, which already had overlapping knowledge and practices.

3.5 Hesitation and insecurity

We initially observed hesitation in some of the student groups, especially in group E in 2016, where there was considerable hesitation and insecurity about cultural codes, as we as teachers learned late in the course trough the supervision. Also, group F expressed in 2018 this feeling in their evaluation of the conversations with their organisation Researchinst. In the second evaluation they expressed that emotionally, it takes some courage to actively ask people one has never met before if they would like to co-operate on a student project (Conversation evaluation, Group F). Group E waited almost four weeks into the course before making contact with their organisation Innovatio. Coming from a different cultural background, the students had difficulties balancing respect against taking action. First, they hesitated to reveal that they did not believe that they were allowed to contact the companies themselves, so the first step was to reveal that to the course teachers. Second, in discussion with the students it became clear that they thought that they lacked authority to contact Innovatio and felt very insecure about doing so. This was surprising to us, and as teachers we found it interesting to understand more about student understandings in the very early phases of a collaborative project with varied stakeholders. When this misunderstanding was resolved, the project members contacted Innovatio by e-mail, Skype, and F2F, and the project even continued after the course ended.

4. Conclusion

With considerable good will and attention to context, collaboration practice emerged in the projects. A kind of trial-and-error practice developed from not knowing what the challenge was or how and when to talk about it. The co-production of knowledge was continuing during the course but also afterwards. The conversations were centred around the prototypes, which became a cultural object emerging in the negotiation between the culture and knowledge of the students and the culture and the knowledge of the companies and organisations. The company representatives expressed that they learned new “hows” i.e ways to develop the way they work with innovation challenges, and new “whats” i.e. that they got inspiration for new ideas and solutions. Some of the organisations, for example Innohealth, Planning Department and Innovatio continued to work with the prototypes and implemented the results in their organisations, and continued in that also the collaboration with the students. The intermingling with technology in the projects affected the collaboration practice, thus it affected the co-production of knowledge and conversational prototypes in various ways. What to talk about and present affected how relationships developed together with the technology. The collaboration practice took different forms in the different projects, and the socio-material assemblages developing in each project were clearly very context and time dependent. For example, the process was affected by the maturity of the organisations in using social media both internally and in outside collaboration. The project phase requiring adapted communication practice and use of Skype was not part of the practice in all cases; instead, the students used e-mail, telephone, and F2F meetings when possible. Our attempt to overcome the boundaries between the collaboration tools in private versus corporate/organisational use started with the assumption that using and interacting with different technologies could add a layer to pre-existing structures or norms (Leonardi 2009). New practices started to emerge, but the students who lacked social media literacy made slow starts to their projects, which suffered not only because the students were new to project management but also because they did not understand the social media landscape of professional collaboration. The students often preferred the most stable tools (e.g., there was considerable insecurity concerning Skype), as they did not want to lose time due to technical difficulties. We had students from other countries who, because of hesitancy, did not make timely initial contact with their company, even though this was stipulated in the task.

This study demonstrates that, as teachers, we should not assume that our students and their collaboration organisations are social media literate, and that cultural understandings of hierarchy must be addressed. Social media competence needs to be deliberately trained and reflected on. Installing opportunities for the students themselves to share knowledge with the companies/organisations also involves a knowledge of social media as a place where being able to handle dominant symbol system of the culture. It should be explicitly addressed in the curriculum as a learning goal of the course Project Management in Innovation and Design, and not simply tacitly assumed in organisational and managerial training. The five literacies mentioned above, i.e., *attention*, *participation*, *collaboration*, *network awareness*, and *critical consumption* (or “crap detection”) (Blankenship 2011), seemed to matter in our co-production setting. When it comes to the co-production of knowledge in innovation and design projects, we would suggest adding three new literacies, as follows.

The first is *meta communication*, i.e., learning a practice how to negotiate and talk about how to communicate project content, about forms of communication and learning, and about when and how to use social media in conversation.

The second is *peak performance*, i.e., letting students explore their knowledge of personal strengths and weaknesses and of cultural context. Making choices of suitable communication tools and knowing how to adapt presentations to different forms of social media should fuel the collaboration rather than be a hindrance.

The third is *design awareness* i.e., learning to consciously use the dominant symbol systems of their cultures, of the company culture and the popular culture for different goals when the context needs it (personal, aesthetic, cultural, social, and political goals).

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Analysing the Educational Benefits of 3D Virtual Learning Environments

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Abstract: This paper provides additional analysis and results on previous work conducted by the authors on the effectiveness of Virtual Reality (VR) and Virtual Learning Environments (VLEs) on secondary school students. Current case studies were examined to determine how effective a 3D virtual learning environment could be for education. A game based virtual learning environment was produced to test information retention of a group of school students aged 13 and over. Students were split in two groups. One interacted with the game and the other read a worksheet on the same material. Both groups then took a memory retention test. The results were compared to determine which group performed better overall. Testing found that the group that interacted with the 3D virtual learning environment scored lower but more consistently than the group that used the worksheet. It also found that discomfort and nausea affected some students who interacted with the virtual learning environment. However, a positive result was observed for students with reading and writing difficulties. The evidence collected by the research suggests that immersive 3D virtual learning environments for education are not yet at a point where they can effectively replace traditional methods. However, the study found that the use of immersive 3D virtual learning environments could be suitable -or even preferable- in some cases of students with specialist learning needs.

Keywords: virtual reality (VR), head mounted display (HMD), virtual learning environment (VLE), Oculus Rift, education, learning

1. Introduction

The purpose of this research was to determine the educational effectiveness of a 3D virtual learning environment by creating and testing an interactive and immersive educational game that utilises current Virtual Reality (VR) technology and comparing it against traditional educational methods. Particularly focusing on immersive VR and the use of Head Mounted Displays (HMD). The methodology section will discuss the main hypothesis as well as the process by which the effectiveness of our Virtual Reality learning environment was determined. The details of the proposed solution will be described as well as the kind of data collected and the data collection and analysis methods. In addition, the methodology section will also explain the design of the questionnaires and evaluative tests. The development section will discuss the details of the development process. Individual sections will describe the 3D assets created, the interactive aspects of the solution, the design elements and finally third-party sources of information (and additional assets) used. Discussion will also take place on the design, implementation and specifications of traditional teaching materials used on the subject that our solution was compared against. The results and conclusions sections will analyse the findings, draw conclusions and present ideas for further work. Limitations and improvements on the existing work will also be discussed.

2. Current work

Following a review of the most popular and widely available head mounting VR displays it was decided that the Oculus Rift was the most appropriate headset to use for this study. This was the case for a number of reasons. The Oculus Rift is a head mounted display designed specifically to be affordable, easy to develop with and to be used with video games. These attributes suit the requirements of this research well. Furthermore, the Oculus Rift is compatible with several popular game engines such as Unity and Unreal Engine. This offers some options when building the virtual environment making it easier to choose an engine that is cost effective, powerful and fit for purpose. Figure 1 shows the Oculus Rift Development Kit 2 (DK2) that was used in our study.

Figure 1: Oculus Rift development Kit 2. The headset used for our study

However, despite its current popularity, the Oculus Rift is not the only head mounted display on the market. Other similar products such as the Sony hmz-t3w and the Avegant Glyph were also considered. Although the Oculus Rift was chosen due to its developer support, video game oriented design, low cost and accessibility, these other systems are also discussed in the next section.

2.1 Other head mounted displays considered

The Sony hmz-t3w is designed more as a home theatre than as a video gaming accessory, it is designed to be used with a mobile device for home movie viewing and even though it does have video game support this does not appear to be the focus of the product unlike the Oculus. In 2015 the device cost £1299, a rather steep price compared to the Oculus Rift's $350 (£222). A lack of gaming support as well as the high cost set the Sony hmz-t3w way below the Oculus level in terms of accessibility. The majority of schools cannot be expected to stock IT classrooms with such expensive technology for each student therefore this HMD was not chosen. The Avegant Glyph was in a similar position to the Sony hmz-t3w, it is more of a general multimedia HMD than specifically designed towards use with video games. Though it is not as expensive as the Sony hmz-t3w with a much lower cost of $499 (£316), availability was limited and access to the hardware was difficult making it impossible to acquire for this research. The original HTC Vive was a direct competitor to the Oculus Rift with similar if not marginally better technical characteristics but it was not available at the time of this research. Furthermore, when it did come out it was also heavier and more expensive. Because of these factors it could not have been used but as the technologies are comparable we believe that the findings would apply to this headset as well as the one tested. There were other similar products considered that are not mentioned here but none of them were found to be as inexpensive, convenient or accessible as the Oculus Rift.

2.2 Health and wellbeing with the Oculus Rift

According to the Oculus Rift Health and Safety Warnings (2014), children under the age of thirteen should not use the Oculus Rift. Children over the age of thirteen should be monitored as prolonged use of the Oculus Rift can "negatively impact hand-eye coordination, balance, and multi-tasking ability" (Oculus.com, 2014). As the research aims to implement the Oculus Rift for testing on school aged children, these health concerns pose some ethical issues. The Oculus Rift and those using it would have to be closely monitored or completely restricted to either diminish or avoid these harmful effects. Even though the research was aimed at Key Stage 3 (KS3) students which is the legal term for the three years of schooling in schools in England and Wales when pupils are aged between 11-14, no pupil below the age of 13 could to participate. In addition, whilst using the Oculus Rift as well as after test sessions were over, pupils were monitored by attending staff (teachers, teaching assistants etc.) for signs of discomfort, distress, sickness, loss of balance or other telling signs of diminished wellbeing.

Less serious afflictions caused by a head mounted display like the Oculus Rift include eye strain and headaches which are known issues and depend on a number of factors the discussion of which is beyond the scope of this paper. As these issues are fairly common it is easy to prevent them or at least diminish their effects by adopting standard practices such as reducing time spent using the HMD.

2.3 Positive effect of the Oculus Rift and HMD's on wellbeing

Despite the health risks outlined in the previous section, there are indeed some health benefits to using a head mounted display. Surprisingly these include pain control and psychological therapy. For example, in 2014 an Oculus Rift was used in a therapy session to alleviate the pain of an eleven-year-old boy who had suffered serious electrical burns across 36% of his body, including his head, shoulders, arms and feet (Hoffman et. al. ,2014). The young boy was subjected to three different therapy sessions spread across three days, one without the Oculus Rift, one with the Oculus Rift and then one more without it. It was found that both the severity and unpleasantness of his pain was reduced significantly whilst wearing the Oculus Rift compared to therapy sessions without it, indicating that the immersion of the device was so powerful as to take him completely into the virtual environment and disconnect him from the physical pain in his body. This study shows that the technology can create environments so convincing and immersive that it can detach the user from a sensation as strong as the pain of severe electrical burns. This is a positive example of how the Oculus Rift and similar HMDs can be beneficial to the wellbeing of users. It is also a strong justification that virtual reality and head mounted displays have relevant, positive and practical application in areas besides entertainment. The strong immersive power of these displays also suggests educational activities would be more engaging for users who interact with them, achieving greater presence and enabling experiential learning.

2.4 Phobias and the Oculus Rift

This attribute of immersion has the advantage of being able to treat psychological conditions, for example a user with a phobia can face their fear in a controlled, virtual environment. An example of this might be someone who suffers from arachnophobia (the fear of spiders). Using an Oculus Rift a user could expose themselves to a virtual interpretation of a spider to help desensitise themselves to the fear they may normally feel while being in control of their own situation. In a study by Algar (2014), an Oculus Rift was used for this purpose to subject those with a fear of heights to gradually more distressing altitudes. Algar used video game style goals to help the user deal with their fears more effectively in the virtual environment. Algar's findings showed that users who interacted with the Oculus Rift environment with game style objectives were more motivated by the simulation than those who did not have the objectives. This shows that the immersion of the Oculus Rift combined with video game design elements can be used effectively to motivate a user into doing something they may normally find disconcerting or even terrifying. This is good justification for this research as it shows that the Oculus Rift can be more effective in motivating a user than a real life or physical alternative and safer. It also shows that interaction mechanics used in video games can help individuals in stressful situations. An important aspect when considering the application of virtual reality in a classroom environment.

3. Methodology

The proposed research aimed to determine the effectiveness of an immersive 3D virtual learning environment in conveying information to a body of students in the Key Stage 3 (KS3) bracket. For those not familiar with the UK system. KS3 is the legal term for the three years of schooling in maintained schools in England and Wales. Normally known as Year 7,8 and 9 when pupils are aged between 11-14. The results were expected to determine whether a 3D virtual learning environment can convey information more effectively than the traditional alternative of reading off printed material. Testing was accomplished by collecting and analysing data for each of two groups (control and test) and comparing those results to conclude which of the two methods were more effective. One group (test) used the interactive virtual learning environment to learn about a local landmark building in Nottingham UK. Greens' Windmill (shown in figure 2) on which the 3D VLE was based. The second group (control) read the same information from a written work sheet. Both groups answered the same test, the results of which were collected to produce an average score for each group. These scores were compared to determine how effective the 3D virtual learning environment was as a teaching tool.

The test group explored the 3D virtual learning environment for an allocated amount of time and then answered a test paper containing questions based on what they should have learnt during their play session. The control group was to learn this information in a more traditional way by reading a paragraph of text about the windmill (accompanied by relevant pictures). They were expected to read through the text as many times as they needed within the time given and answer the same questions as the test group. Once results were received the average score for each group was calculated and scores were compared between groups to determine which method of teaching was more effective. Prior to that groups were randomised based on the following criteria:

- A mix of both girls and boys in each group with -if possible- the ratio of boys to girls being 1:1.

- A mixture of both video game and non-video game playing students in each group at a ratio of 1:1.
- The ability levels of all students (concerning school work) was to be as diversified as possible

Figure 2: Green's Mill at Nottingham UK

It was hypothesized that students who were given the opportunity to play the windmill game for a period of 15 minutes would achieve higher scores on the test than those who did not.

3.1 Data collection methods

This research utilised quantitative data collection methods only. This was due to a) their suitability in collecting and processing varying amounts of quantifiable data from multiple subjects at the same time, b) the ease of deployment to the particular target audience and c) the ability to collect data electronically and to a centralised location as well as collect data remotely via the internet. Interviews and focus groups were also considered but due to time constraints and limited access to the target group they were not used although they could have provided interesting information, particularly in terms of design ideas.

3.2 Statistical analysis and questionnaire design

For the statistical analysis we calculated the mean score and standard deviation for each group. The standard deviation was used to determine consistency of performance within each group as well as between the two groups. Finally, an unpaired t-tests was conducted to test the statistical significance of the results. There was also general demographic data that was collected such as age, gender and previous experience with games, computers and VR. We used this information when randomising the groups to ensure a fair distribution of students between them. We also collected information for health and safety purposes. Specifically, to determine if students had any health issues that would prevent them from being able to play the windmill game or if special exceptions and allowances would need to be made for them. The demographics and previous experience questionnaire was written using Norman Bradburn, Seymour Sudman and Brian Wansink's guidelines from "Asking Questions" (2004).

3.3 Control group

The control group did not use the 3D virtual learning environment but instead used the more traditional method of a classroom worksheet. Each student in this group was given 15 minutes to read a body of text about the history of Green's Windmill. A historical location in Nottingham, England. The text contained information about the windmill that the student would need to remember in order to answer a short test quiz afterwards. The test was 10 questions long. All questions on the test pertained to the body of text they read previously. An incomplete test could be submitted however unanswered questions would be counted as incorrect. Once the student had completed their test paper they would submit it to a moderator who marked the answers given.

Once all of the students in the test group were tested, their scores were compared to produce an average score for the whole cohort.

3.4 Test group

This group used the new methods developed in this research as opposed to the traditional methods to learn about Green's Mill. The tasks this group had were essentially the same as the previous control group. Students in this group also had to complete a preliminary questionnaire. This was followed by a 15-minute session to make their way through the virtual reality application on which they would later answer 10 questions. The differences with the control group were that they were not learning using a sheet of paper but instead they were learning using a 3D virtual learning environment and a HMD. The 3D virtual learning environment in question was a first-person game for the PC where the user must navigate through Green's Windmill in Nottingham. Whilst doing so they would learn dates and facts about the windmill that they would later be questioned on. Each student in this group could go around the virtual learning environment and learn about the windmill. Information was displayed in a linear fashion but the user could also access any information on demand if they needed through a virtual interface for as many times as they liked. After 15 minutes, the game stopped and the student was asked to complete the short test consisting of 10 questions. The questions all pertained to information they should have just learnt whilst using the virtual learning environment and were identical to the ones the control group had to answer.

4. Development

The development of the windmill game took approximately 5 months to be completed and roughly 300 man hours of work. The windmill game was designed and built by the authors, with some third-party help in bug fixing and testing.

4.1 Geometry and asset creation

Creation of the geometry of the windmill, its interior furniture and machinery and other embellishments for the game environment was the portion of development that took the longest to complete. Not because the work was overly difficult but because of the amount of modelling needed to be done. Having a large bank of reference photos and technical diagrams helped to speed up this process significantly, however due to the complex nature of constructing a multi-floored, inter-connecting, tower mill, the modelling still took a large part of the development time. The modelling was done entirely in Autodesk 3DSMax 2014. Textures were produced in Adobe Photoshop CS6. The interior of the windmill is, in reality, incredibly compact with machinery and furniture for the purposes of flour production, grain storage etc., however, due largely to time constraints the digital model of the windmill produced for this research is very sparsely furnished in its interior with only some bare minimum components of the machinery being present such as the upright shaft. Despite that, the windmill is still identifiable as a windmill and this lack of furnishing is predicted not to affect the educational experience of the player. The sense of realism and immersion of the game might have been affected however because of this. It would be interesting to see studies comparing educational differences on the basis of the above in future. We are going to revisit this issue in the future work as well as the limitations section of this paper. Certain pieces of geometry were needed for the purposes of teaching the player about the windmill. These were not objects that existed in reality at the windmill but were fabricated for the intention of conveying information to the player in the game environment. The list of these items is not extensive as much of the information conveyed to the player was done through in-game voice overs. However, some images were used to backup or enhance the information from the voice overs. This kind of geometry included sign-posts with maps of the windmill's various floors or large canvas paintings of pictures from the past (where the history of the windmill was concerned).

Educational content involves getting information to the player in an interactive way. Originally, this was planned to be in-game characters and objects in the environment that the player could interact with and control (such as actually operating the mill itself). However, due largely to time constraints as well as technical constraints on the development side, the educational experience of the windmill game was limited to more of a museum tour as opposed to interacting with it in a more organic and realistic way (not that visitors can operate the mill in reality of course). Despite this compromise on interactivity, the educational content of the game was still imparted to the player in an interactive and engaging way, using player controlled audio clips and visual aids (again, much like information panels in front of exhibits in a museum). The main way in which this information was imparted to the player was through manually activated in-game narrations. These were identified as large metal pedestals with bright shiny red buttons on top which were hard for players to miss. Getting information involved the player identifying these locations in virtual space, getting to them and interacting with them.

4.2 Development of the non-virtual worksheet test

Before the non-virtual worksheet was created it was decided exactly what information the research would aim to convey to users and to do this, research was carried out using the Green's Windmill existing information booklet. This booklet covered both the historical and operational information of the windmill from the 18th century to the present day and was produced by associates of the windmill. As this document was a first-hand source of information regarding the windmill, it was concluded to be the most relevant source available during development and therefore all educational content was derived from this source. Dates and names were cross-referenced with online sources but were generally found to be accurate (or at least, consistent). This post-training test represented the primary point of data collection for the test results of the worksheet and virtual windmill game comparison. From this test it would be determined whether the windmill game was effective as an educational tool or if it did not meet the predictions of this research.

5. Results

The test results for the windmill game group and worksheet group are shown below. These results are the individual scores of the students marked based on their answers to the questions in the post-test. The total number of students in the worksheet group was 16 of which 11 were girls and 5 were boys, these students varied widely in computer game experience. The total number of students in the windmill game group was slightly higher at 17 students of which 12 were girls and 5 were boys.

The questions were structured as follows. Questions 1 through 6 were simple, fact-based, multiple choice questions. Question 7 was a two-part question requiring the student to write two unique answers (1 mark available for each). Question 8 showed a diagram of the windmill with mixed-up labels for its various floors, the student had to draw a line between the correct floor and the correct label (1 mark available per correctly drawn line with a total attainable score of 5 marks). Questions 9 and 10 were both short essay questions asking the student to briefly explain the purpose of two of the floors of the windmill (the bin floor and stone floor respectively). Students then received one mark for each function of the floor they could recall up to a maximum of 2 marks per question (for example: stating that the bin floor is used for storage gave them 1 mark and stating that it also funnels down to the stone floor gave a 2nd mark).

Table 1: Test results of control group

Control Group Test Results																
Student	1	2	6	9	10	13	14	16	19	20	22	23	27	28	30	32
Score	14	10	8	14	5	15	10	9	3	10	10	15	15	14	11	12

Table 2: Test results of windmill game group

Windmill Game Group (Test) Test Results																	
Student	3	4	5	7	8	11	12	15	17	18	21	24	25	26	29	31	33
Score	7	6	6	12	8	10	9	9	6	9	8	7	14	16	12	8	5

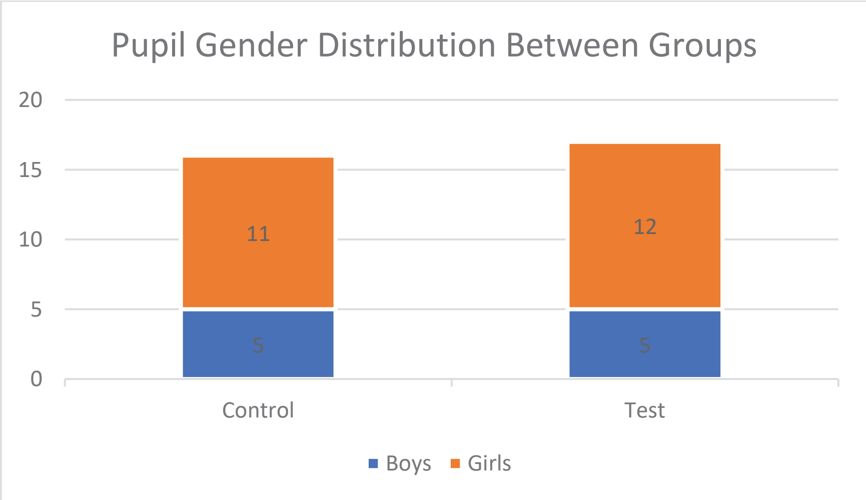

Figure 3: Distribution of male and female pupils between the test and control groups

Table 3: Individual responses of students per group

Question	Test	Control
1	6/17 correct answers	14/16 correct answers
2	15/17 correct answers	15/16 correct answers
3	4/17 correct answers	10/16 correct answers
4	4/17 correct answers	12/16 correct answers
5	16/17 correct answers	15/16 correct answers
6	0/17 correct answers	3/16 correct answers
7	0 marks – 2 1 mark – 2 2 marks – 13	0 marks – 3 1 mark – 5 2 marks – 8
8	0 marks - 1 1 mark - 0 2 marks - 3 3 marks - 5 4 marks - 0 5 marks – 8	0 marks - 0 1 mark - 2 2 marks - 1 3 marks - 1 4 marks - 1 5 marks – 11
9	0 marks – 11 1 mark – 4 2 marks – 2	0 marks – 11 1 mark – 2 2 marks – 3
10	0 marks – 10 1 mark – 4 2 marks – 3	0 marks – 9 1 mark – 4 2 marks – 3

5.1 Comparison of group results

The average score for the windmill game group's post-test results were 8.9, therefore as the post-test was marked out of 17, the average score for the group was just over half of the total available marks for the post-test. The average score for the worksheet group's post-test results were 10.9, therefore as the post-test was marked out of 17 the average score for the group was above half of the total available marks for the post-test.

As can be seen from the scores in the tables above and the averages calculated per group, the 3D virtual learning environment of the windmill game was effective in conveying information to a body of KS3 students but was not more effective at doing so than traditional school methods that are practiced currently. The difference in average scores per group is roughly 2 marks when rounded up to the closest number; 9 marks for the virtual windmill group and 11 for the worksheet group. This comparison of averages shows that the worksheet group scored higher marks on average but only by a small difference.

It can be theorised that this difference is related to variations in the general learning abilities of the students involved in the test. A bigger sample of students should produce more statistically significant results. An alternative explanation could be that the results were not reflecting the level of ability of individual students but their learning styles. Regrettably due to time constraints Kolb's Learning System Inventory (LSI) could not be implemented and subsequently tested on students. However, the values of Kolb's LSI may explain the sporadic pattern of performance based on the individual learning styles of the students.

It is possible that certain students performed better because they thrived in a learning environment more closely suited to the ways in which they learned naturally. However, with a larger sample size the individual learning styles of the students would be inconsequential as they would affect both the control and test groups more uniformly. This is assuming the groups were randomised based on their learning styles as well as the other attributes discussed previously. This is also the case with learning the same material in a typical school environment. The standard deviation between the groups can be seen in table 4 below:

Table 4: Mean, standard deviation, standard error of mean and population between groups

Group	Windmill Game Group (Test)	Worksheet Group (Control)
Mean	8.900	10.900
SD	3.000	3.500
SEM	0.548	0.639
N	17	16

In future, testing students' individual intellectual ability to answer educational questions could be tested and analysed in order to explain the reasons behind differences in performance more confidently. However, the test group standard deviation shows that students interacting with the 3D virtual learning environment retained information more consistently than those who learnt through traditional means. The 3D virtual learning environment was able to produce precise results from a range of students of potentially different technical and intellectual abilities. From those with a large amount of computer gaming experience to those with very little to none. Overall the results are not statistically significant for a confidence interval of 95%. A two-tailed t-test produced a P value of 0.0888. Whilst the actual t value was 1.7572. This however might be down to the limited number of students per group as the same t-test with the same means and standard deviations for each group would have produced statistically significant results if the number of students per group were 30 or higher.

5.2 Students with below average Reading and Writing abilities

During the testing of the windmill game, a 14-year-old student took part that was supported by a personal assistant helping them with their reading and writing. The student reportedly had a reading age of 7 and a writing age of 9 making normal school work very difficult for them. Though this student had literary abilities of only half their age, the student did exceedingly well on the post-test. Having played the windmill game first, the student's score was 12 out of 17 which was one of the highest scores attained in the windmill game group overall. Indeed, the student's score was so high it fell just 2 marks short of another student in the same group who was stated to be gifted and talented (based on the school's merit system of exceptional ability in a certain subject). The similarity of these scores in the context of the juxtaposition of their respective owners represents a significant achievement for the effectiveness of the windmill game as a 3D virtual learning environment for that particular user. It shows that students who may have difficulty with traditional school work involving lengthy or difficult reading and writing above their abilities can still process and retain information through different visual or auditory means (or both in this context). This way students who may normally struggle or are left behind by the school system can be afforded greater opportunities for success through alternative means. This is one of the most interesting findings of this research that suggests more work might be needed in evaluating the potential benefits of interactive virtual reality applications for students with special needs.

5.3 Correlation of results in windmill game (test) group based on previous computer game playing experience

Level of pre-existing computer game experience (and general IT skills) is a variable that could potentially affect the results of a student's score, a student who is pre-disposed to certain game playing behaviours or is knowledgeable of the conventions and traditions of computer games may have an advantage when interacting with a 3D virtual learning environment compared to those who are less experienced (or have no experience at all). This was found not to be the case in our sample group. No correlation between computer game or general IT aptitude and high marks was observed. This indicates that the amount of experience a student has in playing video games does not affect the potential scores they can achieve through learning using a 3D virtual learning environment of our particular design. This is a positive result for the effectiveness of 3D virtual learning environments as it shows that they can be inserted into situations where users of any level of experience can use them to learn effectively.

6. Conclusions

The use of 3D virtual learning environments for KS3 students as educational tools was shown to be partially effective in relaying information to students. Student information retention was shown to be consistently high in recalling the facts and figures they had been taught through interaction with the windmill game. However, it was also shown that a 3D virtual learning environment was less effective than what can be considered to be standard or traditional teaching methods that are popular in schools today. This was observed in the test results collected. Though the windmill game's 3D virtual learning environment can convey information to a student and have that student retain the information with reasonable and consistent clarity, it could not be considered an effective or efficient alternative to current standard practice as it achieved generally lower results overall than the traditional worksheet approach it was compared to. Though the results of each group were comparable, the use of 3D virtual learning environment s in schools over traditional methods can be argued against based on grounds of cost, production time and overall efficiency of teaching:

6.1 Cost and production times

The cost of developing the game was calculated to be very high compared to the low cost of the traditional method. This included the cost of the HMD, the various licenses for the software needed to produce the game such as those for the 3D and design packages, game engines, utilities, audio production and editing software etc. The cost of employing additional developers would also have to be calculated. It took approximately 300 hundred hours to develop the prototype and the authors had some experience developing material of this type. A more polished product would require more time than this. This could increase its effectiveness but would also increase costs. These of course do not include the classroom deployment costs of multiple Oculus Rifts or similar HMDs and computers powerful enough to run such 3D environments for every pupil in a class simultaneously. Until and unless those costs come within most schools' budgets even if virtual reality training applications were shown to be more effective, takeover could take some time. If adoption did happen at large scale, economies of scale could offset some of these costs but would still remain significantly higher in comparison to traditional methods.

6.2 Efficiency as a teaching tool

Unless each student could be equipped with a HMD simultaneously, a 3D virtual learning environment could not be considered an efficient teaching tool as multiple students could not be taught course content at once. This is not an issue when considering traditional methods of addressing whole classes verbally or using simple printed worksheets or a common display screen.

Another reason it might be unlikely the technology could be fully implemented into a classroom environment in its current state is the ill side effects it may have on some students. In particular, motion sickness, disorientation, headaches, eye strain and other associated issues. These could distract students from the educational content and cause harm immediately as well as over time. It is unclear whether with higher resolutions, higher refresh rates and better quality lenses this would change. Perhaps some of the ill effects might not be currently addressable. Perhaps the disconnect between the user's senses, the asynchrony between the audio-visual signals received by the user from the HMD and the rest of their senses (i.e. touch, temperature or even orientation in physical 3D space) might need new technologies to be invented.

Despite the Windmill game's limited success in demonstrating the effectiveness of 3D virtual learning environment as educational tools for general school environments, there is some evidence to suggest that they could be effective (if not preferable) in certain specialist situations where having information delivered in a visual, auditory and immersive way is preferred. This is evident in other related studies (Kim & Ke, 2017), (Honess, and Quinlan, 2017) but also from looking at the data of this study. Specifically, in the case of the student with the lower reading and writing ability, it could be seen that where the student would normally struggle with school work delivered in a traditional format the nature of the windmill game being able to convey information through images and sounds enabled them to exceed expectations in their test performance. This is interesting in terms of the potential application of 3D virtual learning environments as alternative learning tools (or learning supplements/aids) for students with special educational needs. Future tests could be targeted towards the development of educational environments for students with special needs specifically. Although developing custom solutions based on a student by student basis can be argued to be more difficult and expensive it may be a worthy investment if the results lead to students with difficulties gaining the chance to learn and perform at the same level as their peers. In conclusion, there is some evidence to support that immersive 3D virtual learning environments for education are not yet at a point where they can effectively replace traditional methods in school environments. However, the use of immersive 3D virtual learning environments can be suitable or even preferable in special situations.

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ECO CHAMPION: A Transcultural Educational eco Game for Children

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Abstract: Environmental protection and sustainability are a challenge that bundle ecologic, social and economic factors. Furthermore, in a global world all kinds of ecological challenges are interwoven. Environmental problems are often caused not only by local conditions but influenced by pollution and inconsiderate behavior elsewhere, e.g. a notable amount of the plastic waste found on west African strands can be traced back to passing ship. Despite this complexity kids commit themselves without resignation and recognition of constraints for an environment worth living in. With a serious game for school kids we try to address the shortcomings of the common perception of ecological challenges as local incidents and as a matter of personal struggle against dedicated culprit. Hence in our game, a coherent serious of mini games, the player has to fight environmental problems based on actual cases and with the need of cooperation. To address cultural differences, we used a modular design and implemented a multilingual approach. We gave our partners and the local school kids (elementary school) the ability to submit dialog parts and pictorial game assets without bothering them with the technical complexity of the engine (Unreal Engine). The game development team created a set of hero like player characters. The player takes on the role of the different champions to solve special missions. By relying on scenarios of international acting NGOs and by cooperating with schools in Rabat (Morocco), Buenos Aires (Argentina) and Gessertshausen (Germany) we created Eco Champion and it's first mini-game prototype „Garbage Patrol". In our cooperation we utilized suggestions and visualizations from the partnering schools. With our game we aim at enhancing improvement of children's knowledge, skills and attitudes towards environmental and global issues through friendly online activities and games with a play and learn approach.

Keywords: game design, eco games, game analytics, culture

1. Motivation

In 2002, the United Nations General Assembly proclaimed a World Decade "Education for Sustainable Development (ESD)" for the years 2005 to 2014 with the goal to anchor principles of sustainable development in national education systems throughout the world. This has brought about a variety of teaching materials to be used in the classroom including working sheets, textbooks, and also educational games, some of them are in old-school, analogue format, such as card-board games, and a few of them are educational, interactive computer games. However, pollution, over-consumption and scarce, unevenly distributed resources are still among the key issues that influence our everyday lives today. To provide a livable world for our children and future generations the need to promote a sustainable lifestyle remains a big and urgent challenge. Moreover, in an increasingly globalised world ecological challenges appear to be tightly interwoven. Examples include plastic garbage washed up on West African beaches which is not only caused by residents but ocean currents and even passing ships, as well as shipments of hazardous waste from industrialised countries to third World countries.

Facing environmental issues is a human challenge that touches every aspect of society. Sustainability is commonly described as a bundle of ecological, economic and social factors. Moreover, the protection of the environment is driven by a variety of motivation and the challenges appear very different through the possible contradictory perspectives of different stakeholders. As a „wicked problem" (Rittel and Webber, 1973; Levin et al., 2012) by the global state of adding value and hard to investigate material cycles it is demanding to explain this topic to children without oversimplification. But children are particularly aware of environmental pollution as they are using their environment not only as playground but as a strong reference for their identity. Also, they are not used to an adult indifference or resignation through the excessive demands of its complexity. To strengthen the courage of children in asking for change and backing them up with a profound knowledge of environmental contexts, approaches and methods we look for a format that proves clearness while maintaining complexity. We think that the game format and especially game development is an reasonable attempt because of its openness to create and bring to life coherent world models.

This paper introduces “Eco Champion”, an educational computer game which aims to stimulate and foster environmental awareness among elementary school students (age group 6-10). A central assumption of the underlying concept is that ecological challenges should be perceived as local incidents within global contexts. and as social conflicts of often legitimate but conflicting interests. In the sequel we first clarify our understanding of environmental awareness from which we derived basic requirements for eco games in general, and we provide a brief overview of the field. For our own game, Eco Champion, which is based on a starting concept of one of us (Jens Müller) and the experiences of one of our project partners, the NGO Ecofund, we first drafted a script (game story). To be able to localize the game for children from different geographical regions with different cultural backgrounds, an attempt was made to elicit design-relevant input from children living in different countries (Section 3). Thereafter, we sketched a first game prototype featuring different skins to accommodate for cultural differences among target players. The last sections summarize the state of the project and gives an outlook on next steps.

Our project is a cooperation between the University of Applied Sciences Augsburg and the NGOs Ecofund (www.ecofund.org) and Manos Verdes (http://www.manos-verdes.org). Furthermore, three elementary schools in three continents are involved. Our shared ambition is to sensitize and engage for environmental issues. We believe, that this can be done best by cooperation, thus we built up a communication network to value, use and implement experiences of all participants.

The objectives of the team project at the University of Applied Sciences Augsburg are to develop innovative media formats. Our study program interactive media brings together knowledge, methods and attitudes from applied art and information science. We believe that interactivity should expand to participation approach. Especially serious games are an appropriate format for that attempt due to its conceptual openness and wide range of genres. The demanding development and maintaining process could only be mastered by interdisciplinary teams and it could be opened to a shared experience of developers and users. Objectives in our teamproject are:

- creating applications by bringing together art, design and programming
- managing complex formats by teamwork
- cooperate with different clients and participants

The objectives of Manos Verdes are to promote the exchange of knowledge and technologies for the protection of the environment between Europe, Latin America and other continents to create awareness for the responsible and sustainable use of our natural resources. Activities of Manos Verdes are

- environmental education, especially for children,
- environmental communication,
- establishing networks between schools, universities, businesses and municipalities,
- publish training materials and organize events,
- coordinate student and corporate volunteer programs.

At Ecofund we believe climate change conferences and government laws are important, but we need more local champions and they need our help to preserve our ecosystem. We believe that everyone can be a champion, that small efforts can produce broader positive effects on our ecosystem. We believe it is more efficient and sustainable to preserve our ecosystem through small locally motivated actions than, once the ecosystem is damaged, to restore it through expensive taxpayers funded programs. Preserving our planet is not an impossible task but a challenge within everyone's reach. It is this very spirit of positive action that we are trying to spread with Ecofund and the unique platform it provides.

- Information: Our Ecoblog takes you on a journey to the most remote locations, e.g. protecting migratory birds in “Banc d’Arguin” in Mauritania ensures that after a cold and grey winter, we in Europe can still hear the songs of birds in the spring.
- Dialogue: Thanks to integration of social media within our web platform, global citizens can exchange stories and ideas on how to protect our biodiversity.
- Action: We identify, highlight and boost positive actions by connecting supporters with Champions and their concrete projects. Our Champions do extraordinary things every day to preserve our biodiversity.

The school classes in Rabat/Morocco, Villa Ballester/Argentina and Gessertshausen/Germany apply to the project as a hub for interdisciplinary questions and to foster media competence. Objectives are:

- strengthen awareness of the immediate environment
- talk about the environment and living conditions
- Identify possible courses of environment friendly action
- harnessing the enthusiasm for games in the classroom

2. Environmental awareness

Environmental awareness has different meanings in different usage contexts. We adopt the view of environmental psychologists Spada (1990), Hellbrück and Kals (2012) and consider environmental awareness as a multi-dimensional construct that encompasses the following components:

- knowledge about the environment and its protection,
- consternation, i.e., the degree of feeling personally affected by environmental challenges. Consternation is closely linked to a person's perception of environmental issues,
- value orientation concerning sustainable preservation of the environment and natural resources,
- intention to behave and manifest environmental-friendly behaviour and to engage in pro-environmental activities,
- actual behaviour.

While all components affect each other in one or the other way, there is no automatism in the sense that more knowledge about the environment and its protection results in a sustainable environment-friendly lifestyle.

In a study with children at the kindergarten/elementary school level, Wiesenthal and colleagues (1996) examined the children's level of knowledge about environmental protection, as well as the relation between knowledge and real protective activities. They conclude that environmental education must start at concrete experiences of the children. They consider such individual experiences as a requirement for sound expertise concerning ecological contexts.

Reviewing some studies on environmental awareness among adults and children, Schock (2014) concludes that students seem the most suitable target group for educational efforts on promoting environmental awareness. According to her, young people are more likely to have positive environmental attitudes and willingness to behave environmentally conscious. Educational interventions should show behavioural alternatives and learners should be able to test behavioural possibilities for a variety of motives.

Educational computer games bear the potential to transport subject matter knowledge, to increase perception of environmental issues, and to provide a sandbox for testing alternative options for action in a playful manner. In the next section we discuss a number of educational games that can be related to dimensions of environmental awareness.

3. Eco games – A brief overview

Given the plethora of online references to educational eco games, the provision of a comprehensive survey is far beyond the scope of this article. Rather, we restrict ourselves to provide the reader with a number of entry points for a web search, and we give reference to a number of eco games that we considered relevant for our work on the Eco Champion game.

3.1 Where to find eco games?

Good starting points for a search on educational eco games are collections of educational resources maintained by federal agencies, institutions, associations, NGOs, schools, and engaged private people. The United States Environmental Protection Agency (EPA) maintains the webpage "Games and Quizzes about the environment" (EPA, 2018). The page lists around 10 eco games, each issuing a certain environmental challenge. Also it provides several links to other collections, such as the Games collection maintained by the US National Institutes of Health (NIEHS, 2018). In Europe, various eco games have been developed within projects funded by European research programs (notably from FP5 to the current H2020 program). Outcomes resulting from these projects include games to strengthen awareness for sustainable use of energy, e.g. BeAware (Jaccuci et al., 2009), EnerCities (2010), and water, or protecting the environment, such as flood prevention, e.g. 2020energy (2012): However, more often than not, games developed as part of research projects are no longer accessible or technically maintained soon after project termination. Some countries like Germany support schools and teachers by means of online catalogs of educational resources. An example is "Deutscher Bildungsserver" (DIPF, 2018). However, in this catalog only four eco games are listed. There are also special interest groups and NGOs who maintain catalogs to educational resources. An example is the "Games for Sustainability" platform (Centre for System Solutions, 201).

A few eco games can also be found on commercial web-based platforms for the gaming community. For instance, the steam platform lists a simulation game named "Eco" (StrangeLoopGames, 2016) in which players must build up a civilization in a virtual ecosystem. Also, literature on serious games research provides further references to concrete eco games. Katsaliaki and Mustafee (2012) conducted a survey on 35 serious games related to sustainability including SimEarth (Maxis Software, 1990) from as early as 1990 to "EnergyLife" (Gamberini et al. 2011) published in 2011. A survey focusing at survey on game applications addressing water conservation and management is provided by Savic and colleagues (2016).

Finally, a word of caution concerning accessibility and playability of referenced games is in order. Digital media and especially computer games strongly depend on the underlying technical implementation platform. The older the games, the less are the chances that they are still operational. For instance, in the last decade Java Applets and Adobe's Shockwave browser plugin have been the techniques of choice for many game implementations but they are becoming more and more outdated and unsupported and thus some of valuable but older games will disappear, too.

3.2 Typical genres for eco games

A number of web pages designed encompass quizzes related to environmental education. Examples include simple query-answer patterns like the "Environmental Awareness Quiz" (Petty, 2014) or combinations of quizzes and impact calculators, such as the e-learning tool "From cutlet to rainforst" visualizing the ecological footprint (WWF Austria, 2011).

The more complex eco games we have visited during the search belong to the category "simulation game". Simulation games like Enercities (2010), Eco (StrangeLoopGames, 2016), Sustainable Shaun (Sustainable Learning, 2015) or "Recycle City/Dumptown" (EPA, 2011) make the player a key stakeholder in a simulation of the ecosystem which may foster learning and understanding of complex interactions among decisions and their outcomes. For instance, "Recycle City/Dumptown" published by the United States Environmental Protection Agency (EPA) aims to help students understand the impact of applying specific measures for managing a town's waste stream. The player takes on the role of a city manager. She can launch certain waste management programs (e.g. home composting, drop-off recycle center, pay-as-you-throw, etc.) and watch the impact of such environmental programs on a number of charts. The underlying game mechanics is a simulator/calculator for waste management based on statistical data of US households.

There are also games that fall into the action or adventure genre. For example, EarthGirl (EOS, 2013) is a typical "platformer" where running and jumping to avoiding obstacles and enemies are the primary gameplay elements. The game is localized for five different languages (English, French, Chinese, Japanese and Indonesian), however, localization concerns textual elements only, e.g. labels on user interface buttons and introductory text passages. The adventure e-transform (2017) let the player explore a housing complex and become acquainted with conflicting perspectives on energy related questions. The player depends on the cooperation of the NPCs to solve the tasks.

3.3 Are eco games effective?

Most of the visited online accessible eco games lack information on to what extent they have been evaluated with regard to bring about desired learning outcomes, such as an increase in the students' environmental knowledge or the actual impacts on changes towards environment-friendly values, intentions and behaviors. One reason might be that the conduction of sound empirical evaluations is costly and time consuming and requires expertise beyond mere game development. A notable exception is the work by Gustafsson and colleagues (2009). They designed a mobile game with the aim to encourage teenagers and their families to reduce energy consumption in the home. They conducted a small-scale field test in which the compared recorded energy-consumption data before, during, and after a ten days long game trial. They found that their game concept was highly efficient in motivating and engaging the players and their families to change their daily energy-consumption patterns during the game trial. However, due to the very small sample size of only six teenagers and their families who took part in this case study, the findings are not conclusive as it remains unknown whether game play can engender behavioral change in the participants beyond the duration of the trial. There are also several meta-analysis on case studies in which effectiveness of serious games was evaluated. A meta-review carried out by Wouters and colleagues (2013) included 29 serious game evaluations with games in different formats (e.g. simulation, narrative, pedagogical agent, etc.) from across diverse instructional domains such as mathematics, economy, science, and biology but not eco games in particular. A main finding of their meta-review is that the use of instructional support in game-based learning can improve learning.

3.4 Do we need more eco games?

Having revisited a number of existing eco games we see at least the following arguments as drivers to think up and develop further eco games:

- Strengthening environmental awareness and sustainable development remain important educational tasks to be tackled, and if game-based learning can make learning more effective, it is worth to invest further into this medium.
- Improvements to existing eco games are always possible. As pointed out in Section 2, we believe that players should be able to capitalize on individual experiences made in their specific living environments. This calls for a much rigorous localization of eco games far beyond mere language localization.
- As each generation grows in the context of contemporary media and technologies there is also the need to "upgrade" and modernize learning materials and tools accordingly.

4. Conception of the Eco Champion game

For the Eco Champion educational game, we first formulate several working hypotheses from which we derive requirements the game should meet.

4.1 Working hypotheses and requirements

The following working hypothesis address the core mechanics and main goals of our game:

> *WH1: Perception and consternation in children can be increased if they can recognise a link to their own experiences while playing the game.*
>
> *WH2: Providing different authentic local environments makes evident that while the problems look similar the particular conditions may inherit its own options for troubleshooting.*
>
> *WH3: Giving the players alternative options to cope with environmental issues will help to better understand causal relationships between behaviour and effects on the environment.*
>
> *WH4: While interacting with different NPCs the player realises that environmental issues can best be addressed by mediating interests.*
>
> *WH5: Organising the game development as an open process with participation of school children transforms the game into a communication tool for the concern on the environment.*

WH1 suggests that the game should provide a collection of problem cases to increase the likelihood that one of those matches with a player's own experience. Furthermore, as the game should attract players from different countries, localisation will be required. However, in this case it's not just a matter of language localisation. Rather, playground, inventory, and characters should be chosen and rendered in a way that match the player's experience and expectations when thinking of the environment.

WH2 goes beyond the previous scope of linking gameplay to familiar experience by availing awareness of local conditions. Observation of concrete conditions helps against feeling lost in the complexity and factuality of given circumstances. Problems become relativised by being compared with other local occurrences. Reality can be realised as a human made construction, which can be altered by involvement.

WH3 relates to the game mechanics to be provided. There should be both, actions with environment-friendly outcomes as well as actions that are not suitable for solving environmental. Game mechanics may stimulate teaming up with others to solve environmental problems. In any case the game must ensure that outcomes of actions are clearly recognisable.

WH4 refers to the human ability to cooperate. Complexity is faced best by looking for helping hands. We utilise typical game mechanics like power-ups and a dialog system to implement a cooperative gameplay.

WH5 acknowledges that games as interactive media not only rely on instant feedback. Adventure or action games may invite to explore exciting worlds and narratives and connect to virtual characters and other players. While implementing AI, chats and multiplayer mechanics is beyond the scope of this project, we provide e.g. a simple dialog system. beyond a technical level interaction is social action. We achieve this by organizing an open development process.

And last but not least, Eco Champion should be perceived as a game that is fun to play. While there are controversy opinions on the existence of a universal player typology / player satisfaction model (for a survey see Nacke et.al 2014), it is observable that players have individual preferences for specific game genres, although preferences may change over time.

4.2 Game outline

With regard to WH1 and WH3 the Eco Champion game has been conceived as an extendable suite of dedicated mini games, each addressing a specific environmental challenge. Also, each mini game must offer action choices so that players can learn about action consequences on the environment, whether they are good or bad. At the current state the following mini games, based on experiences and real projects by Ecofund are under development:

- **Garbage Patrol:** There's garbage all over an urban place. Get the garbage out of your neighbourhood. Disrupt bad habits of disposing waste by convincing NPCs to alter their habits. Separate waste and acculturate the concept of up-cycling.
- **Harbour Master:** A fishing vessel collided with a rock. Prevent an oil slick. Use a boat to catch the oil. Organise people to build a pipe system to pump off oil.
- **River Manager:** A recently commissioned industrial textile dyeing plant discharges its toxic waste water unthreatened into the nearby river. The river is not only an important source of water for the surrounding villages, but also an important source of food. Clean the river. Mediate between the interests of textile workers and fishermen.
- **City Mayor:** More and more cars and mopeds are being registered in the city. There's a thick smog cloud over the city. Fight the Smog. Motivate People to change to public transport or bicycles. Make intelligent investments into the infrastructure
- **Park Ranger:** The hot sun desiccated the earth. To clean their fields, farmers have set the grass on fire. Unfortunately, the small fires begin spreading uncontrollably, large areas of forest and pasture are in danger. Cut a path to prevent the fire to spread further. Get help from lumberman and fire fighters. Get access to the extinguishing aircraft.
- **Saviour of the Seas:** Drifting nylon nets degrade the marine ecosystem. Once lost by the fishermen, nylon nets take about 400 years to completely disintegrate. Entangled fish die a senseless death and attract predatory fish, which also get caught in the nets. Get nets out of the sea. Convince fisherman not to throw old nets into the sea and better use cotton nets.

All the mini-games are bound together by a framing story. In a central control room missions are handed out to the player, who adopt the role of a local champion. An Eco Champion – which is also the name of the entire game – is a local hero who solves problems through direct action but also by cooperation with different actors (NPCs) or by mediating between contradictory perspectives and interests. This game concept is based on the seven years of experience by Ecofund. Thus, we are able to make sure that the game script is linked to real world scenarios. The profound experience of the NGOs and their creative and constructive approaches in problem solving are a core resource for creating our game play and the design of the player’s missions.

As stated in WH5 our attempt is to involve children as co-designers during game development. While participative approaches to game design involving children have been exercised by others, too – for an overview see Langridge et al. (2017) – we hope that this will help us to accommodate for cultural differences and regional characteristics of environmental problems. Furthermore, it should foster the commitment to the given missions and put the students into the role of co-developers, using the game format for a more communicative and cooperative exchange and knowledge transfer. This takes into account that the school children have substantiate implicit knowledge in the coherence of their local surroundings. This approach is described in the next section.

5. Getting input from children

Perception and consternation in children can be increased if they can recognise role models and best practice examples. That may give them orientation and encourage them. The involvement of children as co-designers should accommodate for cultural differences and regional characteristics of environmental problems.

5.1 Preparation

As a starting point, we produced three versions of the Garbage Patrol, one localised for German children, a second version for Moroccan, and a third one for Argentine children, based on the infrastructure of the participating NGOs. We explained the participating schools our objectives and worked out a questionnaire and worksheets to elicit input for game design from the children.

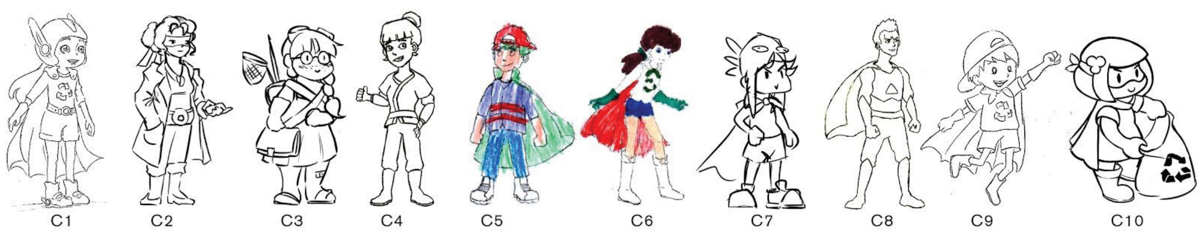
The questionnaire asks for gender and age. We show the dev teams drafts and ask the children for comparison with local conditions. The worksheets comprises room for sketching individual places and items of waste. A second worksheet shows different kinds of player characters (as heroes). The children are asked to rate the characters. Furthermore, the pupils are asked to draw their own character.

Determing the characters the school children identify most with should help to set up the localised versions with an authentic and understandable game world. To achieve a consistent and professional graphic style we transfer the childrens drawing to our style. The submitted images of garbage takes us a step further. Here we have to adopt the game story to apply to the special conditions at different locations.

5.2 Input for game assets by children of different countries and evaluation

In our first survey we received answers from 53 children from Rabat/Morocco, Villa Ballester/Argentina and Gessertshauen/Germany (see section acknowledgements). All the submissions show a good understanding of our questions. In rating they stressed the whole scale giving clear statements. The possibility to draw own pictures had been embraced very well.

Background examples submitted by the children from Germany (bg1), Argentine (bg2) and Morocco (bg3).



Characters c5 and c6 had been the favorites of the Moroccan and the German students. In this compilation the favorites are substituted by colored submission of Maroccan pupils.

While the Argentin children submitted their own characters and landscapes, the Moroccan and German school children in addition evaluated the given characters.

The majority of the Moroccan school children preferred the character c5 (10 of 22), most female children voted for character c6 (5 of 11), most male pupils for character c5 (7 of 11). Likewise, the majority of German children voted for c5 (6 of 19) and c6 (6 of 19), most female children voted for character c6 (6 of 12), most male pupils for character c5 (6 of 7).

The response to kinds of garbage shows major differences between the countries. While the German Pupils mostly depict food scraps, cans, bottles and even leaves, the Argentine pupils often refer to pollution by ships, industry and discarded bottles. Moroccan children respond with drawings of e.g. soda bottles and food packages. How much the submission is influenced by previous lessons of environment-oriented teaching and later by playing the prototype will be examined in a later stage of our project.

6. Prototype of Eco Champion and the Garbage Patrol mini game

The Game starts in a control hub. Blinking red lights point to environmental issues around the world. In a chat like dialogue the player gets a description of a given challenge. For every mission she/he is able to activate a local champion. This starts a minigame and the player slips into the role of the local hero. After successfully finishing the mini game the red light turns into green and the player achieves time credits.

Screenshots of the localized version for Germany, Morocco and Argentina.

For illustration, we concentrate on the mini game Garbage Patrol. The player character is equipped with a barrow and moves through an obstacle course. The mission is to collect garbage. The wheelbarrow has a limited capacity and must be emptied regularly. Colliding with obstacles causes garbage to fall off the barrow. At the right side of the parcour the player can deliver the garbage to a recycling depot. Delivering garbage separated by type the player achieves objects of value, which can be brought back to the parcours and deployed for powerups like a second barrow or for winning NPC to help collect garbage or avoid dumping.

Variants of the mini game resemble the different experiences of the participating school children in Rabat/Morocco, Villa Ballester/Argentina and Gessertshausen/Germany. The garbage lying around looks different, helpers are individually motivated, power ups are unique for every skin of the game. The localised Garbage Patrol mini games share the same game mechanics while the graphics, dialogs and NPCs and power ups are based on the experience of the local students. Therefore, we organized classroom workshops in the participating schools.

The game development is done by the student team in the interactive media study program at the University of Applied Sciences Augsburg. The team worked in distributed roles e.g. as game artists, level designers and programmers. Using Photoshop, Unreal Engine and other tools, prototypes are built for evaluation at the participating schools.

7. Next steps

7.1 Development of further mini games

Meanwhile some members of the development team create the next minigame, Park Ranger. We follow the same workflow. First, we do a rebriefing of Ecofund's game proposal and discuss different concepts for technical implementation. Then we create a logical consistent and playable prototype with our own graphics. In a next step we will involve school children for localizing and alternative gameplay.

At the current stage we focus on a basic gameplay and a simple story in one screen, hence mini games. In a further iteration the game mechanics should be evolved further to better incorporate and visualize the social complexity of environmental issues and to enhance the achievement system. We now provide the player with power ups that refer to the stakeholder approach. By now the player is only able to activate NPC-helpers that do the same tasks than the player. Beyond that we work on a concept in which the player has to contact various NPCs representing different perspectives and dedicated abilities on the subject and animate them to help accomplish the given mission. This will require an informed discussion with the school children. As soon as the cooperation with partner schools has been deepened the school children could be involved in an earlier state, enabling the pupils to contribute their own experiences of environmental problems and suggest suitable solution strategies.

7.2 Game evaluation

Much work remains to be done regarding evaluation work. Firstly, game play evaluation will be conducted to adjust game mechanics to a level of difficulty which is appropriate and fun to play for the children. In addition, we plan to evaluate the effectiveness of Eco Champion mini games in terms of measurable learning outputs. This will include gaming sessions with children surrounded by pre- and post-gaming interviews to examine if the children acquired new environmental knowledge and to what extend the game can contribute to a child's value orientation towards sustainable preservation of the environment.

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Fostering Quality in MOOCs: A European Approach

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Abstract: Societal, educational and personal changes have brought Open (Online) Education in the forefront of the global learning setting. One of the most significant challenges behind the EU Modernization Agenda is for education to respond to the characteristics of future students and to new needs in society. According to the Europe 2020 agenda, 40% of young people should complete higher education studies by 2020. The entire European university sector witnesses an increase of student numbers. Conventional learning methods are suboptimal solutions for these massive student numbers. Thus, important questions and issues arise: How can we anticipate increasing student numbers combined with the likelihood of lower funding? How should we combine online and traditional formats to devise sustainable university business-models? In order to address these challenges Europe is investing in flexible educational solutions as this is embraced by the EC in its Open Educational Resource (OER) agenda. During the last years Massive Open Online Courses (MOOCs) became very popular: Since the year 2008, when the first MOOC was provided, the number of MOOCs is constantly increasing. The year 2012 was considered as the "Year of the MOOCs". However, MOOCs and OER are a good solution as long as they retain a certain level of quality. So far, experience and practice are leading to an increasing debate about their quality as an educational tool. The high drop-out rates of MOOCs that are typically measured in traditional distance education courses as well as in all formal education settings are discussed causing requests for rebooting MOOCs and the research on them and their quality. This article addresses the open issue of integration of quality approaches and mechanisms into the design of MOOCs through the development of a European MOOC Quality Reference Framework (QRF). The MOOC QRF provides a generic, organisation-wide system to help Higher Education Institutions and external stakeholders to design, develop, monitor, evaluate and improve the effectiveness of MOOCs along with the quality management practices. Based on flexible, configurable quality criteria and indicative descriptors, monitoring and reporting is adapted to organisational needs. The article presents the structure and quality dimensions of the MOOC QRF. It is based on the first international quality standard ISO/IEC 40180 and currently submitted to the European and international standardization committee (CEN TC 353 and IOS/IEC JTC1 SC36) for approval as first quality standard for MOOCs. The MOOC QRF is practical to encompass a wide range of approaches to quality assurance emphasizing that it is the quality of the outcomes that matters most in the design of MOOCs, thus leading to a new era of learning experiences in Europe.

Keywords: quality reference framework (QRF), massive open online courses (MOOCs), open education and learning, massive online open education quality (MOOQ), global MOOC quality survey

1. Introduction

The societies and their economies, working and living conditions are changing all over the world. That includes the educational systems that are challenged by moving objectives and development targets (Nyberg, 1975, Stracke, 2018). Competing businesses and interests at national, regional and international scales are demanding for citizens to acquire and develop much different skills and competences, also new kinds of literacy, and many educational public authorities are understanding this shift and following this request (OECD, 2016). Personality and competence building in public education should prepare for new economies and jobs that are emerging but not yet fully developed.

On the other hand the personal living conditions are also changing considerably, not only related working opportunities and pressure but also related individual communication, collaboration and learning. The raise of the world-wide internet and social media including online communities is affecting people’s lives as well as personal learning. Many new opportunities for online learning and collaboration have been developed and are available for almost all interested people worldwide though technology and Internet access limits are still leading to unbalanced and non-equal situations mainly in developing countries (Stracke, 2018). Nevertheless we can call it a global movement due to the continuous increase of technology and Internet use all over the world (World Bank, 2016).

As a consequence of the societal, educational and personal changes, Open (Online) Education has experienced a major development raising awareness amongst all actors (European Commission, 2011, Stracke, 2015). It has led to global grass-root movements, events, communities and associations as well as to international policies and implementations in national and regional educational systems. Next to the UNESCO declarations on Open Education and in particular on Open Educational Resources (OER) (UNESCO, 2012), it was driven by the European Commission through the communication on "Opening Up Education" (European Commission, 2013) demanding a change and improvement in European education and society.

During the last years Massive Open Online Courses (MOOCs) became very popular: Since the year 2008, when the first MOOC was provided, the number of MOOCs is constantly increasing (Gaskell & Mills, 2014, Stracke, 2018). The year 2012 was considered as the "Year of the MOOCs" leading to an increasing debate about their quality as an educational tool (Daniel, 2012). In particular, the high drop-out rates of MOOCs that are typically measured in traditional distance education courses as well as in all formal education settings are discussed causing requests for re-booting MOOCs and the research on them and their quality (Reich, 2015). Although this discussion results mostly from an improper use of formal learning concepts in what is basically a non-formal learning experience (Onah, Sinclair, & Boyatt, 2014), alternative measures have been proposed and discussed to focus better the learners and their individual goals (Stracke, 2017).

2. The quality initiative MOOQ

To address the quality issues, the MOOQ initiative was established as the European Alliance for Improving Massive Online Open Education Quality (MOOQ). MOOQ is directly relevant to several key aspects of the EU Modernization Agenda (European Commission, 2011) and the main objectives of the MOOQ alliance are:

- Europe is already taking steps in investing in flexible educational solutions as this is embraced by the EC in its OER agenda; “Digital learning and recent trends in (OER) are enabling fundamental changes in the education world, expanding the educational offer beyond its traditional formats and borders. […] Europe should exploit the potential of OER much more than is currently the case” (European Commission, 2011). MOOQ shares and contributes to this objective by providing guidelines for designing more successful MOOCs from an educational and business model point of view.
- One of the most significant challenges behind the EU Modernization Agenda is for education to respond to the characteristics of future students and to new needs in society. MOOQ contributes to the transferring of first class European expertise in Open Learning to the higher education system using formal channels (standardisation).
- How can we anticipate increasing student numbers combined with the likelihood of lower funding? How should we combine online and traditional formats to enhance quality and at the same time devise university business-models sustainable?
- One target of the Europe 2020 agenda is that 40% of young people should complete higher education studies by 2020. MOOQ contributes to this objective albeit, the design of MOOCs to achieve this end without quality guidelines or standards will result in the phenomenon of increased dropout rates and/or failed attempts to deploy MOOCs by HE institutions. Thus, the goal to increase the number of graduates is served.
- The entire European university sector witnesses an increase of student numbers. Conventional learning methods are suboptimal solutions for these massive student numbers. MOOCs and OER are a solution as long as they retain a certain level of quality. MOOQ contributes to this end, beyond the experimentation phase being used by many HE institutions, by offering a systemic approach to massive student-centred online learning. By counter-parting the mere digitalisation of content or the use of simple process-oriented standards, the proposed project contributes towards the formation the appropriate pedagogical, organisational and business models for open and flexible education.
- MOOQ will research and formalise the design of multi-stage, mixed model MOOCs that may be offered during anyone’s lifetime, including non-formal and informal learning. These MOOC modes strive to serve new target groups such as combination of study and work, practitioners in professional networks in sectors of innovation and learning in the context of regional development (smart specialisation). This is a contribution to the implementation of the 2013 Communication by the EC on Opening up Education (European Commission, 2013).

The vision of MOOQ is to improve the quality of MOOCs leading to a new era of online learning experiences. Therefore MOOQ defined as its mission to develop a Quality Reference Framework (QRF) for the adoption, the design, the delivery and the evaluation of MOOCs in order to empower MOOC designers and providers for the benefits of the learners. Therefore, the main goal of MOOQ was the development and the integration of quality approaches, new pedagogies and organisational mechanisms into MOOCs with a strong focus on the learning processes, methodologies and assessments. To achieve these broad objectives, MOOQ has consequently selected and followed a mixed methods approach that is presented together with its results in the following section.

3. The MOOQ research results and achievements

MOOQ addressed the open issue of integration of quality approaches and mechanisms into the design of MOOCs by pursuing and fulfilling the following objectives:

- Analysis on existing practices for integrating quality approaches on emerging open online courses, including active discourse on open issues and concerns arising from the massive, large-scale implementations, showcasing paradigms of key players in the field.
- Collection of demands and needs related to the quality of MOOCs from different target groups and their detailed analysis and scientific publication.
- Development of a Quality Reference Framework (QRF) in collaboration with all interested stakeholders for the design, evaluation and improvement of MOOCs.
- Design, deployment and assessment through pilot testing of two collaborative MOOC pilots "Introductions to Embedded Systems" and "Introduction to Software Technology", using in practice and showcasing how to apply and manage the QRF.
- Standardisation activities that shall allow the integration of the QRF into specifications and standards both at European level (CEN-European Committee for Standardisation) and internationally (ISO).

MOOQ has developed and realized a mixed method approach for the scientific research combining the analysis and interpretation of quantitative and qualitative data from three online surveys including open questions and semi-structured interviews as presented in the following tables 1 and 2:

Table 1: Overview of all participants of the global MOOC quality surveys and of the subsets for open questions

	MOOC learners	**MOOC designers**	**MOOC facilitators**	**TOTAL**
All participants	166	68	33	267
Open questions	117	41	27	185

Table 2: Overview of the interviews with MOOC designers, facilitators and providers

	MOOC designers	**MOOC facilitators**	**MOOC providers**	**TOTAL**
Key questions	15	10	13	38
No. of Interviews	12 (1 hour min.)	12 (1 hour min.)	12 (1 hour min.)	36 (>50 hours)

The key findings are already published and revealed that MOOC learners and MOOC designers have different perspectives and preferences in particular in the fields of online interactions and collaboration (Stracke & Tan, 2018, Stracke et al., 2018): All four interaction types have significant correlation with the experiences of the MOOC learners (and even very high significance for three out of the four interaction types) whereas none of the four interaction types has any significant correlation with the experiences of the MOOC designers (Stracke & Tan, 2018, Stracke et al., 2018).

4. The quality reference framework (QRF) for MOOCs

The Quality Reference Framework (QRF) was designed and organized by MOOQ, the European Alliance for the quality of Massive Open Online Courses (MOOCs). The QRF is based on the International ISO standard ISO/IEC 40180 (2017), the former quality standard ISO/IEC 19796-1 (2005), the results from mixed methods research by MOOQ including the Global MOOC Quality Surveys and semi-structured interviews as well as the feedback from the MOOQ Workshops at international conferences. The desktop research and literature review and in particular the findings from the three international surveys and 45 semi-structured interviews (as reported in the section 3 above) were instrumental in the iteration and progressive refinement of the QRF. In addition, the contributions and feedback from the participants of the MOOQ workshops at the following international conferences were integrated into the QRF:

- ICDE 2015 in Sun City, South Africa

- OE Global 2016 in Krakow, Poland
- EC-TEL 2016 in Lyon, France
- OE Global 2017 in Cape Town, South Africa
- IEEE EDUCON 2017 in Athens, Greece
- ICALT 2017 in Timisoara, Romania
- EARLI 2017 in Tampere, Finland
- EC-TEL 2017 in Tallinn, Estonia

The QRF provides quality criteria and a checklist for designing MOOCs. They were discussed and developed in close collaboration with all interested international stakeholders. Their contributions and evaluation led to practice tools for designers, facilitators and providers to improve future MOOCs for learners worldwide. Furthermore the QRF was used in the design for the two MOOQ MOOCs what provided valuable feedback, too. The QRF consists of three dimensions including quality criteria and instruments as presented in the following table:

Table 3: Dimensions of the quality reference framework:

Dimension 1: Phases	**Analysis, Design, Implementation, Realization, Evaluation**
Dimension 2: Perspectives	Pedagogical, Technological, and Strategic
Dimension 3: Roles	Designer, Facilitator, and Provider

The first dimension of the QRF defines the phases.

The QRF consists of the following five phases:

- 1. Analysis (A): identify and describe requirements, demands and constraints
- 2. Design (D): conceptualise and design the MOOC
- 3. Implementation (I): implement a MOOC draft and finalize it through testing
- 4. Realization (R): realise and perform the MOOC including support and assessment
- 5. Evaluation (E): define, run and analyse the evaluation and improve the MOOC

The phases can be and are often processed in parallel. They are dependent of each other what is often leading to iterative cycles and progressive refinement. Each phases consists of several processes, e.g., "A-1 Initiation" as first process of the analysis phase. The evaluation phase can and should already start at the beginning of the planning and designing of the MOOC. The evaluation addresses all other four phases to allow a formative evaluation of all processes. Therefore the evaluation can ensure a continuous improvement cycle during all phases and the whole development of the MOOC.

The figure below illustrates the five phases:

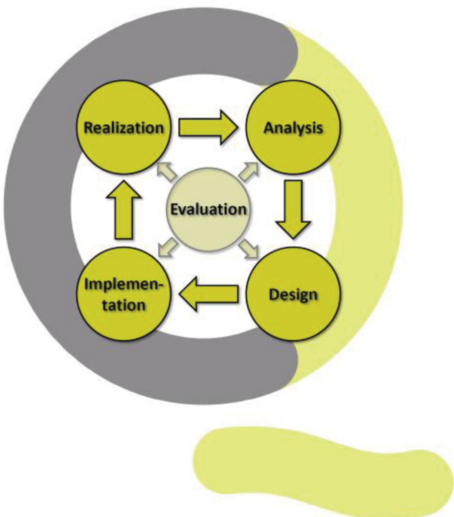

Figure 1: The phases of the quality reference framework (QRF)

The second dimension of the QRF defines the three core perspectives:

The QRF covers the following three main perspectives that have to be considered and addressed in the five phases:

- 1. Pedagogical
- 2. Technological
- 3. Strategic

The third dimension of the QRF defines the roles in MOOCs:

The QRF focuses the three main roles (designers, facilitators and providers). Roles are clustered into these three core groups as follows:

- Designer: Designer includes content experts, content authors, instructional designers, experts for MOOC platforms, technology-enhanced learning and digital media and any others who may contribute to the design of a MOOC.
- Facilitator: Facilitator includes the pedagogical facilitators and experts with content knowledge (such as moderators, tutors, teaching assistants) who manage forum, provide feedback and monitor learning progress, technical facilitators (such as technical support for learners) and others who may contribute to support participants in their learning process in a MOOC.
- Provider: Provider includes (internal and external) MOOC providers, technical providers (such as technology providers, programmers, software designers and developers), managers, communication and marketing staff and others who are involved in the decision-making processes leading to the delivery of a MOOC.

A detailed description of all three dimensions and their quality criteria can be found in the QRF.

It is most important to note that MOOC designers, facilitators and providers have to select the appropriate and relevant phases and processes according to their situation, the learning objectives, target groups, context and conditions. Some processes are already decided and (partly or completely) defined by pre-conditions and requirements (e.g., the available resources, budget and staff). In addition, the Quality Reference Framework provides the QRF Key Quality Criteria and the QRF Quality Checklist for designing and developing MOOCs. Main target groups of the Quality Reference Framework are the designers, facilitators and providers of MOOCs as well as the MOOC learners. The Quality Reference Framework can be used to analyse the needs and demands for future MOOCs, to design, develop and implement new MOOCs and to evaluate and improve existing MOOCs.

The main benefits of the Quality Reference Framework are:

- It provides a generic framework that can be adapted to each specific context.
- It identifies key quality criteria for better orientation on the MOOC design.
- It presents a checklist for the quality development and evaluation of MOOCs.
- It enables a continuous improvement cycle for MOOC design and provision.

5. Towards a quality standard for MOOCs

The Quality Reference Framework (QRF) was continuously revised and refined after each research and discussion step. More than 30 versions were developed during the last three years. The latest and stable version was submitted to the European and international standardization committees as New Work Item (NWI) for discussion and approval. Currently the European Standardization Committee CEN TC 353 "Technology-Enhanced Learning" and the International Standardization Committee ISO/IEC JTC1 SC36 "Information Technologies on Learning, Education and Training" are debating the QRF to reach consensus. As mentioned above, the QRF is based on the unique international quality standard for technology-enhanced learning ISO/IEC 40180 (2017) that is the regular revision and replacement for the very first ISO quality standard in learning and education ISO/IEC 19796-1 (2005). In addition, the QRF is also the first NWI and application of ISO/IEC 40180 (2017) and ISO/IEC 19796-1 (2005) for a specific type of technology-enhance learning: After the official voting and approval by the European and international standardization committees, the QRF would be the first European and international quality standard for MOOCs.

6. Outlook

MOOQ was a first step in our ambitious and long-term approach to improve the quality of MOOCs and online learning for all: MOOC learners, designers, facilitators and providers need to mutually learn more about their preferences, needs and demands for a better understanding and realization of quality education online. The development of the Quality Reference Framework (QRF) based on the scientific findings from the mixed methods approach and international collaboration with all interested stakeholders is a promising first milestone. We hope that the further discussion based on its submission to the European and international standardization will lead to its further refinement and approval as first quality standard for MOOCs with large-scale implementation and impact throughout Europe and worldwide.

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Effects of Task-Technology fit and Learning Styles on Continuance Intention to use e-Learning App

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Abstract The era of disruptive technologies and the 4th Industrial Revolution has transformed the education sector where 21st century education is increasingly driven by cutting-edge innovations that impact the learning experience and challenge traditional pedagogical concepts. This paper focuses on two aspects of online teaching and learning; firstly, the impact of technology fit on continuance to use the e-learning tool, and secondly the extent to which learning styles may influence the strength of continuance usage. Previous research identified the significant role that perceived fit can motivate learners in continuing utilizing e-learning system in blended learning environment. In addition, it is proposed that learning styles is a contingent variable that affect e-learning usage. Learner's individual differences to the design and delivery of teaching and learning will contribute to the overall effectiveness of the learning context and thereby influence the continuance intention to use specific learning tool. The survey questionnaire of this study presented an investigation on students of a higher learning institution that further substantiated the claim. Alternative hypotheses regarding students' attitude toward the mobile app and social influence were also examined. Despite recent assertions that the intention in continuing use of e-learning tool is strongly associated with the perceived fit between the task given and technology, the effect of individual differences on continuance intention to use e-learning tool warranted further exploration.

Keywords: learning styles, task-technology fit, continuance intention

1. Introduction

The Higher Education Ministry of Malaysia has set forth new initiatives to cultivate holistic, entrepreneurial and balanced graduates to be globally competitive in meeting the needs of Industry 4.0 (Md. Abdul Haseeb, 2018). To revamp the Malaysian higher education system, the redesigning of learning spaces followed by the use of different pedagogies would enable the curriculum to be fluid and innovative without being bound by rigid traditional practices (Ranai, 2018). This phenomenon is intertwined with digital natives identified as "Generation Z" with the common characteristics of technological and communication-savvy; ranging from high-school adolescents to university students who are most susceptible to new media trends (Fernandez-Cruz & Fernandez-Diaz, 2016; Calin and Birsanescu, 2017).

For that reason, Taylor's Integrated Moodle e-Learning System (TiMeS) was established at Taylor's University, Malaysia where learning activities of existing modules are organized on dedicated module sites to bridge the gap between the instructor and learners whilst increasing opportunities for self-study. In addition, the TiMeS mobile app was created to supplement the TiMeS site that allowed students remote access through their existing touchscreen devices. The enabled "e-immediacy" similar to the learners' social networking behaviours significantly motivates positive learning through instantaneous correspondence with the instructor and the use of emoticons to share values, feelings and emotions; at the same time participating in intellectual activities and tasks (Song,Kim & Luo, 2016; Swan, Garrison & Richardson, 2009). As a result, the system design fulfills the learners' needs in its task-technology fit (TTF) as discussed by Yu and Yu (2010).

Subsequently, characteristics of every learner determine their individual-task fit (ITF) and continuance intention with consideration of each their ongoing use and the ability to gain command and control of his or her performance. There are currently limited studies on the aspects of the individual learner in determining the continuance intention usage of e-learning tools (IU). With that said, this present study on the use of TiMeS app among Taylor's University students is two-prong; the first is the impact of technology fit that motivates the continuance of learners to use the e-learning tool and secondly; to determine whether their individual learning styles have had a significant influence among the learners in adopting the e-learning tool. This study also outlines the gaps that assumed technologies alone changed information-seeking behaviour of users through new media practices hence disregarding the role of learner personalities that adapt to methods that suit their learning needs and technology use.

1.1 Task-technology fit (TTF) and individual-task fit (ITF)

Task-technology fit (TTF) was underlined by Goodhue and Thompson (1995) as the capacity of technology that assists an individual in completing tasks. Pajo & Wallace (2001) found that the amount of time needed to learn the technology and the technical support provided by instructors to use them is imperative to learners (McGill, Klobas & Renzi, 2011). Earlier TTF research had similarly emphasized on the external contingent from the quality of technology; namely its perceived convenience and ease of use deemed important to the module, relevant and useful as well as valuable to the learner as internal contingent (Zhang et al. 2017; McGill and Hobbs 2008: Davis 1989; Swanson, 1987). In addition, features that offer gratifying rewards also affect continuance intention. Yu and Yu (2010) suggested that learners respond to character-building functions such as gamification and leaderboards that gives them a sense of individual achievement. This is highly correlated to the individual-task fit (ITF) that pointed out the different levels of technological proficiency of each learner in controlling a new learning system. While TTF attempts to engage the user with technology functions, the outcome from ITF linked to the user capacity would greatly influence the continuance to use the e-learning mobile app. Thus, we hypothesized that,

H1: TTF has positive effect on continuance intention to use e-learning mobile app (IU)

H2: ITF has positive effect on continuance intention to use e-learning mobile app (IU)

1.2 Attitude toward technology (ATT) and subjective norm (SN)

Rooted from the Theory of Planned Behavior (Ajzen, 1985), ATT and SN are direct indicators to behavioral intention. ATT acts as the internal force that reflects on positive or negative feelings towards an e-learning tool. SN, on the other hand, represents the external force governed by the perceptions of others on the e-learning tool. Chu and Chen (2016) pointed out that individuals who demonstrate higher intention to use e-learning tool are found to portray positive ATT. Further studies proposed that individuals with higher SN are more likely to use e-learning tool suggested by others (Ajzen,1985; Parkes 2013). As SN is a normative influence motivated to comply with the views of reference groups, ATT serves as salient indicator to learners' intention to use e-learning tool (Taylor and Todd, 1995). The effect of SN on IU however, is inconsistent. Chu and Chen (2016) further contended that the strength of SN on IU is likely to be altered by social sanctions. The inclusion of ATT and SN demonstrates the importance of internal and external force implications where an individual who holds negative ATT towards e-learning app is likely to reference to feedback of others and would have less intention to continually using the app. Nevertheless, learners at Taylor's University are responding positively towards the TiMeS app. Thus, we hypothesize that,

H3: ATT has positive effect on continuance intention to use e-learning mobile app (IU)

H4: SN has positive effect on continuance intention to use e-learning mobile app (IU)

1.3 Learning styles (LS)

Individual learning styles are seen as an equally important variable in the relationship between the continuance of e-learning tools with ATT. The Kolb Learning Style Index (LSI) comprise of four paradigms (Diverger, Assimilator, Accommodator and Converger) which each literally describes its learner traits in conceptualizing and processing new knowledge (Manochehr, 2006; Chapman, 2006; Kolb & Kolb, 2005a; Kolb & Kolb, 2005b). Kolb had postulated that despite differences in reactive ATT and behaviours; all of the learning styles placed emphasis on working independently. However, only Assimilators appreciate the presence of a facilitator to demonstrate and provide a nurturing setting such as lectures. The addition of an e-learning tool would allow instructor-learner relationships to thrive both inside and in the classroom through communicative functions enabled by the app whilst also giving learners space to grow. The level of guidance for the learner is not limited, instead it is further enhanced by physical and remote attentiveness.

Honey and Mumford (1989) had also separated four learner aspects, namely Activists, Theorists, Reflectors and Pragmatists. Firstly, Activists benefit from hands-on activities such as games and simulations. In contrast, Theorists learn best from activities that utilize their analytical skills. Meanwhile, Reflectors enjoy brainstorming and problem-solving activities; whereas The Pragmatists in their literal sense prefer tasks that have future job-related implementations. Opposing schools of thought questioned the reliability such learning styles where there is limited evidence of such categories in guaranteeing success in learner performance, particularly through learning technologies (Alves, Miranda & Morais, 2014). However, similar to Kolb's and Honey and Mumford's models, three LSI from Felder and Silverman (1988), Myers-Briggs (Myers & McCaulley,1985) and Gregorc (1985) also extracted paradigms that are dependent on the learners' existing skills such as deduction, abstraction and strong visual or verbal dimensions. In addition, the paradigms of the LSIs reveal sequential or global understanding that sees a linear learning progress. Subsequently, these LSI are critical of learners choosing methods that suit their aptitude and self-confidence that was build in their prior learning. Therefore, we hypothesize that;

H5: The impact of task-technology fit (TTF) on continuance intention to use e-learning mobile app (IU) is affected by learning styles (LS)

2. Methodology

The sample consisted of 168 undergraduate students who enrolled to full-time courses at Taylor's University Malaysia. The participants are aged between the range of 18 to 25 with a mean age of 19.85 years, and the sample comprised of more female (n=95) and male (n=56). As indicated in Table 1, more than 93.28% of the participants have used the e-learning mobile app for more than one month, and most of the participants are using the TiMeS e-learning mobile app on a weekly (35.76%) and daily (45.03%) basis.

Table 1: Description of the subjects.

	Items	*n*	%		Items	*n*	%
Gender	Male	56	37.09	**Experience of using TIMES mobile app**	More than 2 years	9	5.96
(n=151)	Female	95	62.91		More than a year	32	21.19
				(n=151)	7 - 12 months	33	21.85
Age	18-21	133	88.08		1-6 months	67	44.37
(n=151)	22-25	18	11.92		less than a month	10	6.62
				Frequency of using TIMES mobile app	Almost every hour	1	.66
					Daily	68	45.03
				(n=151)	Weekly	54	35.76
					Less often	28	18.54
					Never	0	.00

The sampling pool fulfilled the following conditions: (1) the course included e-learning activities for more than three weeks; and (2) the participants have installed the e-learning mobile app for more than three weeks. As a result, final sample of 151 participants resulted with 17 participants eliminated from further analysis either because they did not complete the questionnaire or did not satisfy the sampling criteria. In order to make the sample representative, we asked the instructors of different specializations (such as humanities, education, management and science) for the permission to disseminate the questionnaire to the class via TiMeS module site. In addition, students were informed about the research objectives and their participation is voluntary basis. All responses were anonymous to ensure the students' privacy is protected.

2.1 Measures

Participants completed an online questionnaire that included multiple items measuring the task-technology fit (McGill and Klobas, 2009; Schmitt et al., 2008), individual-task fit (Yu and Yu, 2010), learning styles (Honey and Mumford, 1992), subjective norm (Sentosa and Mat, 2012; Yu and Yu, 2010), attitude toward the e-learning app (Baker et al., 2007; Park, 2009; Taylor and Todd, 1995), and intention to use (Liu et al., 2010; Teo and Noyes, 2011) (see Table 2). Each item was measured on a 5-point Likert scale with values ranging from 1 (strongly disagree) to 5 (strongly agree). The subscale for each variable were determined through factor analysis procedures. The TTF subscale consisted of 8 items (α = .92), the ITF subscale consisted of 3 items (α = .86), the SN subscale consisted of 3 items (α = .79), the ATT subscale consisted of 7 items (α = .94), and the the intention to use mobile app subscale consisted of 6 items (α = .94). Besides, each learning style (activist, reflector, theorist and pragmatist) was captured by 20 items, and the cronbach's alphas for the activist, reflector, theorist and pragmatist were .93, .95, .94 and .94, respectively.

Table 2: Variable definitions and measurements

Code	Measurement Construct	No. of items	Sources
TTF	Task-technology fit	8	McGill & Klobas, 2009; Schmitt et al., 2008
ITF	Individual technology fit	3	Yu and Yu (2010)
ATT	Attitude towards e-learning (TIMES) mobile app	7	Baker et al., 2007; Park, 2009; Taylor and Todd,1995
SN	Subjective norm	3	Sentosa & Mat, 2012; Yu & Yu, 2010
LS	Learning styles	80	Honey and Mumford, 1992
IU	Continuance to use e-learning mobile app	6	Liu et al., 2010; Teo & Noyes, 2011

3. Result

The effect of task-technology fit (TTF) and individual-task fit (ITF) on continuance intention to use e-learning mobile app (IU). To the test the effect of TTF on IU, we ran the correlations test and the result indicated that TTF and IU are significantly correlated, r = .67, p = .000. A simple regression was used to test if students' perceived TTF predicted their continuance intention to use the mobile app. The results showed a significant relationship between TTF and IU (p = .000), and the TTF predictor explained 45% of the variance [R^2 = .45, F(1, 149) = 123.02]. Similarly, the ITF and IU are significantly correlated, r = .61, p = .000. The result from a simple regression showed that students' perceived ITF predicted their continuance intention to use the mobile app, which ITF elucidating 37% of the variance [R^2 = .37, F(1, 149) = 88.1]. In addition, multiple regression analysis was used to examine if the perceived fit (TTF and ITF) significantly predicted IU. The result revealed that both TTF (β = .57, p = .000) and ITF (β = 1.08, p = .001) significantly predicted IU, which these two predictors explained 49% of the variance (R^2 =.49, F(2,148)=71.5, p<.001). Taken together, TTF is a better predictor than ITF in the context of intention to use e-learning mobile app with higher correlations (r = .67) and variance (R^2 = .45). Students' judgment of match/mismatch between the task and technology greatly influence their intention to use the e-learning mobile app. Aligned with the previous literatures (McGill and Klobas, 2009; Schmitt et al., 2008), findings suggest that both task and technology characteristics are key determinants to utilization of e-learning mobile app. To encourage continuance usage, the instructor has to ensure the task given fit well with the features of the mobile app.

The effect of attitude toward e-learning mobile app (ATT) and subjective norm (SN) on IU. To the test this effect, we ran the correlations test and the result indicated that TTF and intention to use were significantly correlated, r = .83, p = .000. A simple regression was used to test if students' ATT predicted their IU. The results showed a significant relationship between ATT and IU (p = .000), and the TTF predictor explained 70% of the variance [R^2 = .70, F(1, 149) = 340.93]. Supporting the argument by Karaali, Gumussoy and Calisir (2011), ATT is closely related to the favor of continuance usage of e-learning tool. The positive ATT from student will lead to favorable behavioral intention (e.g. continuance to use TiMeS mobile app). Contrarily, negative ATT will create unfavorable behavioral intention where students would not continue to use app. Further to this we examined the relationship between SN and IU, and the result indicated that TTF and intention to use were significantly correlated, r = .81, p = .000. A simple regression was used to test if SN predicted students' IU. The results showed a significant relationship between SN and IU (p = .000), and the TTF predictor explained 66% of the variance [R^2 = .66, F(1, 149) = 289.34] (see Table 3). According to past literature (Chu and Chen, 2016; Venkatesh & Davis, 2000), the stronger SN would contribute to higher intention of e-learning use among students. The findings support this claim in which the participants' continuance intention to use the e-learning mobile app increased 1.79 when participants demonstrate positive SN. This suggests that participants are concerned about their friends and lecturers' opinions on e-learning tools usage, and value interpersonal relationships.

Table 3: Results of the linear regression analysis

	Effects			β	SE (B)	B	t	*p*	*F*	R^2	Adj. R^2	*r*	Support
H1	TTF	→	IU	.57	.05	.67	11.09	.000	123.02	.45	.45	.67	Yes
H2	ITF	→	IU	1.08	.12	.61	9.39	.000	88.10	.37	.37	.61	Yes
H3	ATT	→	IU	.77	.04	.83	18.46	.000	340.93	.70	.69	.83	Yes
H4	SN	→	IU	1.79	.11	.81	17.01	.000	289.34	.66	.66	.81	Yes

Table 4: Results of the multiple regression analysis

	Effects			**B**	**SE (B)**	**β**	**t**	**Sig. (p)**	***F***	**R2**	**Adj. R2**	***r***
	LS → IU							.000	12.51	.26	.24	.51
	Constant			6.88	2.45		2.80	.006				
	Activist			.11	.04	.27	2.96	.004				
	Reflector			-.05	.05	-.14	-1.16	.247				
	Theorist			.15	.06	.37	2.67	.009				
	Pragmatist			.01	.04	.03	.30	.764				

The moderating effects of learning styles (LS) on continuance intention to use e-learning mobile app (IU). To test the hypothesis that the IU is a function of multiple factors, and more specifically whether LS moderates the relationship between TTF and IU, a hierarchical multiple regression analysis was conducted, First, two variables were included: TTS and LS. These variables accounted for a significant amount of variance in IU, R^2 =.471, $F(2,148)$ = 65.8, p<.001. In this light, we also found that TTS significantly predicted IU (β = .503, p = .000), as did LS (β = -.019, p = .025). To avoid potentially problematic high multicollinearity with the interaction term, the variables were then centered and an interaction term between TTS and LS was created (Aiken & West, 1991). The interaction term between TTS and LS was added to the regression model, which accounted for a significant proportion of the variance in IU, R^2 = .5208, $F(3, 147)$ = 53.25, p = .038, b = - .002, t(147) = -2.096, p < .05. Examination of the interaction plot (see Figure 1) showed an enhancing effect that as LS and TTS increased, IU increased. Students who demonstrated high TTF, believed that the e-learning mobile app fits with the tasks given are more likely to use the e-learning app regularly. In addition, their learning styles does affect the strength of IU. When students have higher preferences in learning styles, they demonstrate higher TTF and more likely to continue with the use of e-learning app. Thus, H5 is supported.

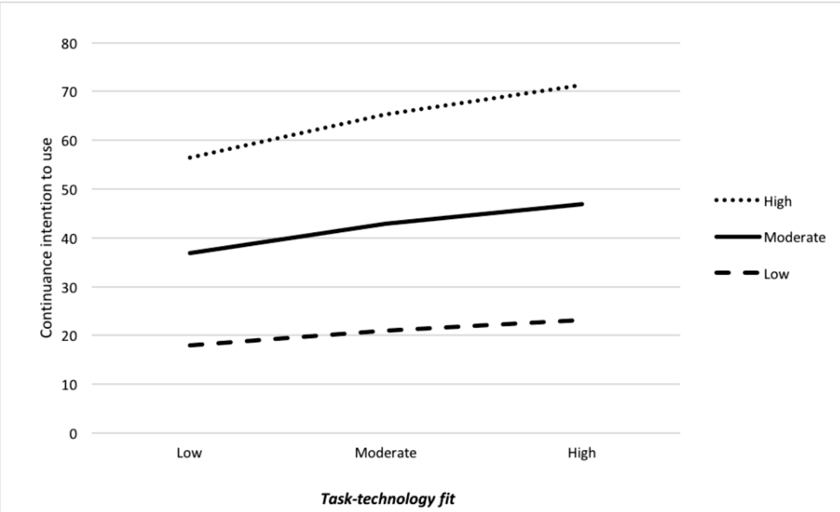

Figure 1: Moderation of the effect of learning styles on strength of continuance intention to use e-learning app

The analysis of the frequencies of the learning styles preference data revealed that the Pragmatist group was the highest category, with more than 148 participants who recorded as moderate Pragmatist (n = 87) and high Pragmatist (n = 61). The Reflector category represented the second highest that includes 147 participants, with moderate Reflector (n = 40) and high Reflector (n = 107). Consistent with Rassool and Rawaf (2008)'s study, our findings revealed that some students exhibited dual learning style category. For instance, students whose scores were high in Activist were also high in Theorist. To understand the effect of each of these learning styles (activist, reflector, theorist and pragmatist) on IU, we ran another multiple regression test. The result indicated that the model explained 25.5% of the variance and that the was a significant predictor of IU, $F(4, 146)$ = 12.51, p = .000. While Activist and Theorist contributed significantly to the model, with (β = .106, p =.004) and (β = .148, p = .009) respectively, Reflector (β = -.025, p =.25) and Pragmatist (β = .013, p =.764) did not (see Table 4). According Mumford (1992), Activist student interested in taking up new challenges and experiences. For Activist student, learning new tools (e.g. e-learning app) matches their interest and they are looking forward to how different tasks are implemented through the new platform. As for Theorist students, their intention to continually using the e-learning app is determined by the match/mismatch between the tasks given because they pay greater attention to detail and prefer clear objectives. If the learning outcomes of the activity is clearly outlined, they will likely to use the e-learning tool constantly. Ultimately, the use of e-learning app (e.g. TiMeS) seems more appealing to Activist and Theorist students. Students who are active in seeking new experiences, and students who prefer to have their learning activities to relate to learning outcomes are the potential groups that respond actively in activities conducted on e-learning app.

4. Discussion and conclusion

This study examined the effect of perceived fit (TTF and ITF), attitude and subjective norms on students' continuance intention to use e-learning app. Our study further investigated the students' continuance intention to use e-learning app by considering student differences in learning styles (activist, reflectors, theorists and pragmatists). Data collected from 151 participants verified the developed hypotheses, and few noteworthy findings are identified. First, there is a stronger relationship between TTF and IU rather than ITF in the context of continuance intention. Learner perception of match or mismatch between the technology characteristic and task characteristics affected their intention on continuance usage of e-learning (e.g. TiMeS) mobile app. The implication here is the instructor shall consider the features and functions of the TiMeS mobile app before they design the learning activities. Although the TiMeS mobile app is increasingly becoming the main platform for e-learning activities, it is rather a hasty attempt to use the same approach as other platforms. Considerations such as the learning outcomes, timeliness, accurateness and usefulness of the information need to be addressed when the instructor intend to carry the activity via TiMeS mobile app. Different from other types of mobile app, e-learning app focuses on facilitating individual learning opportunities, and encouraging interaction between learners. To encourage students' continuance intention to use the e-learning mobile app, more thoughtful activities that guide that learning and promote their interest in learning are highly substantial.

Second, our findings suggested that ATT presented significant positive correlations to continuance usage of e-learning tool. ATT appeared to have higher effect on IU as compared to other factors. This result was compatible with findings from previous literatures (Baker et al., 2007; Park, 2009; Taylor and Todd, 1995) and proved the importance of ATT in predicting the favorable outcome of IU. Findings revealed that the continuance intention to use e-learning mobile app is also likely to be affected by SN. Acting as a normative variable, the opinions from others (e.g. friends and instructors) could urge students to use the e-learning tool regularly. In collectivist culture, Malaysia is depicted as group oriented and interpersonal relationship is being placed as a high degree. Besides peer pressure, instructors often viewed as someone with higher authority and students are likely to comply with the instructions given to avoid any academic risks. Thirdly, the strength of the relationship between the TTF and IU is depending on the LS. When students demonstrated positive TTF, they are likely to use e-learning app continuously. The magnitude of this effect is amplified by the influence of learning styles. In the view of this result, we found out that Activist and Theorist students are the prospective categories that favor e-learning mobile app more. There was significant correlation between the learning styles of these two groups and their continuance intention to use TiMeS app. Students who are more open to new challenges, and favorable to outcome-based learning learning are the active users for e-learning app. Therefore, instructor should specify the learning objectives of the task given on e-learning app and use different activities (e.g. games, quiz, blog etc.) to encourage students' continuance.

Our study mainly focuses on the aspects of learner differences in determining the continuance of e-learning app usage. Apart from examining the task and technology characteristics, we take into account the various aspects (TTF, ITF, ATT and SC) that contribute to the students' continuance intention to use e-learning app. The present study addressed the research gap of in the study of TTF. Although many literatures supported the idea that ITF explained individual difference in perception of task, but the discussion is limited to one's concern of whether the task is suitable to him/ her. The notion of ITF failed to account for learner differences in learning styles. Ideally, the use of e-learning app fits well to Activist and Theorist students. Therefore, future research should also consider to include learning styles or better investigation of the impact of other e-learning tools.

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An Andragogic Perspective on Women Entrepreneurial e-Learning: Styles and Methods

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Abstract: As a result of the increasing role of technologies for learning, e-learning became an essential tool for Women Entrepreneurs. Furthermore, women entrepreneurs are adult learners with specific methods and styles of learning. They are significant contributors to the national and global economy, and therefore, it is important to have an andragogic perspective in approaching women entrepreneurs for training and learning delivery. Entrepreneurship Education (EED) is the main competence acquired by women entrepreneurs, in view to achieve entrepreneurial success, and e-learning is a component of EED. This study undertakes an andragogic perspective on Entrepreneurship Education, with its specific styles and methods of learning and investigates its impact on success. The objectives of the study are the following: (1) To investigate the impact of Entrepreneurship Education upon Women Entrepreneurs' Success; (2) To find out the methods and styles women entrepreneurs use for entrepreneurial e-learning from an andragogic perspective, in order to achieve success. The main Research Question of the study is "What is the impact of Entrepreneurship Education on Women Entrepreneurs' Success?", and the subsidiary question is "What are the methods and styles of entrepreneurial e-learning that women entrepreneurs use in order to achieve success?" Entrepreneurship Education helps learners to understand the meaning of entrepreneurship, and the entrepreneurial responsibilities, and provides them with the entrepreneurial capabilities to achieve success. This is an exploratory research with the hypothesis tested and the prediction of the impact of Entrepreneurship Education upon Women Entrepreneurs' Success. Further, the study involves a survey with 450 questionnaires distributed both by email and face-to-face to women entrepreneurs in SE Wales. The results indicates that e-learning is an essential component of Entrepreneurship Education and this is a significant predictor of Women Entrepreneurs' Success. The study demonstrates the importance of e-learning within Entrepreneurship Education and for Women Entrepreneurs' Success, and constitutes a contribution to theory. By adding to the literature on entrepreneurial e-learning, this study is a contribution to knowledge. The study constitutes also a contribution to practice by advising the policy makers to place accent on a training adapted to women entrepreneurs as adult learners, in the context of new technologies.

Keywords: entrepreneurial e-learning, methods and styles of learning, andragogy

1. Introduction

Women Entrepreneurs are major contributors to the national and global economy (Brush, 2000; Minniti, 2010; Klapper and Parker, 2010), and also, they are adult learners with specific styles and methods of learning (Sarri, 2011; Boeren, 2011; Fayolle, 2013; Czerkawski, 2016; Dixon, 2017). Entrepreneurship education is the main competence required for women entrepreneurs, in order to build strengths and capabilities to start, and develop their businesses, and achieve success. In the last thirty years, there was an increasing role of technology, and recently, the world witnesses a massive emergence of new technologies, ready to be used for business, education, communication and socialization, by women entrepreneurs. E-learning for women entrepreneurs is a component part of Entrepreneurship Education, in other words, means 'entrepreneurial learning' by means of technology. Although, recent management literature focused on the state of management learning, most of the research studies had a non-gender perspective, addressing topics from a male point of view. Hence, very few articles and academic papers regarded this topic from a gender perspective, and included female entrepreneurs, considering them as managers and leaders. According to Salaman and Butler (1994), British male managers were untrained and uneducated, and figures indicated that only 15% of 90,000 male managers received a form of education and training in management. Moreover, 2.5 million managers in the UK, hardly received one day training per year (Salaman and Butler, 1994). Consequently, research (Salaman and Butler, 1994) concluded that management training and education in the UK was behind West European countries (West Germany and France), USA and Japan. Furthermore, the complexity and the competition within the global economy, required male and female managers to learn, and much emphasis was placed upon the 'management learning' (Salaman and Butler, 1994), which faced the challenge of Information Communication Technologies (ICTs) and later, the new emerging technologies (Indrupati and Henari, 2012; Dixon, 2017). Besides this concern (management learning), two new issues emerged: 'learn how to learn' (Salaman and Butler, 1994) and 'use technology to learn'. As opposed to male managers and their education, women entrepreneurship was expanding. This was the time when women entrepreneurship phenomenon, emerged across the world, as a result of ICTs, which permitted women the access to education, set up and develop businesses from home, while performing their family duties. Whilst much of the literature at that time, emphasised the lack of education and training for the male counterparts, some literature (Wellins, 1994) began to describe the unprecedented concerns: competitions, globalization, and technological change, and highlighted the latest requirement for entrepreneurs and employees: participation, flexibility and autonomy. There was the empowerment and the initiation of self-directed development and the culture of self-directed teams (SDTs) of employees (Wellins, 1994). These (participation, flexibility and autonomy) were actually attributes suitable for women entrepreneurs as adults, who were juggling between home and work, and were asking for *flexibility, participation and autonomy*. Thus, these were the features of the ICTs and new emerging technologies, and the main attributes provided to women entrepreneurs, by working flexible from home, in order to achieve fulfilment and success. It infers that, these were new forms and answers to education, business, communication and socialization, shaped by the new challenges and required by the new complexities (Kolb, Lublin, Spoth and Baker, 1994; Pall, 2011). Besides these realities, there was a massive change in the labour force in the UK, characterised by an *increase in women participation*, trend which is predicted to continue over the next decades (Alimo-Metcalfe, 1994). Women entrepreneurs were considered "an untapped reservoir" and major contributors to the every economy (Alimo-Metcalfe, 1994, p. 224). According to research most of the women were employed or had businesses in sectors such as: retails, catering, education, health and local government (Alimo-Metcalfe, 1994).

2. Literature review

2.1 The adult learners and andragogy

This study argues that women entrepreneurs, are adult learners, and hence, complying not with pedagogy, but instead, with the andragogy. Pedagogical assumptions were created by monks, and were based on teaching essential skills to children and based on the reaction of children to teaching (Knowles, 1980). Whilst, the transmission of knowledge is sufficient for teaching children, a contrasting situation happens when teaching adults (Knowles, 1980). The transmission of knowledge, according to philosopher Alfred North Whitehead, is appropriate only when the time span is bigger that the life span for an individual (Knowles, 1980). As a result of the time span being shorter than the human life, teachers face rapid change of knowledge, which can become rapidly obsolete, making knowledge transmission ineffective (Knowles, 1980). It follows that, the education is no more based on the transmission of known knowledge, but instead, the education is a continuous process, a long life learning process (Knowles, 1980). Adult learning therefore, suggests that women entrepreneurs create, collect and control external and internal knowledge. Furthermore, the learning process begins by empowering women entrepreneurs, who finally are able to identify and solve problems (Leonard-Barton, 1994). According to Leonard-Barton (1994), learning leads not only to knowledge embedment by means of participation in networks, but attracts also innovation within the entrepreneurial process.

Andragogy is in fact a deviation from pedagogy, or in other words, andragogy is a shift from dependent learning, towards a self-directed learning (Knowles, 1980). Whilst pedagogy means 'the art and science of teaching children', andragogy, is defined as 'the art and science of helping adults to learn' (Knowles, 1980, p. 43). This infers that, the adults learn without a teacher. Within the pedagogical model, the learner is a dependent individual. Within the andragogical model, the learner is independent (Knowles, 1980), with motivation and readiness to learn, with own experiences and styles of learning, and with the tendency towards self-directed learning (Knowles, 1980). This study regards women entrepreneurs from an andragogical perspective, as independent and self-directed learners, who can learn within the traditional face-to-face model, or by means of information communication technologies (ICTs) and new emerging technologies, synchronously or asynchronously.

2.2 E-learning, styles and methods of learning

As a result of the present technological age, businesses, education, communication and socialization requires individuals, men and women with technological capabilities. Despite young women entrepreneurs using digital technologies such as: laptops computers, mobile and cellular phones, game playing and social networking, from an early age, however, there are discrepancies between women entrepreneurs, specifically between younger women entrepreneurs and older women entrepreneurs (Fee, 2009). Thus, some women entrepreneurs could be called digital natives, whilst other women entrepreneurs might be named digital immigrants, just because they adopted and adapted later in life to these technologies (Fee, 2009). In order to succeed in business, and without considering their age, women entrepreneurs need to embed within their enterprises, the element of technology, whether this is in the form of software applications, cloud platforms, digital platforms, cellular and mobile phones or tablets and laptops. Moreover, they have to learn continuously and update their technological and entrepreneurial knowledge. Hence, e-learning is present and integrated not only within the university curriculum, but also, within the entrepreneurial digital platforms and within technological networks of women's entrepreneurship. Both digital natives and digital immigrants, adopt the technological culture and immerse within it (Fee, 2009). It is not a surprise that women entrepreneurs are digital and use e-learning to advance their knowledge and businesses. Learning places 'the learner' at the centre of 'the circle' providing him/her with a purpose which is to learn and do better than before (Fee, 2009).

The American Society for Training and Development (ASTD), defined *e-learning* as "a set of applications and processes, such as web-based learning, virtual classrooms and digital collaboration" (Fee, 2009, p. 15). This definition was developed in the following years, and became more comprehensive. Thus, *e-learning* for adult learning and women entrepreneurs particularly, regards everything that is provided or enabled by means of technology, with the purpose of learning (Fee, 2009). It follows that, e-learning includes: the process of gathering information, knowledge, skills, capabilities, techniques and methods by means of digital platforms and digital social sites and networks (Facebook, LinkedIn, Twitter, Instagram, Pinterest and cloud platforms), mobile phones, tablets, iPhones, iPad, Androids and laptops (Alshamaila, Papagianidis and Li, 2013).

In other words, based on Fee's (2009) definition, the authors of this study define *E-learning* as an approach to adult learning advancement, a range of learning methods for gathering information, by employing digital technologies, which permit, enrich and supply learning for women entrepreneurs. Although, there is *an informal learning* with no particular design, that women entrepreneurs collect, by means of technology (social media for instance), knowledge and information, there is also *a formal* embedded *adult learning* for women entrepreneurs, which can incorporate, according to Fee (2009), the following three components: technological component, learning content and learning design (Clark and Mayer, 2008). These can be accessed via server and by passwords. However, this study focused on the more informal lifelong adult learning, which implies synchronous or asynchronous e-learning. Although, most of the research on adult learning refers to the pedagogical model, which is not suitable, neither relevant for adult learning and women entrepreneurs, the formal learning *design component* should incorporate elements of andragogy. Furthermore, the informal women entrepreneurial learning should also have included elements of Andragogy (the art and science of teaching adults), and a more self-directed learning approach (Fee, 2009).

According with Fee (2009) *e-learning* should incorporate methods such as: coaching, guided work-based learning, action learning, distance learning and online learning. However, the authors of this paper argued that *e-learning for women entrepreneurs*, in its latest form, includes all the informal learning mediated by ICTs and new emerging technologies (Facebook, Twitter, LinkedIn, You Tube, Skype, Mobile phones, iPhones, iPad, laptops, tablets, Androids, computers, Instagram, Pinterest and cloud computing), which creates a learning culture and empowers women entrepreneurs to learn self-directed and flexible (Pall, 2011). According to recent research by Northey et al. (2018), learning is no more limited by space and time. There is a "here and now" characteristic of learning (Pall, 2011; Martin and Ertzberger, 2013, in: Northey et al., 2018). Technological platforms achieve now a better role than being just storage for learning material, and this role is the facilitation of learners' interaction (Northey et al., 2018). Moreover, Northey et al. (2018) emphasised that, the new emerging technologies such as smart phones, tablets and laptops, permit the access of the above mentioned platform anytime and from anywhere, which allow learner's flexibility and independence, besides fulfilling family responsibilities. In addition, research (Northey et al., 2018) defined one of the most important digital platforms, the Facebook, as being an asynchronous platform, which provides collaborative learning for women entrepreneurs.

Although, there are various models of learning (online, integrated online and offline, self-managed e-learning, live e-learning and electronic performance support), this study will only discuss Kolb's (1984) model of learning. This model of learning comprises four phases: experiencing, reflection, conceptualizing and experimenting. The adult learner chooses a preferred style of learning. Thus, we distinguish four types of learners: activists, reflectors, theorists and pragmatists. Further, there are different learning styles: visual (learning by looking), auditory (learning by listening and speaking), and kinaesthetic or tactile (learning by doing and touching) (Fee, 2009). Women entrepreneurs are good social communicators and as a consequence, they are flexible learners, self-directed, visual, auditory and kinaesthetic. In addition, e-learning, according to research by Fee (2009), moved away from isolated learning, towards a more comprehensive approach to group and networking learning.

2.3 Entrepreneurship education and women entrepreneurs' success

In order to discuss Entrepreneurship Education for women entrepreneurs, the authors had to divide this concept into two components, of equal importance: the adult learning process and the adult learner. The learning process comprises an entire range of methods and techniques, used to transmit the knowledge, together with the ICTs and new emerging technologies which are embedded within it and facilitate women entrepreneurial learning. The second component incorporated within the Entrepreneurship Education is the 'adult learner' with its technological capabilities and his/her styles of learning by face to face or electronically, by means of technology. The way, in which these components interact with each other, is crucial for the learning outcome and academic achievement, as well as for business growth and success. Thus, according to Northey et al. (2018) Facebook as a technological platform is critical for social interaction, collaborative learning between women entrepreneurs, learning achievement and business success. The participation itself within social and e-entrepreneurial learning, group learning, either synchronous or asynchronous, is essential for success and impacts upon learning achievement and success (Northey et al., 2018). Collaborative learning is initiated and mediated by mobile devices such as: mobile phones, tablets, and iPhones, and is also affected by these (Cerratto Pargman, Nouri and Milrad, 2018). Furthermore, according to these authors, the mediation is both spatial and emotional. In addition, Pimmer, Linxen and Gröhbiel (2012) highlight that, the mobile phones, which are considered educational instruments, provide the means to access the social networks sites (Facebook) as informal learning environments.

Although, education is crucial for human life (Dewey, 1921) and key for survival (Schumacher, 2011), there is a lack of studies approaching entrepreneurial learning for women entrepreneurs. However, the studies undertaking such research have different topics and interpretations upon the phenomenon. Thus, whilst Davis (2012) highlighted the lack of learning or training for women entrepreneurs, Gertner (2013) found a positive relationship between education and entrepreneurship. According to Bridge et al. (2009) entrepreneurship education has two concepts: (1) education for entrepreneurial skills and (2) learning to create an enterprise (Bridge et al., 2009). Following the increase in the number of women entrepreneurs, it is required from HEI to employ an adequate perspective in approaching women entrepreneurs for learning and training (Davis, 2012). Furthermore, within such process, gender perspective is essential (Ettl and Welter, 2010). Although, there are many types of learning that women entrepreneurs can use: formal, non-formal, trial and error (Sarri, 2011), this study focuses specifically on the adult informal type of learning (Czerkawski, 2016) and virtual learning (Dixon, 2017) and their effect for women entrepreneurial success.

There are many definitions on growth. Thus, Coulter (2000) depicts growth as the increase in the level of output. Nevertheless, there are no definitions focusing on growth from a gender perspective (Costin, 2012). Hence, Dalborg, von Friedrichs and Wincent (2012) argued that women entrepreneurs have different perspective on growth, emphasising the qualitative side of growth (good reputation, customer relationship) (Brush et al., 2004; Costin, 2012). On the other hand, the concept 'success' is defined as "the achievement of some objectives" (Bartlett, 1988, p. 48). In Bartlett's view, success equals growth. Moreover, as Bartlett (1988) argued, growth is an aspect of success (Sullivan and Meek, 2012). This study considered both aspects 'success': used sales and profit as a measure of growth and the intrinsic or qualitative aspects of success. In support of such argument, the authors of this study, mention the research by Mitchelmore, Rowley and Shiu (2013), which emphasised the competencies for success, and implicitly, highlighted the qualitative aspects of 'success'. Further research by Reijonen and Kompulla (2007) indicated that business growth and success are influenced by training and education. Martin Cruz et al. (2009) linked entrepreneurship education to business success. There is a positive relationship between education and business outcome (Davis, 2012). Role models impact positively on success (Lockyer and George, 2012). In addition, learning and networking are affecting business growth and success (Andersson and Tell, 2009; Peris Bonet, Rueda Armengot and Galindo Martin, 2011). According to the above literature review, the authors hypothesised the following directional hypothesis (Bryman and Cramer, 1997; Pallant, 2013; Tomos, 2017):

H1: Entrepreneurship Education has a positive impact upon Women Entrepreneurs' Success.

3. Research method

The epistemological position of this study is a positivist philosophy, which entailed hypothesis tested and permitted explanation of the phenomenon, and knowledge confirmation (Bryman and Bell, 2011). The study designed a sample with 450 women entrepreneurs, and employed probability random simple sampling technique, achieving 30% response rate. By designing a bigger sample, and having a good response rate, the authors reduced the chance of sampling errors and increased in the meantime the accuracy and representativeness of the sample (Bryman and Cramer, 1997; Bryman and Bell, 2011). The research design provided the study with a cross-sectional design, with data collection developed at a certain moment in time, more specifically, across three months June-August 2015. Moreover, this is a regional study and a seminal research, focused on women entrepreneurs in one of the poorest regions of the United Kingdom, within the SE Wales, which is characterised by lower rate of economic development, and by inherited poor entrepreneurial culture and low economic inheritance (Fotopoulos and Storey, 2017). The study used the quantitative research method, which is in line with the positivist philosophy, and employed survey, as the main instrument for data collection, with questionnaires. The questionnaires included aspects related to demographic data, entrepreneurship education, information communication technologies and entrepreneurial success. The authors applied a triple method for data collection, by distributing the questionnaires by email, telephone and directly through self-completion questionnaires. However, the survey with questionnaires, sent to women entrepreneurs by e-mail, was unsuccessful. The most successful way proved to be the face-to-face survey with self completion questionnaires, distributed directly to women entrepreneurs on the High Street, in commercial area, participants to networking events, fairs and exhibitions, and collected after half an hour by the researcher (Bryman and Bell, 2011). For the elucidation of the audience, the authors of this paper highlighted that, this research is part of a more comprehensive and holistic research upon women entrepreneurs' success, and therefore, restricted aspects only are provided here, in order to address the hypothesis and the research questions of this particular study. The main concepts of this research are Entrepreneurship Education and Women entrepreneurial success. Furthermore, the constructs of the concepts are reliable, and the reliability is provided by the Cronbach's Alpha values, which varies between 0.617; 0.704; 0.857 and 0.946 indicating marginal, fair, good and excellent reliability for the four Likert summative scales of the questionnaire (Pallant, 2013; Tomos, 2017). The quantitative data was gathered by survey with questionnaires, and coded by using a complex Coding Book, which was followed by data processing and data analysis with SPSS (Connolly, 2007; Argyrous, 2014; Pallant, 2013). For the analysis of the quantitative data, the authors used correlation, regression and factor analysis (Pallant, 2013).

4. Findings and discussions

Below, the authors present the objectives and the main findings, and the result of hypothesis tested:

Objective 1: To investigate the impact of Entrepreneurship Education upon Women Entrepreneurs' Success; Objective 2: To find out the methods and styles women entrepreneurs use for entrepreneurial e-learning from an andragogic perspective, in order to achieve success.

> *Hypothesis: Entrepreneurship Education has a positive impact upon Women Entrepreneurs' Success.*

The results of the analysis are presented in the following table (Table 1):

Table 1: Statistical analysis

Hypothesis	Findings	Statistics	Results
H1: *EED has a positive impact on WES.* Hypothesis Reformulated: *EED impacts on WES.*	Exploratory study. Half Supported hypothesis	Descriptive statistics. Simple Regression Analysis. Total Factor Analysis and Extraction. Multiple Standard Regression Analysis (MSRA)	79.7% OF 149 valid cases answered "EED enhances business success". r=-0.197; sig=0.008 p<0.05 TFA predicts DV (TFA MSc)

Source: ©Tomos, 2017

Table 2: Variances explained by factors within the dataset

Factor	KMO	Sig (Bartlett's Test of Sphericity)	Number of factors extracted	FA/Explained variance	Labels allocated to factors
FA EED	0.637	0.000	2	43.7%	1) Learn from participation; 2) Learning preferences and styles of learning.

Source: ©Tomos, 2017

The analysis demonstrated the impact of EED on women entrepreneurs' success. Although, there is a significant impact, the effect is however negative, fact which demonstrate the complementarity of the EED upon WES. This explains that EED does not impact on its own on WES, but together other factors, to be further explored. The results also demonstrated that women's entrepreneurial interpretation and view of success (Dalborg, van Friederichs and Wincent, 2012) are different from their male counterpart. Thus, women entrepreneurs' success embeds both qualitative and quantitative components, being expressed as intrinsic and extrinsic elements of the same phenomenon. Although, the success could be explained as growth in the sales and profit, the same concept, could also be interpreted in terms of good relationship with customers, flexibility, family/work balance, allowing women to juggle between family and work, self-esteem, social life, participation in community life, access to knowledge, information, participation and learning (Brush et al.; Costin, 2012). The success is the result of a complex relationship between factors working together to meet women entrepreneurs' needs, and entrepreneurial learning, and Entrepreneurship Education (which incorporates e-learning) is just one of these factors. Women's entrepreneurial success needs to have a more holistic perspective (Andersson and Tell, 2009).

The findings showed that women entrepreneurs prefer a more informal style of learning, which is adult learning (Czerkawski, 2016), flexible, adapted to their work/life requirements. Such flexibility is met by means of technology and eventually by virtual learning (Dixon, 2017) or asynchronized technologies of learning, such as Facebook, Linkedin and Twitter, and by means of ICTs (laptops, tablets, computers, androids, iPhones, iPad, mobile phones and cloud computing). Although, women entrepreneurs use also the experiential learning and trial and error (Kolb, 1984; Sarri, 2011), it seems that a flexible informal and more virtual learning is convenient and more appropriate for juggling between family and business. This interpretation of the results, is in line with research by Czerkawski, 2016) and Dixon (2017). Furthermore, women entrepreneurs like also a participative style, with networking and meeting in order to share information in a face-to-face manner and to strengthen each other. These confirm the adult perspective or the andragogical perspective (Boeren, 2011), which has to be considered when approaching women entrepreneurs for training and learning.

5. Conclusions, contributions and implications for practice

The results of the analysis, leads to the conclusion that EED impacts upon women entrepreneurs' success. However, EED does not act alone but in combination with other factors. These results are validated by other research (Henari, 2012; Dowson et al., 2011; Roomi, 2009; Bridget et al., 2009; Tan, Zhang, and Wang, 2015; Sotiropoulos, 2014). This research together with its findings, is contributing to the increase in awareness of the crucial role of women entrepreneurs for the region and for the country. The study is a contribution to knowledge due to the region selection and the rationale provided for this. Further, the research is a contribution to theory as a result of the andragogic perspective upon women entrepreneurial e-learning. In addition, the research is a contribution to practice, by raising awareness of the imperative for designing an e-educational programme for women entrepreneurs across the country, in view to develop an entrepreneurial culture. Furthermore, academic research on women entrepreneurs' e-learning and the region under discussion are non-existent.

Besides this, the study raises awareness of the imperative of an Action Plan (Rhisiart and Evans-Jones, 2016) for the development of the entrepreneurial culture by designing and embedding an Educational and Entrepreneurial Programme for women entrepreneurs and for young women wishing to set up businesses, at the local, regional and national levels. The emerging idea of this study is firstly, the adult learning perspective (andragogy) for women entrepreneurs, by means of technology. A second idea is the design of appropriate programmes for women entrepreneurial learning, implying more informal styles of learning and gathering knowledge, within a participative and interactive way, with mixed participation, both online and face-to-face, in a participative manner, by networking. Thirdly, the study discovered a lack of research into the teaching methods and learning styles, practical and appropriate for women entrepreneurs' needs in terms of time, location, flexibility (Fayolle, 2013). The study attempted to fill the gaps in the research by approaching such relevant research topic. The study is important also for emphasising the role of gender (Ettl and Welter, 2010) in choosing adequate perspective (andragogic) for training and learning women entrepreneurs (Davis, 2012). Entrepreneurial learning for women entrepreneurs is a lifelong learning process which determines the level of knowledge and their identity (Honey and Mumford, 1992; Jarvis, 2004; Higgins and Aspinall, 2011).

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Using web Radio as a Pedagogical Tool: Skills Development and Collaborative Learning

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Abstract: Radio has been used in education since the beginning of last century. With the rise of the internet, web radio came into life and provided new possibilities for web radio content (e.g. video apart from voice and music), asynchronous broadcast, and cooperation between students from different schools. In this paper, we present our experiences with the NEStOR (Networked European School Web Radio) project, which promotes web radio as an educational tool. The NEStOR project employs the European School Radio, a collaborative web radio station, where schools participate with both entertaining and educational radio shows produced exclusively by students (http://www.europeanschoolradio.eu). This paper presents the skills and the dexterities that students can develop, when web radio process is used as a pedagogical tool within this framework. As part of an introduction to digital tools, creating a web-radio production allows students to get involved in group projects, where they can discuss and reflect on various subjects (intra- and extra-curricular), and collaborate in order to produce a radio show. Moreover, while students search information online for their radio production, they gain information literacy skills and develop critical thinking, as they have to filter the information that is available on the internet. The process of finding information and music for a radio show and the process of recording the final production help students to develop also media literacy skills. We conclude there, that web-radio activities may be employed in classrooms to promote the aforementioned skills.

Keywords: educational web radio, learning scenarios, media literacy, information literacy, collaborative learning

1. Introduction

The use of radio as an educational tool is not new. In the United States, for example, educational radio has been used since the 1920s (Lamb, 2012). In those days, students were mainly listeners of educational radio programs. The rise of technology and the World Wide Web made producing and broadcasting radio programs easier, since recording can now be done on a personal computer without the use of special equipment, while radio programs can be transmitted via the internet, without employing a radio station. The radio broadcasted on the internet is called web radio, and offers new possibilities for learning activities, since students can easily produce and broadcast their own radio programs (Coccoli, 2014). Moreover, the appearance of Web 2.0 tools allowed the collaboration and the interaction between users as content creators in a virtual community. This development has also influenced learning activities in the context of web radio (Güney, Rizvanoglu, & Öztürk, 2013).

In this paper, we discuss skills' development and the potential for collaborative learning when learners produce their own radio programs. Such online radio programs are no longer linear broadcasted, but may also be associated with metadata, synchronized slideshows and even short video clips. The production of such digital audio objects involves various phases, such as choosing a theme, gaining knowledge on this theme, authoring a script based on this knowledge, probably choosing a soundtrack, and then recording, and mixing the audio (and possibly visual) parts of such an object. Finally, these digital objects are uploaded on the internet. Since these phases require time and effort, such productions are ideal for group work, where students in groups address different phases of the production. The whole process thus encourages the development of various skills, such as media literacy, information literacy, and collaborative skills (Boling, Castek, Zawilinski, Barton, & Nierlich, 2008).

2. Research context

In this paper, we present research carried out in the NEStOR (Networked European School Web Radio) project, which aims at developing the necessary tools and skills in order to successfully incorporate web-radio activities into educational settings. The project provides an online platform, called "European School Radio (ESR)" (http://www.europeanschoolradio.eu), which operates since 2009, and attracts more than 400 primary and secondary schools all around Europe each year (mainly from Greece and Cyprus). The ESR station broadcasts a continuous streaming audio (music), which includes radio shows from the participating schools. These schools produce entertaining or educational radio shows, which are broadcasted in the ESR platform. Such productions are either pre-recorded (students record and edit an audio file, which is then uploaded on the platform to be broadcasted later), or live broadcast (students prepare their radio show and perform live from a studio*).* Furthermore, the ESR platform provides a framework for supporting the educational aspects of web radio productions (e.g. guides, learning scenarios, and good practices).

The NEStOR project aims also at evaluating the pedagogical value of web radio, when it is incorporated into educational settings. The project employs a two-stage evaluation process. In the first stage, the learning design approach for introducing web-radio activities in classrooms, and the pedagogical value of such activities were evaluated based on feedback given by teachers (Triantafyllou, Liokou, & Economou, 2018). The results of this evaluation indicated that the introduction of web radio in schools may enable various literacies (such as media and information), and various skills (such as critical thinking, collaboration, creativity, etc.). In the second stage of the evaluation, feedback from a larger number of teachers, students, and the school community has been gathered in order to further evaluate the pedagogical potential of web radio. The preliminary analysis of the data gathered during this evaluation stage confirms the results of the first evaluation, but it has not been finalized yet. Moreover, our observations and experiences with web radio productions as intra- and extra-curricular activities since the establishment of the ESR platform agree with the evaluation results, which indicate that educational web-radio activities may improve students' media and information literacy, and provide context for collaborative learning. Based on these indications, this paper analyses the process of implementing a radio production in order to identify which aspects may improve students' media and information literacy, and how this process can be applied for collaborative learning.

In the following section, we provide the definition of media literacy, information literacy, and collaborative learning, and we present the potential of web radio productions for promoting such skills, as discussed in the literature.

3. Literature review

Web radio has been used for enhancing and motivating learning in different curriculum areas and at different educational levels. In the following, we are focusing on approaches where web radio was used for enhancing collaborative learning, as well as media and information literacy. Before reviewing such approaches, we discuss how these skills are defined in the literature.

3.1 Media literacy and information literacy

The plethora of media available in our modern world makes the need to educate media literate citizens increasingly urgent. The European Commission has underlined this fact already in 2007, and defined media literacy as: "…the ability to access the media, to understand and to critically evaluate different aspects of the media and media contents and to create communications in a variety of contexts." (European Commission, 2007). Moreover, it defined the following levels of media literacy:

> *" - feeling comfortable with all existing media from newspapers to virtual communities;*
>
> *- actively using media, through, inter alia, interactive television, use of Internet search engines or participation in virtual communities, and better exploiting the potential of media for entertainment, access to culture, intercultural dialogue, learning and daily-life applications (for instance, through libraries, podcasts);*
>
> *- having a critical approach to media as regards both quality and accuracy of content (for example, being able to assess information, dealing with advertising on various media, using search engines intelligently);*
>
> *- using media creatively, as the evolution of media technologies and the increasing presence of the Internet as a distribution channel allow an ever growing number of Europeans to create and disseminate images, information and content;*
>
> *- understanding the economy of media and the difference between pluralism and media ownership;*

- being aware of copyright issues which are essential for a "culture of legality", especially for the younger generation in its double capacity of consumers and producers of content." (European Commission, 2007)

In the literature, media literacy is often discussed together with information literacy and digital literacy. According to Hobbs (2006), information literacy "…emphasizes the need for careful selection, retrieval and choice-making in response to the abundant information available in the workplace, at school, and in all aspects of personal decision-making, especially in the areas of citizenship and health." Therefore, she continues mentioning that information literacy education "…emphasizes the critical thinking, meta-cognitive, and procedural knowledge used to locate information in specific domains, fields, and contexts. A prime emphasis is placed on recognizing message quality, authenticity and credibility." In order to emphasize the connection between the notion of information literacy and newer forms of online communication, Gilster (1997) introduced the term "digital literacy" as the ability to understand, evaluate, and integrate information in multiple formats. Other has used the term digital literacy in a restrictive way referring exclusively to the effective use of Information and Communication Technology (ICT) (Koltay, 2011). Since there are inconsistencies with the use of this term, we will use in the following the term "information literacy" to also encompass the notion of ability to understand, and to use information available in a variety of digital sources.

Bundy (2004) defined three main elements of information literacy: generic skills, information skills and values and beliefs. Generic skills relate to problem solving, collaboration, teamwork, communication, and critical thinking. Information skills concern information seeking, information use and information technology fluency. Finally, values and beliefs focus on the aspects of using information wisely and ethically, on social responsibility, and on community participation. He proposed therefore that information literacy education should provide opportunities for students to experience, reflect, and apply learning to novel contexts.

The production of (web) radio programs has been used to promote both media and information literacy in education, since it involves retrieval, filtering and dissemination of information through a communication medium. For instance, Todorova proposed the use of radio for teaching critical media literacy in a large urban Canadian university (Todorova, 2015). In this project, university students produced short radio programs narrating how they view and experience the concept of multiculturalism. She concluded that radio production in the classroom "…is soundscaping that politicizes intimacy, disrupts hegemonic discourses, and allows for teaching and learning to transgress; yet it also illuminates the ways in which self-positionality poses limitations to media literacy education that seeks to link local classrooms to a global world."

Gautam et al. (2015) employed radio for conducting an oral history project with university students. The project was based on a partnership between the university's social studies department and its public radio station. Gautam et al. found that students' information literacy skills were enforced after getting involved in the process of conducting interviews, since they had to think critically in order to decide whose perspectives to include in each project. Moreover, the process of picking up key details in an interviewee's answer, and relating them to the broader historical patterns forced students to think critically on the reasons behind specific social changes. Gautam et al. concluded that what really strengthened students' information literacy skills was that they should construct a broad historical narrative from diverse primary and secondary sources.

3.2 Collaborative learning

Collaboration (or cooperation) is working together to accomplish shared goals, while collaborative learning is the instructional use of small groups so that learners work together to maximize their own and each other's learning. Collaborative learning has its origins in Dewey's and Vygotsky's educational theories (Dewey, 2013; Doolittle, 1997). Members of such groups are responsible for learning the assigned material while making sure that all members of their group do likewise. They do this by discussing the material to be learned with each other, assisting each other to understand it, and encouraging each other to work hard (Johnson & Johnson, 2008).

Johnson et al. (1998) listed five elements essential for successful collaborative learning groups. First, there must be positive interdependence in that members of the group understand that they should learn together to accomplish their goal. Second, there must be promotive interaction in that students interact face-to-face in the group. Third, there must be individual and group accountability in that members are held responsible for their own contribution to the group's success. Fourth, there must be group processing in that members reflect on their collaborative efforts and decide on ways to improve effectiveness. Finally, there must be the development of small-group interpersonal skills such as giving constructive feedback, involving each member, and reaching a consensus.

There are studies that investigated the interaction between radio and collaborative learning. McGroathy identified benefits of planning and implementing cooperative learning activities in acquiring English as a second language by employing a radio show (McGroarty, 1989). Similarly, Lemos Tello found that there is a positive correlation between the participation of students in an online radio show with the aim to foster speaking confidence, and the use of a cooperative learning strategy (Lemos Tello, 2012). Piñero-Otero and Ramos investigated the potential of web radio for the sense of belonging creation and cohesion in higher education communities as perceived by students and professors at Aveiro University, Portugal (Piñero-Otero & Ramos, 2012). They concluded that both students and professors believe that web radio can foster development of a sense of belonging, unity, and communication in the university community (a new channel of communication internal or external) by allowing participation in and dissemination of content production.

In this paper, we discuss both skills development and collaborative learning opportunities, when web radio is used as an educational tool. In order to provide a framework for this discussion, the following section describes the different roles, which members of a radio team undertake during a radio program production, as well as the various phases of such a production.

4. The radio team and the process of a (web) radio program production

There are several people involved in a radio show production. These people undertake different roles during the preparation and the actual broadcasting of the radio show. First, there is the role of producer (or broadcaster) and the role of presenter. The producer group leads, organizes and often makes the radio broadcast. In some cases, there are people dedicated to make the broadcast (read the script, discuss, etc). These people are called presenters. The "program flow modulator" group decides when the radio show/advertisement spots will be played and makes sure to keep the arranged schedule, while the internet and multimedia group is mainly engaged with the online presence of the radio show team (web page, social media, etc.), and the communication among the members of the radio show team. Another group of people involved is the journalists or reporters, which work on finding the information that will become the texts/script of the show. They usually are also the ones to write and edit the script/texts of the show. The public relations team is responsible for promoting the show, and communicating with the audience. Finally, a radio show production requires a technical support team, which takes care of setting up and using the required equipment (computers, microphones, mixing panels, recording, etc.). In the following, we call this group of people "the radio team".

The radio team has to follow several steps for the production of a radio program. Aspinall (1973) identified four phases in a radio program production: assignment, preparation, rehearsal, and performance. The assignment refers to the program that the producer is assigned to make. Whatever the assignment, Aspinall suggests that the producer carefully considers the goal of such an assignment (i.e. is it supposed to entertain, to inform or to educate?), and its target audience (e.g. general listening or a particular section of the audience?). Another important consideration is to find the most suitable way of handling the assignment (i.e. is it going to be a talk, an interview, a documentary or something else?).

For the preparation phase, Aspinall proposes that all people involved in the assignment are engaged into a brainstorming session in order to discuss the subject and generate ideas for the radio program. He calls this session "briefing". During this session, Aspinall suggests that major deadlines are set (e.g. first draft of the script) and necessary bookings are made (e.g. studio/equipment booking). At this stage, both the preparation of the publicity material and the editing of the script take place. Finally, the preparation phase contains casting, i.e. deciding the roles among the radio program team (presenters, journalists, script editors, etc.), and the selection of music for the show.

During the rehearsal phase, all people who participate in the show as presenters read the script, either in front of the microphone or not. Aspinall provides recommendations on how to support presenters during the rehearsal, what to prepare before the rehearsal, and what is the most appropriate pace for various types of shows. Finally, the performance is where the actual show recording/live show takes place. There are several considerations to be made during this phase, and they regard both the attitude of the producers during the recording, and the organization of the recording.

In the following section, we discuss how each of these roles and phases may support the development of media and information literacy skills, and collaborative learning among students, who prepare their own radio show.

5. Skills development during a web radio program production

In the following, we discuss how a radio program production can be used as a learning activity in education. Our assumption is that students create their own programs and they learn through this process. The radio programs can be either entertaining or educational. In the latter case, the radio team (consisting of the teacher and the students involved) aims at educating the audience on a chosen topic (and thereby the students involved in the production). However, there are still learning opportunities for students, even when the goal of a radio program is simply to entertain.

Regarding collaborative learning, the different roles of people involved in a radio program production make this process ideal for group work. Learning opportunities arise already during group forming, whether students are allowed to form their own groups or not. In the first case, the social relationships between students will affect the group forming process (Hogg & Turner, 1985), i.e. students tend to select to work with friends. However, students will eventually realize that to work effectively with “friends,” they must transition from social relationships to task-oriented ones. Moreover, they may reflect on the composition of the group (different abilities, collaboration, communication etc.) and select differently next time.

Once the groups are formed and assigned different roles in the radio team, the students belonging to the same group should collaborate in order to fulfil the tasks assigned to their role. Therefore, students will have to learn how to efficiently allocate the different tasks among the members of their group in order to be successful. Since there are deadlines to meet during a radio program production, students will also need project management skills in order to accomplish the tasks assigned to them on time. Since several groups work towards the same goal (the radio program production), students will be exposed both on intra-group and inter-group collaboration and communication. There are thus several opportunities for students to develop their collaboration and communication skills, and to experience collaborative learning.

Regarding media and information literacy, we will examine skills development in each of the four phases of a radio program production that were described in the previous section. During assignment, the students have to consider the goal, the target audience, and the type of their radio program. In order to make these considerations, students need both to investigate different types of radio programs (educational, music, news, sports, etc.) and also different ways to handle the topic of their program. There are thus many opportunities for students to get familiar with the characteristics of different radio formats (length, pace, type of music, length of text, etc.), and with activities (interview, debate, discussion, talk, etc.), that take place in radio but also in other media (TV, social media, etc.). At this phase, students (possibly with the help of their teacher) should decide on the target audience, and contemplate as to which features of their program will have the greatest audience appeal. Similarly, the kind of approach the students decide upon must be dictated by a knowledge of their audience. Unless students familiarize themselves thoroughly with the assignment, they cannot easily set about the next stage of preparation. Therefore, they get plenty of opportunities to familiarize and reflect on how media work, and the way they approach their audience, improving thereby their media literacy skills.

During the preparation phase, the students should develop ideas for their assignment and start writing the script. For doing so, they should gather and assimilate knowledge on the chosen topic. The students may seek knowledge both online and offline, developing information retrieval strategies. During this process, students are exposed to different sources of information, and they have to relate to these sources. Moreover, they should decide which information is relevant, trustworthy, and valuable for their goal. After gathering all the necessary information, the students should write and edit the text for their radio program. This is also a learning process, since they should try to present all relevant information in a way that will appeal to the audience. Another important consideration is the selection of the music for the radio program, where the teacher gets the opportunity to discuss copyright issues and fair use of internet music with the students. Finally, the students should prepare the publicity material, and therefore decide on how to best promote their program on different media (e.g. web radio platform, social media etc.). There are therefore opportunities for developing both information and media literacy skills during preparation.

At the rehearsal and performance phase, the radio program is finalized and broadcasted. During this process, the students should use technical equipment for recording the radio program and editing the recorded file. Moreover, they should decide on the right pace for the performance. During rehearsal and editing, they have therefore a last chance to critically evaluate and adjust aspects of their radio program in order to achieve the best possible result. The final step after the performance is to upload the edited recording to the web radio platform, and schedule it according to the decisions taken during preparation. Moreover, the public relations group should contemplate on how to best promote and advertise the show on different communication channels. This offers also ways for the students to reflect on the power of the media to influence people's preferences and choices. The same observations appear in the preparation of live productions, where the only difference is the manner of broadcast. In this case, it is required a connection to the ESR server in order to broadcast live the radio show. Moreover, the students participating in the show (i.e. technicians, producers) can interact live with their listeners via an online chat offered in the ESR platform.

6. Conclusion

In this paper, we aimed at discussing the opportunities for skills development when a web radio production is employed as a learning activity in education. During such activities, students with the help of teachers produce their own radio programs. Our discussion is based on the experiences from the NEStOR project, where an online web radio platform (ESR) can be used by schools to broadcast their radio programs. We focused on media literacy, information literacy, and collaborative skills, since these are the most prominent based on the evaluation conducted during the project and our own observations. We believe that the web radio constitutes an attractive tool for cultivating such skills among the educational community. It is of paramount importance however that its introduction in the classroom follows a pedagogical approach.

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Blended Learning Model for a Chinese Integrated Module: A Case Study of a University of Education, Vietnam

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Abstract: Instructional design is a systematic approach that utilizes theories of modern educational psychology, media education theory and technologies to analyse the needs of instruction, suggest solutions, apply the suggested solutions, evaluate the pilot results and improve the design based on the results. Based on the concept of blended learning, we designed the Chinese Integrated Module 1 and formulated the initial instruction plan for one semester. In order to implement this module, the instruction plan includes the detailed instruction schedule for each unit and teaching hour. The Chinese Integrated Modules organised by the Department of Chinese Language of University of Education[1], Vietnam consists of five individual modules, namely Integrated Module 1, Integrated Module 2, Integrated Module 3, Integrated Module 4 and Integrated Module 5. According to the self-efficacy theory of cognitive motivation, the higher the students' efficacy is, the greater their learning motivation is. Therefore, during the first stage, a student's learning motivation depends on such factors as effective learning activities, learning outcomes and their academic achievements. In order to design an instruction model that enables teachers to enhance students' learning achievements and learning motivations, this study aims to develop a blended- learning instruction model for the Chinese Integrated Module. In this model, there was the combination of classroom-based and online instructions It was the first time that this instruction model was adopted in a Chinese course in Vietnam. A teaching experiment was conducted in a class within a semester in University of Education. The results showed that the application of social media platforms such as Wechat and Facebook provided effective learning environments for students. Moreover, the learning space was extended beyond a classroom, which helped teachers and students interact with each other. Furthermore, students were provided with abundant learning resources to study. Most importantly, the blended-learning instruction model could improve students` self- learning ability which has been the prioritised objective of Vietnamese education.

Keywords: blended learning, instruction design, Chinese language teaching

1. Introduction

In the context of language teaching, 'blended learning is defined as a combination of face-to-face (FtF) and computer assisted learning (CAL) in a single teaching and learning environment' (Neumeier, 2005, p. 163). Blended learning requires teachers to use multiple instruction methods to improve instruction efficiency and effectiveness in a specific subject and context (Neumeier, 2005).

Modern cognitive psychology divides learning strategies into cognitive strategies and meta-cognitive strategies (Pang, 2003). The development of self- learning ability is mainly manifested in the improvement of cognitive and meta-cognitive ability (Garrison & Kanuka, 2004). The educational environment of blended learning is proved to develop students' high-order and critical thinking skills (Garrison & Kanuka, 2004). Particularly, the educational environment of blended learning can cultivate learners' cognitive strategies. For instance, repetition is a strategy commonly used in learning declarative knowledge. Zhang and Hu (2007) believe that the online environment promotes the independent study of foreign language learners because using multiple senses while learning helps to achieve good results. During the process of language learning, students need to process a lot of declarative knowledge in order to use it skillfully. The online learning has the advantage of providing both visual image and audio display to enrich learning materials and examples, therefore activates learners' imagination and deepen their memorisation (Zhang & Hu, 2007). The online environment can also facilitate the development of learners' meta-cognition skills which support the learners' development of self-monitoring, self-learning and self-evaluation (Zhang & Hu, 2007).

Furthermore, research found that successful learners usually have strong self-management skills (Zhang & Hu, 2007). The learners can not only master the skills and strategies to conduct all kinds of learning activities but also adopt different strategies when dealing with different learning situations. Blended learning model can provide different extra-curriculum knowledge for different types of students, record students' learning process, support students who have learning difficulties, analyse the common problems and provide guidance to students (Zhang & Hu, 2007).

[1] The name of the university is a pseudonym.

The environment of blended learning can improve learners' cognitive and emotional skills.

Firstly, cognitive skills includes attention skills, coding skills and information processing skills. First of all, network environment provides learning material through audio-visual method so that learners can use different senses which reduces mental pressure and control their attention effectively (He, 2005). Besides, computer software can mark the key language points such as new words, difficult sentences in a way that help students to learn new knowledge and use online functions to guide them to pre-process the information related to the learning tasks (He, 2005). This coding process is helpful to student's self- learning ability. Furthermore, the online environment of blended learning instruction model can improve learners' information processing skills and facilitate learning process (He, 2005).

Secondly, the online education environment of blended learning can improve emotion management skills, and remove the affects of negative emotion. During the process of language learning, learners need to practice actively but most of them feel nervous when they are asked to speak in public. Through online learning environment, learners can communicate with each other on the computer or send each other email freely and they can quit whenever they want, in this case, they can enjoy learning better.

Instructional design is a systematic process in which instructors analyse learning problems and define instructional objectives in order to build up the strategic teaching plan, implement the plans, evaluate the results and amend the plan (Wu, 1994). It aims at improving the learning results based on teaching, learning theories, and communication theory. It divides module design, instruction curriculum, lesson plan, instruction procedures and instruction materials into different instruction systems and chooses instruction system as its research subjects (Wu, 1994).

To date, there have been a hundreds of instructional design models. Instruction design includes a set of procedural steps. Different instruction design models consist different procedures. However, all of these models have some common procedures such as learning need analysis, instruction content analysis, instruction objectives clarification, learner analysis, strategic instruction setting, selections and implementation of instruction channels and assessment of the instruction results. These seven procedures make up the common pattern of instruction process design.

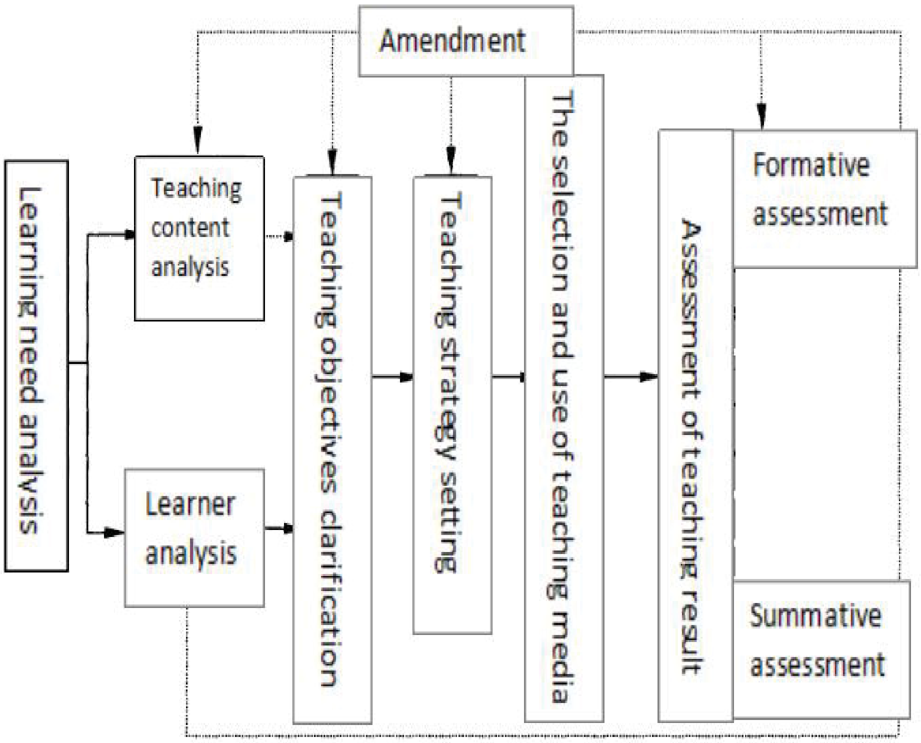

Figure 1: The common pattern of instructional design (adopted from Bo, 1992)

The above common pattern of instruction instructional design describes the basic procedure of instruction process design. In addition to this theory, Huang Fuquan's "two ways and three foundations and four strategies and six steps (2W3F4S6S) holistic learning" theory (2010) was adopted to build up the instruction model design of the Chinese Integrated module based on blended learning. The following diagram explains the instruction strategy of this module.

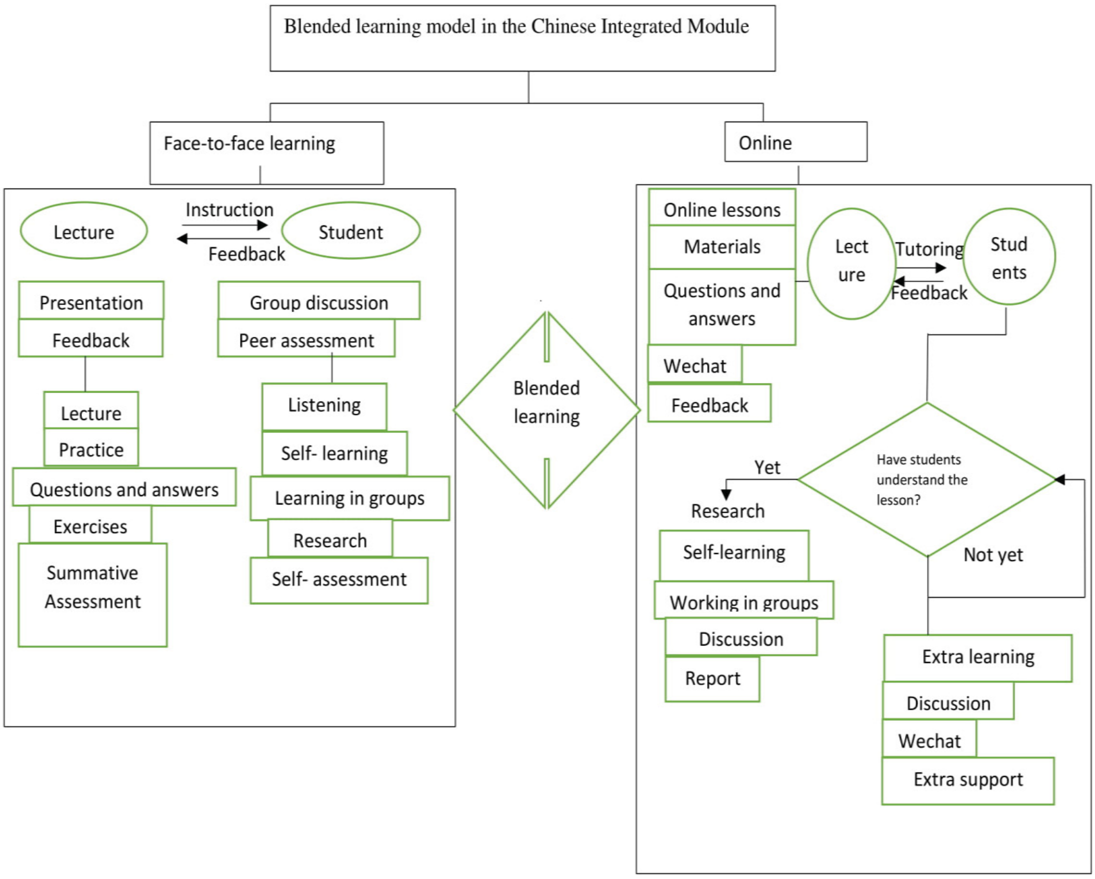

Figure 2: Instruction model design for Chinese comprehensive module based on blended learning

For the face-to-face learning at class, this traditional class instruction model includes a variety of teaching and learning activities such as lectures, presentation, exercises, hand-writing practice, questions and answers, feedback giving and receiving. Depending on each lesson, the suitable activities are to be implemented.

Meanwhile, for the online learning, students' self- learn under a lecturer's support. Students can self-check their learning results by taking an on-line test. If they past the test, they can explore materials by themselves such as surfing online website to learn their interested knowledge, previewing next lesson and finishing homework through group collaboration. If students have problems during their self-learning, they can discuss with classmates or teachers through WeChat. If they fail the test, they can review and consolidate they knowledge and skills, then ask the lecturers or their classmates for help through instant messaging software. After that, they can retake the test.

2. Methods

This study adopts action research perspective to conduct research. Action research, as defined by Peter Reason and Hilary Bradbury, is: a participatory, democratic process concerned with developing practical knowing in the pursuit of worthwhile human purposes, grounded in a participatory worldview which we believe is emerging at this historical moment. It seeks to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people, and more generally the flourishing of individual persons and their communities. (2001, p. 1)

The definition indicates that the priority of an action research is to improve the practice. In this study, the researchers are lecturers in a university of education, one of them is a lecturer of language education. Both of them have been interested in utilising information technology to teach and to enhance quality of students' learning. The researchers also participated in the context of the study and were allowed to make change in teaching language for students in the university. Therefore, action research perspective is an appropriate strategy.

The study aims to ask the general research question: Is it possible to apply a blended learning model in teaching Chinese for the first year students?

The study was conducted in a Chinese integrated module for first year students in Chinese Language School in a University of Education[2] in Vietnam during the academic year of 2016- 2017. The Chinese Integrated Modules consists of five individual modules, namely Integrated Module 1, Integrated Module 2, Integrated Module 3, Integrated Module 4 and Integrated Module 5. Prior to the period of 2016-2017, all modules were completed based on face-to-face instruction model. According to the lecturers teaching the modules, students' reading and writing skills were developed slowly throughout the modules due to the short duration and the large size of the classes. The lecturers did not have enough time to provide practising exercises and give feedback to all students. Increasing interaction between the lecturer and the students or among the students, therefore, was considered as a potential solution. In this case, blended learning model could be effective.

The module in the current study was targed to the first year students who had not had any knowledge and skills related to Chinese. One of the researchers was the lecturer in the class. There were totally 38 students participating voluntarily in the study. The lecturer utilised a new instruction method in which face-to-face learning and online learning with instant messaging software were mixed together during the sessions. In particular, the students had to follow four learning strategies in this module. Firstly, before class, the students had to access an e-learning website to read and prepare for activities in the upcoming sessions. After class, the students had to complete homework in the website. Secondly, the students had to work in groups online through Wechat and Facebook Groups before class and in class to finish exercises with the lecturer' instruction. Thirdly, the students conducted small-scale projects related to Chinese cuture and language individually or collaboratively. Lastly, after each lesson, the students had to complete assessment tasks such as writing a short essay on a topic, writing a reflective essay, or recording their short speech and then uploading their assessment products to the website and obtaining the feedback from their peers and the lecturers.

The Chinese integrated module focused on teaching students pronunciation, vocabularies, hand-writing practice, and grammar so that they could use Chinese to introduce themselves, to write of Chinese letters and short essays. The following table summarises the instruction schedule of the module.

Table 1: Instruction schedule of the Chinese integrated module

Subject: Chinese Integrated Module 1				Class：2016B		Teacher：San
Term：First term of 2016–2017				*Course book: Standard Module HSK 1* *Standard Module HSK 2*		
Week	Lesson	Time	Instruction hours per week	Instruction content	Instruction methods	Note
Week 1-5	Lesson 1-8	09/12-10/16	6	Pronunciation	Lecture+ online self-learning	
				Chinese character	Lecture+ online self- learning	*Standard Module HSK 1*
				Sentence pattern-grammar	Lecture	

[2] The name of the university was pseudonymised.

Subject: Chinese Integrated Module 1				Class：2016B	Teacher：San	
Term：First term of 2016–2017				*Course book: Standard Module HSK 1* *Standard Module HSK 2*		
				Text	Lecture+ hand-writing practice	
Week 6-10	Lesson 9-15	10/17-11/20	6	Pronunciation	Online self-learning	
				Chinese character	Online self-learning	
				Sentence pattern-grammar	Lecture	
				Text	Lecture+ discussion+ hand-writing practice	
Week 11-15	Lesson 1-10	11/21-12/25	6	Pronunciation	Online self-learning	*Standard Module HSK 2*
				Chinese character	Online self-learning	
				Sentence pattern-grammar	Lecture	
				Text	Lecture + group discussion+ hand-writing practice + writing practice	

The study collected data from the students' feedback on the blended learning model and students' results of the summative assessment of the module. This helps to understand the possibility of implementing this model in Chinese language teaching in the context of Vietnam.

3. Findings

The blended learning model in the Chinese Integrated module received positive feedback from most of the participants. The students commented that the blended model provied effective support to their learning. They widened and deepened their knowledge of Chinese language and culture. Moreover, their Chinese language skills were improved. A student stated:

It was a short semester, but I learned a lot. This model improve my cognitive skills so that I could absorb quickly the content of the lessons, the online assignments reinforced my knowledge and skills. The classroom face-to-face sessions helped me to remember the lessons longer. It also created more interest in learning and practising. (Student 1)

As the above student stated, with blended learning, the students had opportunities to learn a lesson many times in both classroom face-to-face learning and online learning environment. Consequently, they could remember the lesson better and longer. Such findings confirmed Zhang and Hu's (2007) and Garrion and Kanuka's (2004) research regarding the influence of blended learning on students' cognitive and meta-cognitive skills. Moreover, the blended model also affected students' learning motivation and interest, which were also explored in several studies reviewed by So and Brush (2007). The students were involved in both individual and collaborative learning activities. The interaction and connectedness in collaborative learning was found as positive factors influencing students' motivation and interest of learning (So & Brush (2007).

The overall satisfaction of the students towards the module was high thank to the blended learning model. They recognised that the lecturer provided a well-organised module with various resources and support through several communication channels. A student expressed her satisfaction to the module:

The curriculum and instruction of the module was perfect. She (the lecturer) provided us all required materials and guidance. The pace of learning was appropriate so that we could complete all learning tasks. (Student 2)

In Student 2's statement, it seems that the important advantage of blended learning was that no student was left behind because all of them had opportunities to redo their exercises and retake their test until they achieved the satisfactory outcomes. Their self-learning ability was significant improved over the learning tasks.

The significant result in the module with blended learning was reported among students in both mid-term and final term assessment. Over 50% of the students gained excellent marks (9-10 points in Vietnamese grading system), a few percentage of the student gained average grade and there was no student failed in the module as presented in the table 2.

Table 2: The assessment results of the participated students in the Chinese integrated module

Assessment	Range of marks	Results	
		Frequency	Percentage
Mid-term	9–10	21/38	55.26%
	8–7	13/38	34.21%
	6–5	4/38	10.53%
Final term	9–10	25/38	65.79%
	8–7	12/38	31.58%
	6–5	1/38	2.63%

Such results corresponded to the findings found in Humbert and Vignare (2004) and Reasons, Valadares and Slavkin (2005). The percentage of the students passed the course with blended learning in Humbert and Vignare (2004) was 95%. The number of students passed the course in face-to-face classes was lower than the one in online classes (Reasons, Valadares & Slavkin, 2005). However, these groups of students still had the lower percentage of course's completion than the students in blended learning classes (Reasons, Valadares & Slavkin, 2005). This to some extent provided empirical evidence for implementing blended learning in higher education to improve students' learning results.

4. Conclusion

The initial results showed that the application of social media platforms like Wechat and Facebook provided effective learning environment for students. Moreover, the learning space was extended beyond a confined space of a classroom, which helped teachers and students interact with each other better. Furthermore, students were provided with abundant learning resources and channels which they could use to study. Most importantly, the blended- learning instruction model can potentially improve students` self- learning ability, which has been the current priority of Vietnamese education.

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Digital Technology and Maths-Education: The Dilemma of Calculation and Conceptualisation

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Abstract: Digital technologies challenge maths education as they provide the calculations that used to be the core of maths teaching. Although calculation is still important to learn, the core of maths-education is increasingly the understanding and application of concepts and language to authentic situations in order for machines to perform adequate calculations. While many e-learning applications support learning skills and calculations, maths teachers have difficulties finding digital resources aimed at maths as concepts and language. Accordingly, teachers experience a dilemma when their school managers expect them to digitalise their teaching. This paper is based on results from an action research project running from 2012 to 2016 following a cohort from first to third grade in a Copenhagen suburban school. The school aimed to implement iPads in everyday practice and provide teachers with competence building. Accordingly, all teachers and students were given an iPad. While the project had a broader scope, the present paper focuses on the teachers' and students' motivation and learning in relation to the iPad and maths in light of the above-described dilemma. As action researchers, the researchers acted as sparring partners for the teachers. The school provided resources for teacher team meetings on a weekly basis. At the meetings, the teachers became familiar with using iPads in learning settings, brainstormed ideas and co-designed experiments for upcoming sessions. The meetings provided a framework for iteratively sharing knowledge and improving practice. The data were collected using anthropological methods: observations, interviews, summaries, thick description, video recordings and collection of materials produced during the project. The data were analysed using condensation and annotation methods. The present paper identifies teacher practices and use of digital technology that amplifies the teachers' dilemma of using technology in maths teaching. Equally, the paper provides examples of practices developed during the project that seem to overcome the dilemma.

Keywords: digital technology, instrumental mathematics, relational mathematics, e-learning, iPad, ICT

1. Introduction

When digital technology or information and communication technology (ICT) meets maths in primary and secondary school, we see dynamics and challenges that differ from what we usually see in relation to ICT and subjects of humanities. Here students show informal competences acquired outside school, such as multimodal competences, digital literacy, and knowledge of genres, media, narratives and games (Drotner, Siggaard Jensen and Schrøder, 2008). When working with student productions as a means to fulfil the learning objectives of, for example, history, native Danish or foreign language, students draw on these competences, along with project management competences acquired from construction and role-playing games (Sørensen and Levinsen, 2014). When it comes to mathematics, challenges arise as students do not have to do calculations themselves anymore (Jankvist and Misfeldt, 2015). Additionally, students are offered instrumentalised tools and methods for solving mathematical problems (Guin, Ruthven and Trouche, 2005; Mariotti, 2002). While students still have to learn some mental arithmetic in order to estimate the correctness of machine-performed calculations, the main effort of maths teaching has gradually moved from instrumental to relational aspects of mathematics (Misfeldt, 2013). According to Skemp (1976), instrumental maths is about following rules without necessarily knowing why, while relational maths is about both doing and knowing why. In learning theory, this distinction equals transmission and reproduction of knowledge versus construction of knowledge. Today, relational maths competences (conceptualisation, language, problem solving, representational forms and informed use of tools) are considered core learning objectives for mathematics, nationally and internationally (Barr, 2014; European Commission, 2016; Misfeldt, 2013; Niss and Jensen, 2002; Tedre and Denning, 2016).

The teachers' dilemma is that digital technologies aimed at maths do not really support the learning of relational maths, while opportunities to learn instrumental maths through applications that provide type assignments are plenty. In addition, teachers are challenged as there is no consensus of how to implement ICT into maths teaching, leaving teachers on their own (Drijvers et al, 2010; Tabach 2013; Trouche et al, 2013).

In the next sections, we elaborate on the mathematics challenge and present the research design before moving on to the empirics and analysis.

2. Mathematics and digital technologies

The official Danish learning objectives for maths (EMU, 2016, our translation) refer to relational maths competences and declare that, 'In the subject of mathematics students develop mathematical competences and achieve skills and knowledge, so that they are capable of committing themselves appropriately in maths-related situations in their present and future everyday, recreational, educational, work and societal life.' Mathematical competences embrace 'problem solving, modelling, reasoning and thinking, representation and symbol treatment, and communication'. At the end of third grade, the students 'act appropriately in situations with maths', that is, they 'develop methods for calculations with natural numbers, use geometrical concepts and measuring . . . perform simple statistical surveys and express chance sizes'. The related subject areas are numbers and algebra, geometry and measuring, and statistics and probability. Overall, the learning objectives deal with relational maths in relation to authentic situations and provide grounds (mathematical expressions) for making machines (calculators, spreadsheets or apps) perform adequately. In accordance with the semiotic nature of mathematics (Duval, 2006), relational maths is also about learning to translate between semiotic sign systems – to model back and forth between authentic situations and mathematical expressions or algorithms that machines can work with.

Instrumental maths is supported by a broad available repertoire of instructionally designed e-learning tools with selectable types of mathematical operations, severities and type assignments (e.g. eMat, MatematikFessor [MathsProfessor]). Relational maths is represented through e-learning tools that combine type assignments with maths stories (e.g. Matematiklandskab [The Maths Landscape]), where the students extract mathematical expressions from readymade stories, and Geogebra and Educreations, where students work on construction assignments within geometry and algebra. These resources are modelled in accordance with the instructivist paradigm that aims at reproductive and testable knowledge. However, a substantial body of educational research within the constructivist paradigm (e.g. Problem Based Learning, Cooperative Learning, Collaborative Learning) claims that acquiring relational competences and transferring them to adequate actions in authentic situations is better facilitated by (social-)constructivist approaches that empower students to act, produce and experiment. While such learning designs are often applied to subjects of the humanities, it is not common practice in maths to encourage students to pose problems or produce their own maths stories (Silver, 1997; Sørensen and Levinsen 2014). Even though interactive interfaces are multimodal and display representations that immediately fall in line with mathematics being semiotic in nature, we found no designed resources modelled in accordance with (social-)constructivist learning theory. This lack conflicts with both the educational authorities demand for digitalisation and the fulfilment of mathematics learning objectives. Thus, teachers find themselves in a catch-22 situation, where they have trouble facilitating and scaffolding students' learning when it comes to relational maths: to understand, compile and explain *why* it is precisely *this* mathematical expression and calculation the machine must perform in a given situation. According to Misfeldt (2013), mathematics is facing a huge challenge as to what should be the content and teaching practice of the subject.

3. Research design and methodology

This study followed a cohort and their teachers from first to third year in a Danish primary school in a Copenhagen suburb, where all students and teachers were given iPads. Apart from exploring the students' use of ICT in specified subjects (native Danish, foreign language, maths and science), the project had a wider scope, which is not referred to here. The project ran from 2012 to summer 2016 and was initiated by the school and supported by the Copenhagen Municipality as an effort to implement ICT and develop the staff's competences. The projects was designed as action research and the researchers collaborated with and were sparring partners for the teachers. The school allocated time and resources for the teachers to participate in meetings on a weekly basis, during which the teachers' knowledge of and ability to apply technology in their teaching were addressed and challenged. At the meetings, researchers and teachers co-constructed learning designs, which were subsequently tried out during the periods between meetings. The teachers were responsible of evaluating whether the designs supported maths learning objectives or not, while we collaborated on developing learning designs and actual teaching practices.

The maths teachers found themselves with challenges similar to those described above and the maths-related teacher competence building moved from technology to the relationship between ICT and relational mathematics. The collaborative dimension was organised around the weekly meetings and in accordance with the teachers' working schedules. Among other purposes, the meetings aimed to support the team's experience of ownership, participation and co-creation; provide room for the team's learning and frustrations; and identify subtle signs (ways of talking and questioning, vocabulary, self-initiation or progression) of learning and change among the students.

This structure was intended to support the teachers in developing professional competences, maintain progression throughout the process, and create a forward and proactive focus ensuring that learning from the meetings was tried out in practice. The project was subdivided into periods, each of which addressed a focus area (Figure 1) drawn from the research description: digital confidence, inclusion/exclusion, evaluation forms, teacher roles, group dynamics, student activities, motivation and digital literacy. New focus areas emerged and, for instance, we introduced a practice of linking students-as-co-creators of math learning goals to multiple uses of these goals as evaluation criteria in iterative formative evaluations (Sørensen and Levinsen, 2014, chap. 8; Sørensen and Levinsen, 2015).

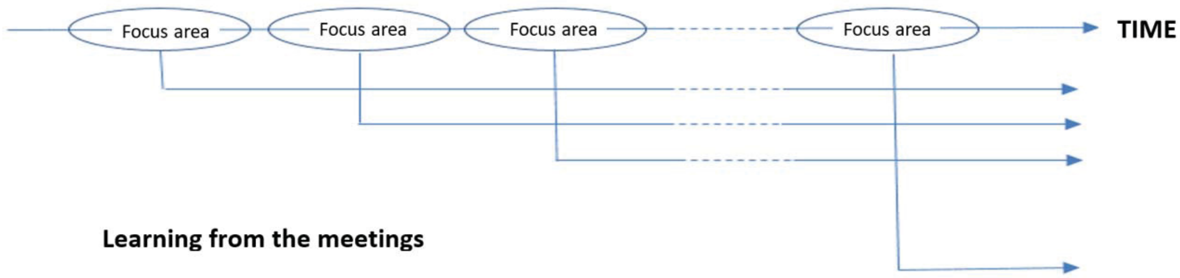

Figure 1: Focus area organisation over time. The arrows illustrate the forward integration of focus areas

Each period had a start-up meeting where the researchers participated, usually making a brief presentation related to the focus area followed by a shared brainstorm intended to identify observable signs pointing to whether learning goals were reached or changes occurred. These signs provided the framework for the researchers' observations. This process led to discussions that influenced both research practice and the teachers' choice of pedagogy and practice. For example, the 'teacher roles'-focus area was linked to the following signs: teacher-defined activities, content and time spend; orchestration; extent and content of teacher speaking time; teacher support for student empowerment; and changes in practice.

The long-term observations and collaboration were of great significance, as they proved that implementing ICT in mathematics was indeed challenging compared to other subjects. We found obstacles as described above, but additionally we found challenges related to the teachers' self-image of what it means to be a maths teacher. It was only in the last period that the learning potential of the students' digital, multimodal productions – encapsulating mathematics problems in maths stories – really unfolded. In this last period, we found deep learning related to both the students' construction of relational mathematics and the official learning objectives.

Action research in this context means close collaboration between participants and researchers when developing new practices (Duus et al, 2012; Nielsen and Nielsen, 2010) through co-designed experiments and knowledge sharing. The meeting structure worked as the methodological framework. The project was complex, and to embrace this complexity we chose mixed methods with a repertoire of data collection methods that do not necessarily include quantitative methods (Johnson and Onwuegbuzie, 2014). The methods included the following: observations of meetings and learning environments; informal conversations, interviews and structured focus-group interviews with students and teachers; emerging opportunities of knowledge sharing; and artefacts. (Creswell, 2008)

4. Mathematics and ICT throughout the project

First, we asked the teachers to write down their expectations and concerns. The maths teachers expected the iPads to motivate the students but also feared that maths could lose professionally because they lacked resources aimed at relational maths: 'and then we are just back to paper and pencil – which is okay but not what we want.' Asked about this, the teachers paradoxically imagined programs and apps aimed at relational maths to be similar to what they already knew. That is, digital technologies based on the instructivist paradigm and aimed at instrumental maths, which according to Misfeldt (2013) profoundly challenges the professionalism of mathematics.

In the following, we present the implementation of iPads as a chronological narrative based on the empirics, while the analysis, theoretical considerations and discussions are interwoven within this narrative.

4.1 First grade

The maths teachers found it difficult to prepare collaboratively but agreed to test different production tools that they imagined could scaffold the students' construction of relational maths competences. They also agreed to position the students as designers of digital productions. The initial expectations of the students' joy in working with iPads and the lack of scaffolding of relational maths were both confirmed. The students were committed and found geometric shapes to photograph and arrange with text in self-selected apps using the iPad. However, their productions became descriptive catalogues of geometric forms. The teachers, experiencing no in-depth learning of relational maths, again became reluctant to experiment and returned to designed resources, such as Educreations, that allow students to produce. Educreations supports students' digital production, analysis, formative evaluation, understanding, memory and adaptation (Foerch, 2016), but focuses on recognition and assimilative learning at the expense of exploration, accommodative learning and relational maths. Simultaneously, the teachers discussed using games such as Minecraft but were again reluctant because they feared the students would gameplay rather than work with mathematics.

During the team meetings, the maths teachers experienced how their non-maths colleagues' practice was positively affected and how students positioned as learning designers of digital productions became committed and good at maintaining a relevant focus. For example, teachers agreed to cut their speaking time to speed-up students getting started digitally. As a result, they enjoyed increased available time, which they used to differentiate. This finding is also documented in our other projects (Sørensen and Levinsen, 2014, 2016).

4.2 Second grade

The team's feedback inspired the maths teachers to try again, and midway through second grade they worked with maths stories and Minecraft. A teacher introduced the framework conditions of his learning design: 'You have to make stories with calculations, they are for your peers but you must be able to solve them yourselves.' The students chose a digital platform (Book Creator, Minecraft or iMovie) and the teacher reminded them 'if it's going to be difficult, it's a matter of multiplying and dividing.' A quiet hum of work began. The students sat in close groupings, shared and learned from each other about game design, the iPad and apps, and discussed the relation between mathematics and Minecraft. They maintained focus, tested their ideas on the iPad and continuously discussed both aesthetics and mathematics. In these processes, iPads and apps offer instant visualisations of ideas that are difficult to verbalise, thus providing border objects for discussions. Two boys who built Minecraft together reported:

> *It is fun to make maths because we can invent our own mathematical operations. We build for a long time and then you are happy for what you build and that we can join with others. We do all things ourselves and we think more" (our translation).*

However, relational maths competence was not challenged and the students maintained the already established formula: narrative+mathematical calculation (Figure 2).

Figure 2: Students' digital maths story in Minecraft. The students produced games in Minecraft with mazes and complex interaction with maths obstacles on Minecraft signboard-objects. These signs point in various directions and the answer to a calculation – e.g. 10+10 - directs the players' progression in the maze

In narrative apps, such as Book Creator and iMovie, we saw examples without any obvious relation between narrative and operation: "Count the number of knots on the braid" (photo – braid with five knots). "What is 47−32?" Even when integrating stories and operations, the students had difficulties with encapsulating mathematical problems. In response to the teacher's challenge to make the stories more complex, they expanded the chain of operations or made the numbers bigger:

> *Two boys throw balls for an iMovie maths story. Each clip shows one student roll the ball to hit a target – three rounds to each. The idea is that the viewer counts the number of hits (4) and then multiplies by 8. In the recordings, it is hard to see whether the ball hits and the teacher facilitates a dialogue. The boys realise that the challenge is in the visual quality of the movie, not the mathematics. They raise the difficulty from 4*8 to 4*18.*

The students reproduced instrumental maths without narratively encapsulated mathematical problems. All tasks could be solved immediately with a calculator and required no decoding. Again, the teachers were confirmed in their concern.

The challenges of linking relational maths competencies and digital production coincided with the competence-building process focusing on the correlation between evaluation practices and the use of co-constructed learning goals as evaluation criteria. We term co-constructed learning goals *goal criteria* (Sørensen and Levinsen, 2014, 2015). Theoretical perspectives provided by the researchers and knowledge sharing within the team helped teachers and researchers to identify the nature of the maths teachers' challenge. At stake was the teachers' ability to see opportunities for scaffolding relational mathematics, co-constructing goal criteria and designing frameworks for students-as-learning-designers. The maths teachers agreed to try out iterative evaluation as a learning practice as an attempt to support the learning of relational maths.

Another challenge that became evident to the researchers, but which required time for the teachers to recognise, was that they themselves were limited by an instrumental approach to maths that undermined their efforts to work with relational maths. Although the teachers talked about relational maths during preparation and meetings, they consistently referred to maths as instrumental in their practice. Consequently, the examples that were co-constructed with the students were about task solving and calculation rather than problem identification, coding and decoding. This articulation contributed to locking the students in a notion of mathematical stories as setting up and solving operational tasks.

The teachers' efforts to change their professional understanding of mathematics teaching and practice proved to be both challenging and long term, even without resistance. Such transformations simply touch deep in the teachers' self-image and take time.

4.3 Third grade

In the third grade, competence building focused on maintaining and developing iPad activities, while teachers and students consolidated co-construction and the use of goal criteria in iterative evaluations as a learning practice (Sørensen and Levinsen, 2015). At the turn of the year, the most active maths teachers were ready with new experiments that aimed to link students' digital productions to relational maths. This case from spring 2015 shows how the teacher Martin and the students were now positioned as, respectively, facilitator and learning designers, and mastered co-construction and the use of goal criteria in iterative evaluations. The case follows Martin and his third grade students during two double classes, in which students produced maths stories for their peers on the iPad.

In the first double class, Martin asked the class: '*What* does it take to make a maths story? There must be a calculation – you have to make traps, but not make it impossible. *Not* a long story before coming to the point.' Soon Martin's language changed to address operational tasks. Together they looked at two stories that presented the challenge as solving calculations rather than coding-decoding a maths problem. That day's productions again followed the formula: narrative+operation with or without relations, with the difficulty increased by expanding the chain of operations.

Based on these experiences, the teachers and researchers discussed how clearer requirements might scaffold a shift in the students' thinking from instrumental to relational math. Martin had realised how his language retained the students' thinking in terms of problem solving rather than coding maths stories that encapsulate decodable mathematical problems. He started the second double class: 'Today it's going to be harder. How can you make maths stories more difficult?' The students answered, 'You can multiply, subtract and add.' Martin said, 'We're going away from 'there's a worm and another, and then Martin eats two and how many are left?' Then they discussed a story about taking cows to the market. Martin asked, 'Why are 2+2 and 2*2 okay, while 4*1 is not?" Anna answered, 'Because there is not one person with four cows – there are two people, each having two cows.' Martin used this dialogue to coach the students to distinguish between encapsulated mathematical expressions and task-solving type assignments. The mathematical rule of the independent order of factors is not always true – not all that makes four corresponds to the mathematical expression that can be derived from the story.

After 40 minutes, several groups presented maths stories that required conceptualisation and reflection in both coding and decoding. Four girls made a murder story in iMovie. They worked with both visual expression and a language-based mathematical problem that their classmates had to decode (Figure 3).

Figure 3: A third-grade student-produced math story: Every year two cows come out of an elevator. (the girls crawl mooing out of an elevator – left). Every second year the serial cow-killer murders three cows (a murder scene – right)

The question was: How many cows are there in the ninth year?

Gustav already had an answer before the movie was finished: 'Four and a half cows.' 'That's wrong!' the girls said. Gustav explained his approach: 'There are two cows every year and every other year three are killed – only one survives. It's half the cows that come each year, so half of nine is four and a half.' The girls insist the answer is six because no cow is murdered in year 9. They argue further: 'and you can't have half a cow because it can't be alive in the tenth year. If it is half, then it is dead even if it's not murdered.' Gustav got angry and said this was cheating: 'you can't do it like that! Maths must be accurate and the correct answer is four and a half cows – basta!'

Martin used the two solutions to show two different logics at play and to facilitate a conversation and the students began to distinguish between pure mathematical expressions and those based on authentic situations. Gustav understood the story as pure maths and ended up with half a cow. The girls understood the story and the linguistically encapsulated mathematical expressions as related to an authentic scenario. Based on the premise of the story, half a cow is not possible. Soon the class began to understand what relational maths is about – what the difference is between solving tasks and identifying, coding and decoding mathematical problems.

In the course of time, Martin had developed a routine of co-construction of goal criteria and asking questions that facilitated the students' reflections. Now the goal criteria were clear and articulated in the students' own language. This supported their construction of relational maths competences, their ability to model and translate between different semiotic sign systems, and the expansion of their mathematical repertoire. A significant change that supported the students' learning is that the digital productions were now used as drivers for reflective discussions, which lead to the accommodation of learning rather than just presented and receiving feedback based on superficial criteria such as good/okay/bad assignments, dissemination and aesthetics.

5. Discussion and perspectives

When digital technology becomes part of mathematical work, students, teachers and ICT all become co-creators of what is mathematically meaningful and what makes sense to pursue. This means that instrumental maths is no longer at the centre (Misfeldt, 2013).

When students act as learning designers of multimodal digital productions with active use of goal criteria in iterative formative evaluations – and especially when the products are learning objects aimed at other students – we find that the ICT and in this case the iPad, with its potential for providing agency, constitutes a strong factor for students' motivation, creativity and relational learning. Students become able to express the difference between instrumental and relational maths. They refer to instrumental maths as 'when you get better at something you already know' and to relational maths as 'you have to think for yourself'. In this project, we saw that using multimodal production resources for digital production of maths stories as learning objects for peers scaffolded relational maths competence building. In a final student interview, a student reflected on the maths stories he made a year prior:

> *'It is easier to make them [the stories] . . . you do it yourself, because then you think more [about] . . . what you do and so . . . if you had to do things already made, then you are not as "what did I do-ish" and what can I do better. Things like that.'*

We find that students acquired relational maths competences and were able to substantiate choices. They used the mathematical concepts and language to code stories and discuss what creates a genuine challenge. We also see that they translated concrete challenges into mathematical solutions. About the link between iPads and student learning, a maths teacher said in the final interview a year after the project:

> *'. . . there is a greater pride . . . kids know when something's great . . . there are some boys and now I say boys . . . who can hardly hold a pencil and they know well when their drawing looks like shit. So it's awesome to get something that looks good . . . This cohort has scored well compared to the national average, the best and highest ever in our school.'*

The teacher can evaluate the score of the cohort because all classes do the national digital test, which provides data that are comparable from year to year and between schools across the country.

In terms of identifying the barriers that lay with the teachers, digital production also had a significant impact. As long as the students produced instrumental maths stories, the teachers wondered why the students did not work with relational maths as intended. Digital production amplifies the articulation of mathematics and contributes to the students' frame of reference, and students quickly link everyday language to mathematical language: *Together*/*what-is-the-difference* equals *addition*/*subtraction*. *How-many-times/sharing* equals *multiplication/division.* During production, mathematical formulations and their digital representations often became subject to intense dialogues among the students. However, only when the teacher shifted from an instrumental to a relational vocabulary, could both teachers and students focus on relational maths. Not only did the digital technologies and new forms of practice challenge the teachers; they were also profoundly challenged to think differently about their own conceptualisation and approach to mathematics in order to scaffold the students towards relational mathematics.

The process of change took time but came quickly for both teachers and students as soon as the teachers realised the importance of language and were able to let go of their instrumental articulations. This change had an immediate impact on the school's future change management. In the concluding interview, Martin said:

> *I have already been in other classes and introduced them to the iPad and empowering the students . . . the management have allocated time for me . . . There we are lucky. The school leader sits on the coffers, but she is cool enough. When she sees something works, it must also spread out.*

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Adapting a DW/BI Module for Gen-Z Students: An Action Design Research Study

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Abstract: Newer generations have different learning styles and approaches—they must be accommodated to ensure optimal learning experiences. Higher education institutions (lecturers) must find new ways of teaching to better meet these students' educational needs. In this paper the researchers make recommendations to teach a postgraduate data warehouse/business intelligence module differently, so as to better engage the latest generation (generation Z). It shows that their unique educational needs can effectively be catered for by applying action design research principles; it enables structured arrangement of activities to diagnose, design, implement and evolve artefacts, whilst continuously evaluating, reflecting upon and learning about created outcomes. It continuously revealed matters that students struggled with, and enabled immediate intervention.

Keywords: Gen-Z students, action design research, data warehouse/business intelligence teaching

1. Introduction

Every new generation is influenced and shaped by the ever evolving world around them. The latest generation entering universities is generation Z (Gen-Z). They were born in an era characterised by, for example, constant and fast-paced technological developments, unlimited access to global information, social media and instant feedback. So, they also see and experience the world in a different way than the generations before them. Accordingly, Gen-Z students have unique educational requirements to be considered by their educators; and educational institutions must adapt as traditional teaching styles that were very effective yesteryears are no longer as suitable today (Jones et al., 2007, Jaleniauskienė & Jucevičienė, 2015, Seemiller & Grace, 2017).

In this study, the researchers considered the learning needs of Gen-Z students, and adjusted the teaching style and practical assignments in a postgraduate data warehouse/business intelligence (DW/BI) course according to action design research (ADR) principles. ADR enables cyclical, structured and visual arrangement of material and activities to design and develop artefacts (Mullarkey & Hevner, 2018). ADR was suitable as its principles resonate well with the characteristics of Gen-Z students; also, the course entails the design and development of a series of evolving artefacts. Students had to continuously reflect on their work in order to identify where they struggle, so as to enable intervention prior to moving on the next phase, and to improve ensuing stages.

This paper is structured as follows: Section 1 introduces the key concepts. The problem statement and study's objective is discussed in Section 2. Section 3 explains the structure of the study. The outcome of the empirical study is discussed in Section 4. Section 5 includes a short discussion. Section 6 provides a summary.

2. Key concepts

The key concepts in this study are: the requirements of Gen-Z students and the postgraduate DW/BI module. These are discussed next to create a shared understanding and to motivate this study.

2.1 Gen-Z students

A "generation" is defined as a group of people born within a specific time frame; they share more or less similar experiences (Blauth et al., 2010). As with all generations, it is unclear what the exact time frame for the Gen-Z generation is—some speculate it is from the late 1990's onwards; others hypothesise that it is from the mid 2000's onwards (Bertagni & Salvetti, 2015). For the purpose of this study, Gen-Z's are considered as those currently entering university, hence the term used for in study, i.e. Gen-Z students.

Literature confirms that Gen-Z's are independent—they grew up in a digital world; they are continuously and constantly faced with information to process; and they expect instant feedback and results from their own actions (Ivanova & Smrikarov, 2009, Loveland, 2017). As a result of overwhelming amounts of (good and bad) information to sort and process, they suffer from "superficial and divided attention" (Desai & Lele, 2017). They "lack problem-solving skills" and, when faced with a serious problem, find it difficult to critically analyse the problem so as to decide on a set direction (Coombs, *in* Ivanovska Lidija et al. (2017)). Still, Bertagni & Salvetti (2015) suggest that they are adaptable and can learn on their own terms. Furthermore, they are visually focused; when provided with study material in a visual way they would therefore be able to learn, understand and implement knowledge more effectively—by using such a "learner-centred" approach, Gen-Z students should involuntarily become more creative in the way that they think and act.

2.2 The DW/BI module

The DW/BI course is currently offered as an elective for a postgraduate (Honours) degree at a leading South African university. The course's aim is to teach students DW/BI design, modelling and development principles as per the Kimball lifecycle approach (Kimball, 2008, Kimball & Ross, 2010). Upon completion they should be able to design, model and develop a DW/BI system—accordingly, the overall practical assignments entail extraction, transformation and cleansing of real (industry) data provided to them in a raw format; staging of data; design and development of a DW, browser, online analytical processing (OLAP) cube, and BI dashboard; as well as development of suitable technical and end-user documentation. Theory is taught in class; students are then expected to continue with the practical assignments and apply the theory practically (to demonstrate higher-order learning), mostly by means of a flipped course approach that adheres to the principles of self-directed learning (SDL). In SDL a learner takes responsibility for his/her own learning experience, and is ultimately better able to apply concepts in similar situations practically (Rothwell & Sensenig, 1999).

3. Problem statement and objective of the study

The overall yearly pass rate for this module is acceptable. However, recent years indicated that students find the practical assignment increasingly difficult. They do well in the theoretical exams; however, they repeatedly needed *additional* tutoring throughout the year to master practical application of theoretical concepts and, hence, the practical assignment. Supplementary opportunities for resubmissions of these assignments had to be created so as to enable them to complete work and continue with next phases. The phases follow on each other; it is thus crucial that students master all the outcomes of each phase prior to continuing with the next.

Historically, the practical assignments were given to them as a single case study where the end-goal, as well as objectives and time lines of interim phases, were briefly stated—refer to Appendix A. These roughly translate to: first, derive the business process and design a suitable database structure in the form of a dimensional model—refer to Kimball (2008) for more detail on dimensional modelling; second, develop a Microsoft SQL DW based on the dimensional model; third, clean the data, import it into the DW, and develop a browser to browse the data in the DW; and fourth, design and develop a BI dashboard/scorecard so that the data can be used to inform management decisions. The aim is to mimic a real-life (industry) project/ scenario. Students are expected to complete the assignment over a period of approximately nine months, spending approximately six to nine weeks on each interim phase. They are awarded a mark at the end of each phase. However, the students seem to struggle with such an implicit phased approach. SDL outcomes were also not reached.

The first phase, where the students must derive the underlying business process, mimics the elicitation of business requirements for a DW/BI system to be designed and developed. However, the business process must be spelled out for them, and translated explicitly into technical requirements prior the students grasping them; and students can only apply the theoretical concepts only after they have been demonstrated to them step-by-step (thus failing in terms of SDL). In addition, students tend to immediately 'jump' to the last portion of the assignment—they want to answer the management queries (which mimics managements decisions to be taken—refer to Appendix A) from the onset and straightaway design a BI dashboard/scorecard. So, upon reflection it became clear that the students did not really get a similar experience than that of a real-life project where a genuine phased approach is followed and the analysts/developers have opportunities to design/develop the system whilst testing portions thereof with the clients/business users.

Accordingly, the objective of this study was to test an alternative approach suitable for Gen-Z students; the teaching and assessment approach in a postgraduate DW/BI module was adapted. Action design research (ADR) principles were applied as they resonate with the educational needs of Gen-Z students, and entail the design and development of artefacts; ADR also mimics a real-life/industry scenario to ensure students become accustomed to such a way of work prior to entering a workplace. The study's structure is discussed next.

4. The structure of the study

In this study the researchers applied action design research (ADR) to segment and structure a practical assignment of a DW/BI module. ADR enables cyclical yet structured arrangement of activities to diagnose, design, implement and evolve artefacts, whilst evaluating, reflecting upon and learning about the (created) outcome—it provides a flexible yet disciplined investigative process whereby to introduce, create and reflect upon required learning outcomes (Mullarkey & Hevner, 2018). ADR is very suitable and valuable for work/research in the information systems field (Bilandzic & Venable, 2011, Sein et al., 2011). The ADR cycle, according to Mullarkey & Hevner (2018), is illustrated in Figure 1.

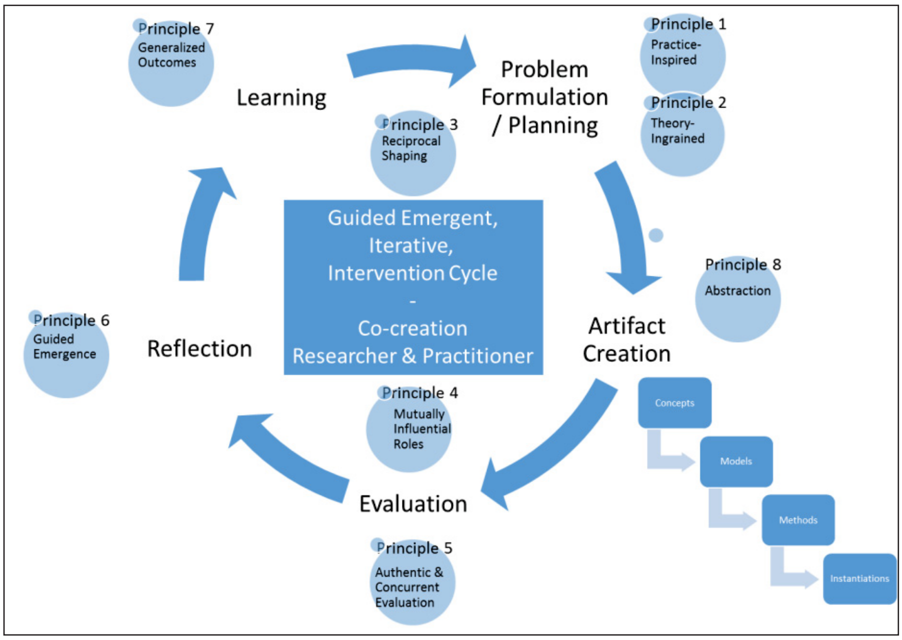

Figure 1: The ADR cycle (Mullarkey & Hevner, 2018)

The ADR process includes cycles, i.e. problem formulation/planning; artefact creation; evaluation; reflection; and learning (Mullarkey & Hevner, 2018). To cater for Gen-Z students that are easily overwhelmed with large amounts of information (Desai & Lele, 2017), the researchers segmented the assignment into smaller, more manageable chunks, i.e. eight (rather than the historical four) distinct stages. Each segment/stage is clearly (visually) structured according to the ADR cycles to allow for proper planning, artefact description, evaluation, reflection and learning. It enables the students to approach each stage as a unique, yet integrated problem to solve. They can successfully focus on a small portion at a time. To keep with the intent of ADR, the underlying principles of the ADR cycles (Figure 1) have been incorporated.

Expected high level outcomes of stages were still communicated to the students at the beginning of the year; but, detail of what were expected from them in the individual segments (stages) were shared with them gradually and as work should commence in each of the individual stages. The practical assignment is (again) done over a period of nine months. However, prior to sharing detailed requirements of a next phase, students' assignments were marked and they were requested to reflect on the previous phase. Reflections and learnings from previous stages, were then incorporated into the next stage. At the end of the first semester stages 1 and 2 of the overall assignment have been completed. It is discussed in next.

5. Empirical study

The overall case study is still to be completed over the period of the academic year. The expected end result (a BI dashboard with supporting DW infrastructure) was still shared with the students in class (verbally) and they were reminded of it continuously and at the beginning of every sub section. The interim sub sections were shared with them gradually as phases only upon commencement thereof. So, the assignment were broken down into eight distinct phases and shared with them gradually, rather than the one case study with four implicit phases. The outcomes (so far) were compared to previous years. At the end of each stage students reflected on the outcome of the phase as well as the process followed. Their reflections were used to identify areas where the struggle, so as to intervene timeously and ensure that *all* learning outcomes have been addressed prior to moving on to the next phase. Students' reflections were also incorporated into ensuing phases to adapt the process and assignment requirements to better incorporate their learning needs.

Students were encouraged to think creatively about the assignments and time were allocated in class where they could brainstorm ideas and design their artefacts. They were allowed to work individually, but they were encouraged to collectively come up with solutions and discuss ideas with each other; time were allocated in class for this. SDL principles were still adhered to as these class sessions were facilitated by the lecturer, but the students were encouraged to come up with their own solutions, discuss amongst each other, and formulate questions in terms of proposed solutions, e.g. "I think that if I do… the result will be… but I am not sure how to test it, please assist me?", rather than ask questions such as "What must I do now?" The next sections explain the structuring of the practical assignment according to ADR principles, and based on Gen-Z students' unique educational requirements.

5.1 Problem formulation/planning: the case study

Students were (as in previous years) presented with the practical assignment in a case study format that simulate a real-world industry situation—refer to Appendix B. However, Gen-Z students want to receive study material that is clear/visual (Bertagni & Salvetti, 2015). Firstly, they were reminded of the goal of the module, i.e. that the course's aim "is to teach you to design and develop a DW/BI system, following the Kimball approach (Kimball, 2008). For this, you received source data from XYZ University. The raw data is in various formats. It must be cleaned and transformed before it can be extracted and uploaded into a DW. Ultimately, University management wants to make informative decisions to establish targets and set goals. Making use of the data collected over a period of time, they must be enabled to make informative decisions, for example, to implement appropriate changes." Secondly, students were reminded of the end-goal of the project, i.e. "…to design, develop and implement a BI dashboard/scorecard for management that uses the queryable data from the DW (that you must also design, develop and implement)." Thirdly, the students were explicitly told to "…follow a phased approach and complete this practical project over a period of nine months." Lastly, the students were reminded that the only stages to be completed for the first semester were stages 1 and 2. It was iterated that stage 1 entails extraction of source data; and stage 2 entails cleaning and conforming of data. The stages are discussed next.

5.2 Stage 1

Stage 1 entailed the creation of a (practice-inspired) artefact, i.e. a set of individual database files with cleaned data, extracted from the source data (given to them as flat files). The assignment was also theory-engrained—they were overtly referred to theory taught in class, i.e. ETL (Extract, Transform, Load) sub systems 1 to 3, i.e. data profiling the change data capture system, and the extract system as per the prescribed text book (Kimball, 2008). So, the students had to take the flat database files given to them, and convert them into MS SQL database files (i.e. a staging database) so that, for the next phase, the data could be easily manipulated. Anomalies in the data had to be identified and rectified. The students were reminded of the end-goal (a working DW/BI system to inform management decisions) so as to let them understand the importance of having clean (error-free) data that will enable these decisions. However, they did not attempt (as previous years) to immediately start to design the BI dashboard/scorecard; the focus remained on the staging of data.

Abstraction of the artefact to be created, and visualisation of the context for the Gen-Z students, was achieved by iterating the 'steps' of the sub systems (Kimball, 2008) to be followed. Upon completion of this stage of the assignment, students' work were evaluated and they were requested to reflect on the process followed in a short essay. The reflections, as prescribed by the ADR process (Mullarkey & Hevner, 2018), indicated the level of understanding that the students have of the assignment, gave direction as what should be incorporated in the next phase, and also served the purpose of encouraging the students to think creatively and visualising the artefact and process for themselves incrementally and without being overwhelmed by the end-goal.

Students' reflections ranged from purely theoretical reflections (i.e. attempts to give standard 'text book' answers) to practical reflections (i.e. a list of practical problems that they experienced), and also a combination of the two. For example, a few students made screenshots of errors and associated resolutions (indicating again their visual nature) when installing the required software and extracting data from source files. The data profiling of the data, i.e. sub system 2 as prescribed by Kimball (2008), made students aware that the data they received contained certain anomalies (e.g. NULL values and duplicates) that had to be rectified (cleaned). They realised that they had to create a staging area for data. This is in contrast with previous years where students were told verbally that the data must be cleaned, but still immediately assumed that the data set that they received were an "academic" data set, hence already cleaned and could be used as-is. Students also realised that they had to thoroughly plan for future processes—a number of students referred to planning for the next phases in these first reflection essays already.

5.3 Stage 2

Stage 2 also entailed the creation of a practice-inspired artefact, i.e. a staging area consisting of a normalised database with cleaned and conformed data uploaded from the individual databases files. Quality of the source data had to be improved, data were to be merged where applicable, and conformed dimensions/metrics had to be created. Again, in an attempt to make the assignment clear/visible, students were referred explicitly to the theory, i.e. how to draft a source-to-target map, and ETL sub systems 4 to 8, i.e. the data cleansing system, error event schema, audit dimension assembler, deduplication system and conforming system (Kimball, 2008). Once more, artefact abstraction was achieved—the theory included 'steps' for the artefact creation.

On the negative side: Even though the stage 1 reflections included practical reflections, most of the students still focused mainly on the theory. Therefore, a practical class was worked into the teaching plan to enable students to start with the design work of the staging area in class already. They were encouraged to discuss ideas with each other and creatively think about the outcome to be achieved. Examples of similar work were visually (by means of a presentation) shared with the students. They were given opportunities to ask specific questions based on solutions that they were able to come up with so far, and bring drafts of their assignments to class for comments. This enabled them to identify the gaps that they inadvertently left in their work so far, and continue with the work with minimal "interference" and additional tutoring from the lecturer. This was an improvement over previous years. Students brought drafts of their work to class; these were drafts of "planning steps", for example source-to-target maps and schemas of the relational (staging) database. In previous years, students would bring proposed answers to queries that can be answered by the BI scorecard at this stage already; they therefore skipped all initial and interim planning phases. This was even though they were reminded of the importance of these in all the theory classes—as these were not explicitly given as assignments, they chose to ignore the conceptual and planning stages of the project. So, it is clear that Gen-Z students must be guided explicitly throughout the process, rather than expected to implicitly apply theory.

On the positive side: Only 22% students were entirely unable to develop the stage 2 artefact. The other (78%) students partially completed this stage successfully—the logical design work were on average 80% completed; the physical design work were on average 60% completed. All the students attempted to do the source-to-target mapping; all made good progress and a few of the students were even able to complete it. This is a major improvement over previous years where, at this stage, the majority of the class (more than 80%) had to be given additional tutoring to merely *understand* requirements for this phase of the work. The students' reflections indicated that they understood *what* was required from them; however, they underestimated the amount of work, so, they did not fully *complete* this stage of the assignment. For example, a student said that in "hind sight I would've started lot earlier with this stage of the project since I hit a few setbacks that caused my planning to fail and the project to be incomplete". One student referred to the assignment as "challenging" and realised that "solving new problems in a short amount of time can be a daunting task". Another said that "[t]his project has really been a challenge since I am forced to think in a different way and see things in a different way that I am used to, which also played a role in how well the project went since it was a struggle to conform my ideas to fit the scope." One realised that the assignment "should be taken more seriously". So, the additional guidance that the students received through the more explicit and detailed (i.e. broken down into sub sections) assignments, gave them clearer direction and enabled them to focus on the task at hand, rather than only at the end goal. They were, however, still cognisant of the end-goal, as reflected by specific questions asked in the extra class where they were encouraged to discuss the assignment amongst each other.

6. Discussion

Stages 1 and 2 of the assignment have been completed at the end of the first semester. Students are better engaged. They have a clearer idea of the amount of work that this practical assignment entails (when compared to outcomes of previous years) and should thus be better prepared for what will be expected from them in the remaining stages that will commence in the second semester of this year. Students still struggled with the assignment as it is fairly complex; however, it was (and is) more segmented and structured. They can therefore easily focus on a single stage only, whilst being reminded of the holistic view to be kept in mind also. Students successfully took responsibility for their own learning experiences. They immediately started to think creatively about the problem given to them. Students were better able to integrate theory and practice (when compared to outcomes of previous years). So, the outcomes of the practical assignment are already a major improvement over previous years. The students now have a sound foundation to build on in the second semester, where they will continue with this project, and design and develop the integrated DW/BI system.

7. Summary

This study introduced and tested an alternative approach to better teach a postgraduate DW/BI module to Gen-Z students. The ADR approach complemented the unique educational requirements of these students. It enabled cyclical, structured and visual arrangement of activities; and learning outcomes were successfully introduced, created and reflected upon. The conclusion is that, by structuring the practical assignment according to ADR principles, the Gen-Z students' unique education are successfully been catered for. The assignments that are broken down into smaller chunks enable the students to focus on portions therefor, whilst still being reminded of the bigger end-goal.

8. Appendix A: Example of a practical assignment given historically to students

You received .csv files containing source data as well transactional data relating to orders from the Franco and Domino diners for the 2014 fiscal year; these are two franchised fast food outlets with branches in some of the major towns in South Africa. Their fiscal years start on 1 January. Both franchises are concerned about their economic futures; the reasons, for example:

- 1. Both these franchises have branches in similar locations. Therefore, the owners decided to look at combined sales data of Franco and Domino to see whether they may benefit from merging.
- 2. Both these stores have unpopular products on their menus. Keeping stock of these items is an unnecessary overhead cost. Therefore, management have decided to scrutinise the sales data to identify these poorly selling products.
- 3. The stores may have inactive customers.

Your practical assignment:

- 1. Create a data warehouse that contains the data from both these diners.
- 2. Extract reporting information and present it in a graphical (business intelligence (BI) dashboard/ scorecard) format to management to support managerial decisions regarding the future of these diners. For example:
- a. Which towns have more than one branch?
- b. Which products are the most popular, i.e. the top 10?
- c. Which products are the least popular, i.e. the bottom 3?
- d. What would the individual diners' gross income have been had they only sold the top 3 products?
- e. Which days of the week are busiest; and which days are least busy?
- f. What was Franco's gross income for the 2014 fiscal year; what was Domino's gross income for the 2014 fiscal year; and what was the combined gross income for the 2014 fiscal? Present this: monthly and yearly.
- g. Do the diners have inactive customers? If so, identify the inactive customers for both diners.
- h. If these diners merged in 2014, identify which would have been the most profitable branch; and the least profitable branch.
- i. Do you think that a merger is a good idea? Use forecasting software (Excel or QM) to predict the sales (of the merger) for the next 6 months.

Remember:

- 1. You must create a star scheme for your data warehouse. Due: end of March.
- 2. You must create a browser to browse data in your data warehouse. Due: end of May.
- 3. You must create an OLAP cube. Due: end of August.
- 4. All queries must be answered from the cube, rather than from source data.

- 5. Your BI dashboard/scorecard must be relevant for the business user. Due: end of October.
- 6. All interim assignments must be accompanied by applicable technical and end-user specification.

9. Appendix B: Practical assignment: Current year

The aim of this course is to teach you to design and develop a data warehouse/business intelligence system, following the Kimball approach. For this, you received raw data from XYZ University. The source data is in various raw formats and must be cleaned and transformed before it can be extracted and uploaded into a data warehouse. Ultimately, management of the university wants to make informative decisions to establish targets and set goals. Making use of data collected over a period of time, they must be enabled to make informative decisions, for example, to implement appropriate changes.

The source data includes: an organisational overview; curriculum/qualifications and school data; student data; employee data; data related to research publications by students and/or employees and/or external people. The source files include data for a time period of five years, a snapshot at the end of each year was made.

The end-goal of this project is to design, develop and implement a dashboard/scorecard for management that uses the queryable data from the data warehouse that you have also designed and developed.

You must follow a phased approach and complete this practical project over the next six months. The following two stages are to be completed for the first semester:

Stage 1: Extracting

Extract the data from the source systems: first, gather and clean the data in the source files; and second, create database files and upload the data into the (individual) database files.

Refer to ETL sub systems 1 to 3, Chapter 9 in Kimball (2008).

Practical project documentation 1 (due 9 May): Reflect on the process followed to extract the data from the source systems. Write an essay (max 1000 words) to describe the process followed. Focus on application of the following aspects in your practical project (refer to ETL sub systems 1-3): data profiling; change data capture system; and extract system.

Stage 2: Cleaning and Conforming

Create a normalised database and upload the data from the individual database files (created in Stage 1) into the normalised database. Improve the quality of the data and merge data where applicable. Create and enforce conformed dimensions/metrics.

Design and develop an ETL system for this purpose, as follows: first, draft a high level architecture plan—refer to Kimball (2008): Figure 4-2, p. 122; second, draft the source-to-target mapping for all data elements—refer to Kimball (2008): Chapter 8 and third, upload the data into the normalised database.

Refer to ETL sub systems 4 to 8, Chapter 9 in Kimball (2008).

Practical project documentation 2 (due 26 May): Reflect on the process followed to create a normalised database and upload data. Write an essay (max 1000 words) to describe the process followed. Focus on application of the following aspects in your practical project (refer to ETL sub systems 4-8): data cleansing system; error event schema; audit dimension assembler; deduplication system; and conforming system. Also upload technical documentation related to sub systems 4-8.

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Curriculum Digital Transformation Through Learning Design: The Design, Develop, Implement Methodology

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Abstract: Implementing design thinking and collaborative approaches to Learning Design (LD), and utilising the latest technology-enhanced learning approaches has the potential to improve the quality of teaching throughout the higher education sector. Even though in a decade of published work, the meaning of LD is associated with a few hundred unique concepts, there seems to exist a general agreement in this field of research and educational technology practice that LD is primarily about generating design ideas, capturing, sharing and eventually reusing them. What is missing is a set of Learning Design Methodologies, which can assist with some of the most challenging issues of LD, such as collaboration, sharing and reusability of the designs. This paper builds the case for the development of such methodologies using an example from an Australian University, where a collaborative learning design methodology for program-level curriculum development was established. The methodology is founded on such principles of collaborative professional learning and design thinking (Hokanson, & Gibbons, 2014). The methodology was piloted by four faculties and eight academic program teams. Technology integration was the focus of learning design. Participants in the methodology were interviewed about their experiences using focus groups. The case study presented here is still work in progress, but it illustrates the results of this initiative to date with an emphasis on promoting the need for more collaborative methodologies for learning design.

Keywords: collaboration, curriculum transformation, learning technologies

1. Introduction

A careful reader of Learning Design (LD) scholarly work may be tempted to conclude that despite the differences in the use of 'Learning Design' as an evocative concept, there seems to exist a general agreement of scholars working in this research field that LD is primarily about generating design ideas, capturing them, sharing them and eventually reusing them. However, the approach which different LD movements adopt towards the direction of 'collaboration', 'sharing' and 'reusing' varies dramatically. There is the proliferation of LD Pedagogical Planners (Conole, 2013) that aim to provide guidance and resources to help teacher and academics build what is essentially a generic lesson plan. This movement places learning technology as a key mediator in the process of LD and shares some similarities with practices that focused on exploring and documenting the generation, application and reuse of learning objects. The learning objects movement has its roots in the Instructional Design movement (Rehak & Mason, 2003). Instructional Design is aligned with behaviourist learning theories and the development of learning objects. The focus of the fashionable learning object design of the late 20th century learning with technologies movement was clearly the designer, often educators, designing for their own classes and contexts, but willing to share their individual and unique designs with others through learning objects repositories. However, the fast pace and disruptive effects of technology on learning and teaching saw the erosion of popular LO tools, such as JORUM, the learning object repository hosted by the Joint Information Systems Committee (JISC), a UK-based not-for-profit organisation servicing the tertiary education sector. JORUM was, after 13 years of existence, officially retired in late 2016, or the transformation of long-standing repositories like Merlot.org, which have become much more community focused with opportunities to share not only objects but also syllabi and LD ideas. Equally noteworthy is the parallel decline in the use of LD Patterns tools, such as James Dalziel's (2008) the Learning Activity Management System (LAMS) or The Learning Designer, to mention a few. One of the reasons for such an erosion in both the Learning Objects movement and the LD tools that were built to support it is the realisation that "teachers in higher education have been notoriously reluctant to use other teachers' educational products (designs)" (Goodyear, 2015, p. 43).

By contrast, the Learning Design movement advocated in this paper is collaborative in nature, which can be likened to a community of practice (CoP) approach. There are a number of well-established workshop programs that implement collaborative learning design processes. When done effectively, the collaborative process approach to Learning Design can be transformational for those designing learning. Three current examples are briefly outlined below, but this is by no means an exhaustive list.

Carpe Diem Workshop

The Carpe Diem process is a 2 day face-to-face workshop that 'provides a structured framework for course teams to understand, design, develop and implement e-learning designs' (Salmon & Wright, 2014, p. 58). Its purpose is to address the pedagogical challenges identified by the design team using a rapid proto-typing and storyboarding approach. All participants are encouraged to be fully involved for the full two days creating a levelling and valued contribution approach from all involved, as well as being beneficial for constructive challenge and knowledge development (Salmon & Wright, 2014). For more information on the Carpe Diem visit https://www.gillysalmon.com/carpe-diem.html

ABC (Arena Blended Connected) Workshop

The ABC is a rapid way to design or redesign programmes and modules in a 90-minute hands-on workshop where teams discuss and create storyboards of student activities, including all assessment. It aims to 'open up areas of dialogue among faculty members, students, professional staff and others and to cultivate new possibilities for practice. It is not the intention that the framework closes down possibilities but that it leads to creative, original ideas for new directions' (UCL, p. 8). For more information on the ABC Workshop visit: http://blogs.ucl.ac.uk/digital-education/files/2015/09/ABC_leaflet.pdf

7Cs of Learning Design Workshop

The 7Cs of Learning Design workshop is a highly interactive 2 day face-to-face workshop that enables academics and course teams to design effectively for learning. This hands-on workshop is based on a well rehearsed, well researched team approach to learning design using learning technologies. It utilises a rich toolkit of templates and resources available to all participants. Its scope and delivery approach is very similar to the Carpe Diem Workshop. For more information on the 7Cs of Learning Design Workshop visit https://www2.le.ac.uk/projects/oer/oers/beyond-distance-research-alliance/7Cs-toolkit

There are at present no LD methodologies embedded in or following on from the various LD frameworks which can help academics and designers understand and build a technology enhanced curriculum across an entire course or program of study. Recent literature in the area calls for a team-based approach to university curriculum development that has the potential to provide dynamic and deliberative university programmes in a holistic and coherent way (Dempster, Benfield & Francis, 2014; Desha & Hargroves, 2014). This paper proposes a new Learning Design Methodology that is built to provide support with curriculum development and technology integration across a complete program of study. Details of this methodology is presented in section 3.

2. The context

The case study presented here was conducted in a large Metropolitan University in Sydney. At the time the University was introducing its new Strategic Learning and Teaching Framework which focuses on the notion of Program (or Course) Level Curriculum Design, Digital Innovation and Employability. The big challenge was that for many years the development of the renewal of the university's programs or units were approached by academics as a bureaucratic task that involved the completion of numerous templates and forms and often in isolation from their colleagues. For example, it was common for a Program Director to decide on major or minor changes in the program while the rest of the program team only contributed their ideas at the unit level. Similarly, when a decision about implementing a new technology was made, this was made with no clear consultation and no strategic thinking in mind. This approach, while reflecting the practical realities of curriculum development, was very challenging for the future of the University. To address the aforementioned challenge, a team of Academics and Educational Developers with the support of the Pro-Vice Chancellor Learning and Teaching developed and piloted a methodology—the Design Develop Implement (DDI)—for program-level learning design. We placed a focus on allowing enough time for teams of academics to explicitly integrate the language, practice and tools for LD with access to expertise required for their context. However our emphasis was not on sharing the learning designs (the product) but sharing ideas around their designs, negotiating them and eventually co-constructing them. Hence, their focus on the co-production of knowledge, which is an integral part of transdisciplinary collaboration, providing a much richer evidentiary basis for how this collaborative work is able to lead to superior and sustainable learning designs. We drew on the Carpe Diem approach to LD (Salmon et al, 2008), but with additional consultation and time being offered to support the formation of a community of practice and to seeing through the implementation of the designs in action. The Carpe Diem was selected as our starting point as it was built around the same principles of design thinking, which we were interested in embedding and is a well-established long running methodology across the higher education sector both in the United Kingdom and in Australia.

3. The design, develop, implement methodology

Design, Develop, Implement is an evidence-based collaborative approach to program design and development. The team-based learning design process is activity based, iterative, forward-looking, and grounded in everyday educational practices. Program teams collaborate to develop design patterns that work with what is practical in context, rather than what could be effective in theory in the future. The DDI comprises four stages that follow a spiral and holistic approach to curriculum development. A very important aspect of the methodology was the 'Context and Readiness' preliminary stage, which ensured buy-in from key stakeholders such as the Associate Deans Academic (or similar), the Head of the relevant Departments and the Director of the Programs to be using the DDI Methodology. Figure 1 outlines the stages and provides a short description of the steps involved within each stage.

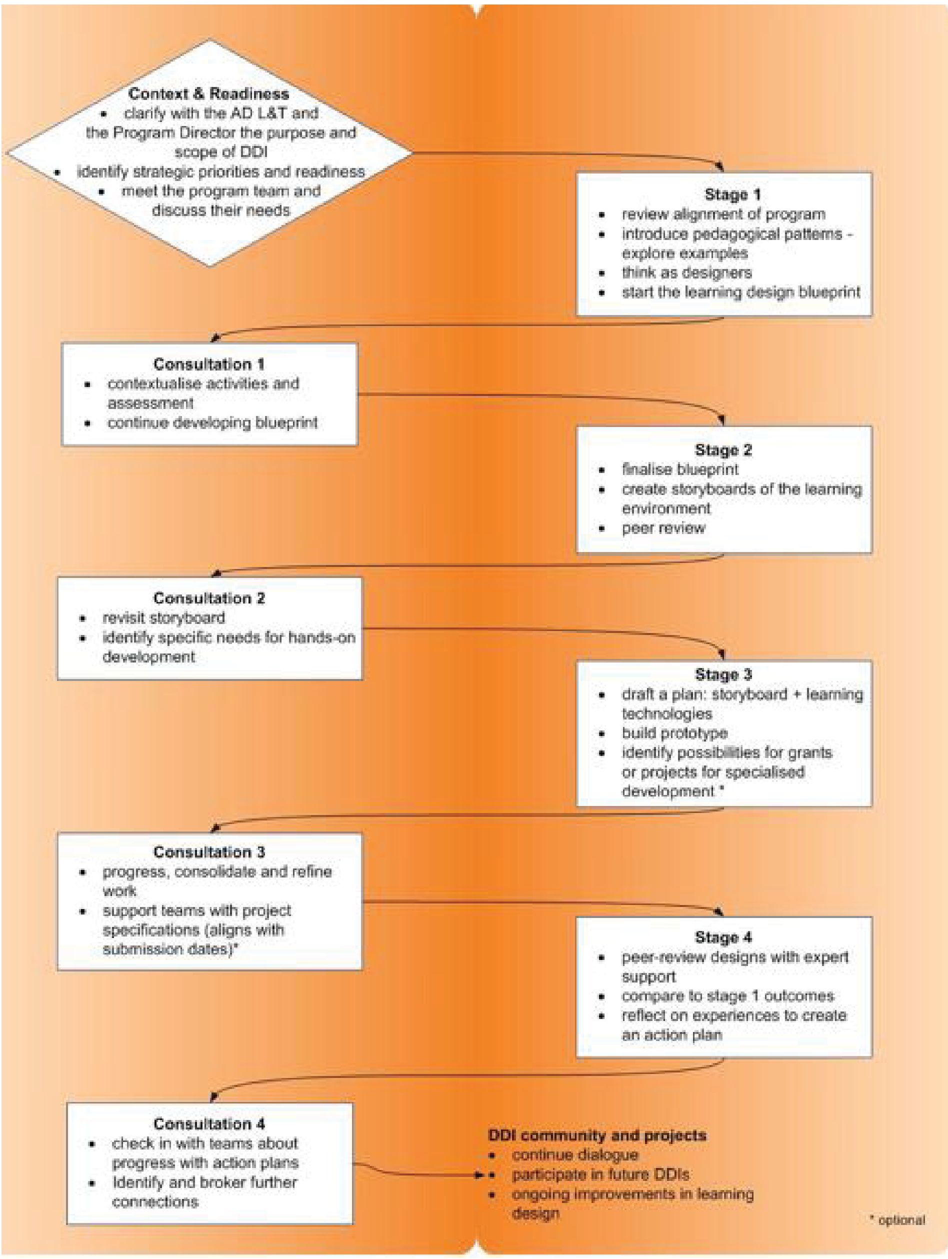

Figure 1: The design, develop, implement methodology

A powerful addition to the DDI process, when compared with other models of learning design (e.g Carpe Diem process) is the 'consultations'. These consultations allowed the necessary time for the teams to embed the outputs of the DDI into practice and supported the community configuration.

Another important feature of the DDI Methodology was the integration of the 3E Framework (Enhance, Extend, Empower) in stages three and four of the DDI. The 3E Framework provides educators and those supporting them with guidance and examples across a range of learning, teaching and assessment activities that show how technology can be harnessed to increase active learning. For more information about the Framework visit https://3eeducation.org/3e-framework/ . In the DDI context, the 3E Template (Table 1) was used to facilitate decisions around an increasingly more sophisticated use of technologies as part of more advanced learning activities.

Table 1: 3E framework sample template

Technology Integration	Enhance	Extend	Empower
Use of Discussion Forum	Use of discussion forum to discuss topics and readings facilitated by an expert tutor.	Use of discussion forum to provide opportunities for student-initiated discussions.	Use of discussion forum as part of a case-based scenario or role play.
Program of Study: BA Major in Sociology	Use of discussion forum in three year 1 units to discuss readings related to major essays.	Use of discussion forum in the "Study Abroad Unit" to connect students while overseas.	Use of discussion forum in the final Capstone Unit.

In total eight teams of academics from all four faculties (Arts, Human Sciences, Science and Engineering, Business and Economics, and Medicine and Health Sciences) participated in the pilot. In addition to the team of academics, a number of individuals partook in the DDI in a supporting/advisory role. Table 2 shows in light blue the roles that must be part of the process in every stage, whereas the roles in light yellow show an indicative set of expert people who may be invited to the sessions based on the demand for their expertise.

Table 2: Recommended DDI roles

Roles	Capabilities (Skills, Knowledge, Values) Required	Role
Facilitator	Facilitation, communication, consulting, teamwork, pedagogy, knowledge of trends across sector	To lead the DDI process across all teams and to communicate with relevant stakeholders.
Team Leader	Facilitation, communication consulting, teamwork, pedagogy, knowledge of trends across sector, project management	To guide and support the DDI process at a team level and intervene with questions and comments.
Note Taker	Clear concise and timely Note takers should aim to maintain a neutral standpoint.	To accurately note all ideas and report back to the teams.
Library consultant	Information Literacy Skills Communication	To provide specialised advise on information literacy as /when required
Learning Skills Consultant	Learning Skills Understanding of students needs	To provide learning skills advise as/when required
Educ Media	Audio Visual 3D Design Other media skills	To provide media advise as /when required
Educ Designer	Learning Design Other learning technologies Communication Project management	To assist with Session 3 of the DDI; help with ilearn development and implementation

A number of learning design templates were used to facilitate the design process, which included introductory brainstorming templates, a set of decision making cards and other templates to help them better visualise their preferred approach to introducing technology in their curriculum. An example of a template that was introduced in Stage 1, during the blueprinting activity, included questions such as:

Table 3: Program level blueprint questions

Learners (e.g. their needs, motives for learning, prior learning etc.)	Who are your learners? What can motivate them to engage with the program?
Intended learning outcomes (knowledge, skills, graduate attributes)	What are the program learning outcomes? What are the key capabilities/competences you wish students to develop?
Learning Environment (face-to-face or online, blended, flipped classroom, open educational experience etc.)	Where will the majority of the learning and development take place? What type of 'blended' experience will you design for? What technologies are available?
Curriculum aspects (approaches to learning, assessment, feedback etc.)	What approach to learning will be taken? In what way will content be provided? What MUST be assessed? What feedback strategies will be used?
Learning Activity (types of activities and types of interactions.)	What are the types of activities that students MUST complete in order to meet the learning outcomes? What are other possible follow up activities that ideally you would like students to engage with?

Another example of a template (Table 4) is the mapping of program learning outcomes to units of study with details of indicative learning and teaching approaches, tools and activities. The following example is an extract from a DDI session with the Faculty of Medicine and Health Sciences. This activity takes place during Stage 2 of the DDI process.

Table 4: Program learning outcomes and activity mapping

Program Learning Outcome (PLO)	Indicative Units of Study	Indicative Learning and Teaching Approach	Indicative Tools & Activities
E.g. To be able to accurately take medical history from patients	E.g. Professional Study and Communications Clinical Practice Placement 1	E.g. Seminars, Simulations, Blended learning approach, self-study	E.g Virtual Simulated Patients, Adaptive Learning Platform Quiz
Add PLO:	Add Indicative Unit	Add Indicative LT Approach	Add Indicative Activities and Tools

4. The DDI process: Feedback from the participants

The project team systematically evaluated the DDI process using focus group interviews with the participants. A thematic analysis revealed two key themes: collaboration and sharing.

Addressing collaboration first, the participants felt that *"it's been a really valuable exercise for a host of reasons. It's been the relationship building component of it, and those opportunities for collaboration." However a number of participants felt that as part of the DDI Methodology they should be given some more guidelines* around when and for how long should a collaboration around a Learning Design task occur; agreement on the arrangement and the roles of the DDI team. They also wanted more guidance around what questions need to be tackled first. All participants reported their desire for some more flexibility to adjust the DDI to fit their needs. The following quotes are illustrative of the need for flexibility in collaboration:

> *"we felt the we needed to spend more time on our blueprint given that our program was a new one…the DDI felt a bit rushed in that it forced us to make some decisions, when more time for scrutiny and collaboration was required".*

A number of participants agreed, though, that *"It would still make sense to get someone from outside the department to be the facilitator".* This was seen as vital to avoid having departmental or other discipline agendas overtaking the creative aspect of the DDI.

As far as sharing is concerned, two key subthemes were raised in the interviews. One was the ability of the DDI to share national, and local institutional knowledge of good exemplar designs backed up with relevant evidence that they work. A participant commented that "the *DDI offered us real examples of good designs that work in practice…also the examples offered through the introduction of the 3E Framework were very inspiring*". Others commented on the fact that the through the DDI and the sharing of examples and design they acquired the language needed to talk about curriculum and become advocates of change. For example, one participant mentioned that *"giving us some of the language and concepts to really start to move our own internal conversations forward was invaluable….* All participants agreed that sharing should be about flourishing and not about imitating existing designs. The focus should be on constructing local, contextual designs drawing on universal ones.

However, a number of participants argued for more diversification and flexibility of the DDI Methodology in order to allow teams to take a full DDI or part of a DDI experience according to their needs. The following quote is illustrative:

> *"it would be perfect if we had different versions of the DDI...for instance we only needed to revise some of our units, not the entire program, so having to spend time on program level discussions felt a bit like a waste of our time".*

5. The DDI process revisited

As a result of the feedback provided, four iterations (models) of the DDI process were created and are currently piloted across many initiatives at the University. These are:

- 1. DDI Programs. This model supports academic teams to develop a new program from a pool of existing units. The emphasis is on the development of the philosophy of the new program, how this philosophy promotes implementing new and emerging technologies and then on aligning/redesigning existing units (from the same or different faculties) to meet the outcomes of a new program.
- 2. DDI Zero. This model supports academic teams towards the development of a new program that requires development of new units. The emphasis is on the development of the philosophy of a new program and the development of new units assuring best alignment between program and units and best use of new and emerging technologies.
- 3. DDI Units. This model supports academic teams to develop new units in an existing program. The emphasis is on making sure that new units are developed in a way that best fit the overall philosophy of the program and demonstrate best use of new and emerging technologies.
- 4. DDI+. This model supports academic teams to align existing units within an existing program. The emphasis is on the review of existing units and the application of small changes (interventions) across some or all of the units within an existing program to promote best use of new and emerging technologies.

6. Conclusion

One of the most challenging tasks in LD is the ability to translate Learning Design ideas into meaningful and contextually useful learning events (activities, tasks) for students, using Learning Design Frameworks. This paper argues the case for the expansion of Learning Design Frameworks to include more holistic, program level and sustainable methodologies as a way forward for the Learning Design movement. Since the DDI is all about 'connecting people' , the questions about sustainability is not so much about the number of people involved but about working smartly together to get the best possible outcome in a feasible timescale. We recommend that the DDI process can support the program level design and technology integration but:

- Program directors and academics need to be 'trained' in the DDI methodology, they need to be familiar with the templates and recourses available to them to initiate a DDI and they take ownership of the process with their teams. The DDI can and should become a process that empowers program directors to fulfil their roles as gatekeepers of the curriculum.

- Executive Leadership across the University should initiate a round of DDI sessions under a Strategic Priority theme. For example, they may wish to nominate academic teams to participate in a DDI process with an aim to redesign aspects of their programs and units for making best use of physical and digital spaces, or better linking between teaching and research.
- Aspects of the DDI methodology can be used in conjunction with other established processes in a university (e.g. linked with internal grant applications for Learning and Teaching or with an award and recognition scheme).

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Game-Based Learning With OER in Higher Education: Development and Evaluation of a Serious Game

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Abstract: Digital games, such as app or video games, are anchored in everyday life. They are interconnected with learning processes. Players learn the applicable rules, for example. Games have motivational effects, enable players to take on active roles and challenge to action. These characteristics fulfil the requirements for active learning in current didactic concepts. However, there is few empirical research on the use of games in higher education. The available findings are limited mainly to simulations. Systematic studies on whether playing serious games is appropriate to acquire competencies for learning objectives in higher education that can be transferred to non-gaming topics and situations, or on the learning effectiveness of game-based learning are pending. Hamburg University of Applied Sciences is currently producing a serious game on the topic of scientific working (such as writing a thesis) to test game development and the use of game-based learning in higher education. Objective is to develop a game for higher education based on central characteristics of games and game-based learning that combines entertainment experiences and learning processes. The integration of existing Open Educational Resources (OER) supports in-game learning processes. The game itself will also be an OER. Another objective is to gain empirical results on usability and effectiveness of the developed game. To achieve this, literature on game characteristics is reviewed first. Second, a model for iterative game-conception processes is developed and the game produced accordingly. Third, triangulation-based evaluation tools are designed. Initial results confirm the benefits of an iterative approach. Users continuously test the game throughout the development process to agile evolve it based on their feedback. The developed evaluation tools support the systematic recording of this feedback and allow a high usability of the game from the beginning. Next step will be to evaluate the learning effectiveness of the game and the experience of using game-based learning with OER in higher education in order to derive recommendations.

Keywords: game-based learning, serious games, higher education, open educational resources, evaluation

1. Introduction

The current generation of students mainly belongs to generation Z, born in 1995 or later. They are digital natives (Michel, 2014), self-confident, looking for self-expression and recognition and motivated by extrinsic incentives (Combi, 2015). Intrinsic incentives, such as fun in one's own performance, as well as social and altruistic motives lose their strength, whereas leisure becomes a value (Scholz, 2014). This generation wants to do things that are fun. If they are fun, private and professional problem-solving processes can lead to an increase in intrinsic motivation (Scholz, 2014). In these cases, they can be very persevering in working on them, for example when playing video games. Video games are anchored in everyday life (Tillmann and Weßel, 2018). In Germany, for example, about half of the citizens, men and women from all educational backgrounds and social classes, played digital games in 2015 (Niedermeier and Müller, 2016). Although there is research on games' motivational effects and contributions to active learning processes, insights into the use of these effects for learning in higher education are hardly available.

Games are not widely used in higher education in Germany. Exceptions are simulations, which are usually not presented as video games (Hitzler, Zürn and Trautwein, 2011). The question whether game-based learning is appropriate for learning in higher education is discussed controversially (Michel, 2014). However, the Shift from Teaching to Learning has brought learners and their active role in learning processes to the centre of attention (Niedermeier and Müller, 2016). Game-based learning is one didactically based approach to promote active learning (Gros, 2007). Nevertheless, the systematic analyzation of the development and learning effectiveness of video games in higher education is a research gap (Kerres, Bormann and Vervenne, 2009; Niedermeier and Müller, 2016).

To examine game-based learning for learning objectives in higher education, a serious video game on the topic of written scientific work is currently being developed and evaluated at Hamburg University of Applied Sciences. To address the research gap, a model for the game development process and evaluation tools are designed. Game development regards characteristics of games and game-based learning and a moderate constructivist view of learning processes. It is a participatory and agile process based on formative evaluation results on usability and learning effectiveness. After several iterations, the game will be provided as OER with a Creative Commons License. OER are open, free-accessible content, material, tools, repositories and courses that support formal and informal learning, teaching and/or the quality of education (Downes, 2007). Benefits are the division and cooperative development of content. The provision of the game as OER enables the use for a large number of participants who are not restricted to one university. The use of the game will be evaluated to gain insights into the use of game-based learning and OER in higher education.

This paper summarizes characteristics of games and game-based learning derived from a literature review (2), the project running at Hamburg University of Applied Sciences (3), the game development (3.1), the evaluation design and initial results (3.2). Finally, upcoming steps are outlined (4).

2. Games and game-based learning

This literature review is the basis for deriving requirements for the design of learning games, which have to be considered in game development. Since comparable serious video games for higher education are missing, it is limited to general characteristics of games and game-based learning.

Game theories of the 20th century describe games as voluntary and enjoyable activities within fixed limits of time and space (Michel, 2014). Although they are governed by rules, they are uncertain and separated from the real world (Caillois, 1961). Players do not produce goods of external value and costs of errors contain within the game (Garris, Ahlers and Driskell, 2002). Games have the power to engage users, when they satisfy human needs, such as the pursuit of effectiveness or feedback on one's own actions (Michel, 2014).

Video games fulfill these requirements in a special way. These electronic games enable users to interact and gain visual feedback on a screen via a user interface. They allow immersion in stories and respond directly and immediately to input. Through the experience of influencing the gameplay, players perceive their own effectiveness (Klimmt, 2008) and self-efficacy, which is motivating, enjoyable and supports entertainment and flow processes (Tillmann and Weßel, 2018). Klimmt (2008) explains that this is the reason why people play video games persistently and repeatedly: Well-designed games create stimulating situations with a constant change between tension and relief experiences through challenges and positive solutions in attractive play worlds. In addition, it is possible to gain simulated life/role experiences by identifying with and acting as a character of the game.

Game-based learning describes the use of games and positive game experiences in educational contexts with serious intentions such as to promote learning processes (Michel, 2014; see Meier and Seufert, 2003 for a classification of digital learning games). "Unfortunately, there is little consensus on game features that support learning, the process by which games engage learners, or the types of learning outcomes that can be achieved through game play" (Garris, Ahlers and Driskell, 2002, p. 442). Garris, Ahlers and Driskell (2002) have therefore worked out aspects of games that enhance learning: fantasy, rules/goals, sensory stimuli, challenge, mystery, and control. Gee (2005) has differentiated them into principles for learning in good games: empowered learners, problem-solving and understanding (see for example Michel 2014 for additional aspects to consider when designing learning games). Although games and learning processes are interconnected, players usually do not perceive playing games as learning situations (Kerres, Bormann and Vervenne, 2009). The use of games in serious contexts attempts to transfer the involvement of playing to other topics, so it is important to balance fun elements and learning units (Niedermeier and Müller, 2016).

Game-based learning is criticized for not using games in the sense of the term, as they are didactically instrumentalized and there is a lack of voluntariness in formal educational contexts (Kerres, Bormann and Vervenne, 2009). Michel (2014) argues that motivational characteristics nevertheless come into play when learners recognize the importance of the game in learning contexts. In addition, playing can facilitate flow experiences. Game-based learning encourages self-efficacy experiences, motivation and emotion (Klimmt, 2008; see Gros, 2007 for didactic success factors in the implementation of game-based learning). Niedermeier and Müller (2016) state that the special potential of game-based learning is the promotion of active, self-determined/-directed and experience-based working on learning content as well as an increased positive perception of learning in realistic and risk-free environments. In addition to working on learning content, learners can understand complex relationships and developments at a metacognitive level. Problem-based learning in authentic situations thus supports the transfer of the learned into everyday life (Kerres, Borrmann and Vervenne, 2009). Tillmann and Weßel (2018) emphasize the importance of (immersive) reflection for successful transfer. There is no optimal learning environment for all learners, it is rather important that learners, learning content and methods fit together (Niedermeier and Müller, 2016). Game-based learning is particularly suitable for content that is perceived as uninteresting, and/or for target groups with low learning motivation, self-control, and/or with an affinity for games (Meier and Seufert, 2003).

Game-based learning uses different types of gamification elements and games, such as simulations (Garris, Ahlers and Driskell, 2002) or serious games (Niedermeier and Müller, 2016). What they have in common is the support of learning through playful methods; however, they are used to promote competency in problem-based learning processes (Niedermeier and Müller, 2016). For the conception of learning games, their didactic design is particularly important (Michel, 2014). Common approaches to didactic design are edutainment, communication-oriented (to stimulate dialogue on content aspects) and construction-oriented approaches (to encourage learners to participate in development) (Klimmt, 2008).

Figure 1 gives an overview of the game characteristics presented in this literature review. These characteristics have been included as basic requirements in game development.

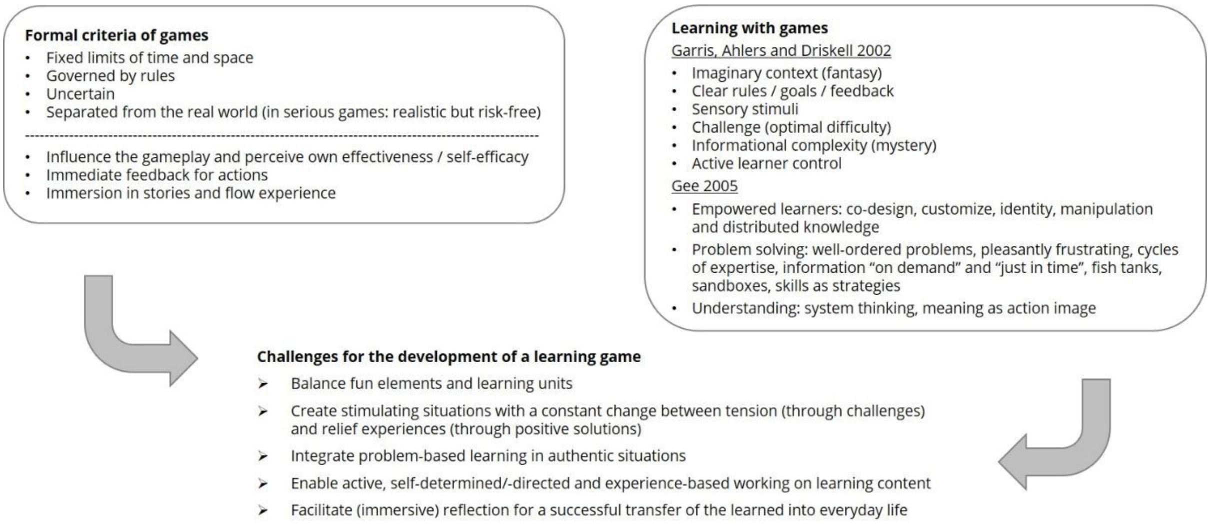

Figure 1: Characteristics of games and game-based learning

The game development bases on an edutainment approach. It is assumed that linking entertaining aspects to learning content has positive effects on motivation and acquisition of competency (Klimmt, 2008). To stimulate learning processes the game is embedded in a didactically prepared learning situation, where transfer and reflections take place. In addition, didactically prepared learning tasks are integrated into the game because players accept the change between play and learn mode only as a brief interruption of the game flow (Kerres, Bormann and Vervenne 2009). The creation of learning games requires formative evaluation to reduce the risk of didactic failures (Klimmt, 2008). The next section presents the project (3), the development of the game (3.1) and the evaluation design (3.2).

3. HORST – Hochschul-OER reloaded: ein Spiel mit Transfer (University-OER reloaded: a game with transfer)

The project "HORST" serves to test and explore game-based learning and OER in higher education. This is supported by the design of a serious game in which existing OER are integrated to develop a new learning arrangement, also offered as OER. Benefits associated with OER, such as adaptation options, are taken into account. Hamburg Open Online University (HOOU), a network of Hamburg's state-owned universities and stakeholders, funds the project. HOOU produces interdisciplinary and across universities open learning content that meets academic requirements. Produced OER are made available to the interested public for sharing and editing. Some produced OER are reused in the project "HORST".

Central learning content of the project is scientific working. This topic was selected because it is relevant and typical for higher education. In addition, this is a content that target groups perceive as rather uninteresting and that is associated with a low motivation to learn. Meier and Seufert (2003) suggest selecting such content for game-based learning, as games show their special potential. Another reason for choosing the topic was the possibility to integrate existing OER into the learning setting.

Target group are students of all disciplines in German-speaking areas. Potential users are also prospective students who want to gain first impressions of scientific working, and students in higher grades who have to write papers. Previous knowledge is not available or required. Since all learning materials are OER, adaptations for other users are possible.

Users should achieve these learning outcomes: Learners can apply methods of scientific working to write academic papers, by researching topics, formulating research questions, analyzing, selecting, and citing literature, implementing an argumentation structure and assessing facts. In addition, they can reflect their work based on scientific quality and evaluation criteria and give and take peer-to-peer feedback. They develop their own learning strategies and literacy. The ability to solve problems in unknown situations is encouraged. On a meta-level, learners gain experiences in virtual spaces and with digitally supported learning.

To promote the achievement of these learning outcomes, the point-and-click adventure game "Homework with Horst: Learning to work scientifically by playing" is being developed. To integrate learning content, there are links to existing OER. While playing one can watch thematically matching videos, for example. According to the intended learning outcomes, the game is divided into the levels “research question”, “selection and analyzation of literature”, “bibliography and citation”, “argument structure” and “conclusion and discussion”. After each game level, learners work on transfer tasks. These invite learners to apply the learned to their own questions. Learners receive and give peer-feedback on their solutions before they proceed with the next level. The game-based learning approach links entertaining game aspects with learning content, transfer tasks and gamification elements (badges). This supports the combination of play and learn mode and the implementation of a didactically founded game-based learning arrangement. Playing a level takes about one to two hours, including working through learning materials. The individually different time needed to work on the transfer tasks must be added.

The game can be a spatially and temporally flexible usable content in individual learning processes or part of lectures. The HOOU-project “Media 4.0” has developed a learning arrangement for teachers on the use of game-based learning in higher education. This refers to the developed game in a flipped classroom scenario.

In addition to learning outcomes for scientific working, options for individualizing the game are included. Programming code and files are provided openly so learners can try out game development. For this additional learning outcome, there will be a tutorial for editing the game.

3.1 Game

Essential in the “HORST”-project is the conception, implementation and formative evaluation of the game “Homework with Horst: Learning to work scientifically by playing”. This section summarizes the development and the game story.

The author leads the project and works with a colleague on the development of the game. This includes story-design, description of characters and rooms within the game, selection of OER and quality assurance of all processes. The start-up Cybersquid produces the game. In addition to programming Cybersquid does the audio-visual editing of the game, such as the drawing of characters based on given descriptions.

All selections related to the game are made to reduce access barriers for target groups. The game engine Unity was chosen because it offers a license model that allows to use the software for free under certain conditions. Anyone can download it and edit the game, which promotes an OER deployment. The platform for the game was determined to be playable in the web browser. This allows players the most flexible access. They do not have to download the game to specific devices or use specific operating systems. All dialogues and sounds are audible and readable in subtitles. This reduces barriers to use the game and recalls the fact that learning is the more effective the more senses are addressed (Michel, 2014).

Purpose of the game development is to link entertainment experiences with learning processes. As described (2), there are several factors in games that influence entertainment experiences (Klimmt, 2008) and enhance learning (Garris, Ahlers and Driskell, 2002; Gee 2005). In terms of learning processes, a moderate constructivist perspective is the theoretical basis of the game. Reinmann and Mandl (2006) discuss that knowledge and skills cannot be passed on to others, but must be actively acquired by learners in self-directed, constructive, situated, emotional and social learning processes. Learning environments that enable such processes are authentic, complex in design, and encourage learners to work on real problems. To support problem-based learning, instructions are integrated, for example for the self-directed handling of tasks (Niedermeier and Müller, 2016). These requirements for the design of entertainment experiences and learning processes were taken into account in the development of the game.

At the beginning of the development, target groups and objectives were defined. According to the project, students of all disciplines are the main target group. Purpose of the game is the development of competency for written scientific working in an entertaining way. To define learning content, typical problem situations were qualitatively elaborated. The identified critical incidents led to a first game idea and were considered as game levels (3).

As part of a storytelling workshop, key elements of the game story were worked out: Starting point of the game is a room in the dorm (Figure 2). Kim, the main character, is a student living there. When players meet Kim for the first time, she looks forward to a day off until she receives an e-mail from a professor to whom she has just submitted a paper. Kim should come to his office immediately (event). When Kim arrives, he tells her that she failed because her paper does not meet scientific standards. It depends on a good grade, if Kim is able to continue to study the same courses with her friends and stay in the dorm, which requires that there are no repetitions in her studies. Kim therefore asks for a revision option. He allows her to resubmit the paper if scientifically revised. Kim faces the conflict that she does not know how to do it. Her mission is to find that out and revise her paper. Players accompany Kim through an unusual university with surprising and entertaining incidents. Kim meets people who support her, but also an opponent who impedes her (probation). Task for players is to solve various puzzles in written scientific work with Kim (sense of achievement). For this, OER has to be worked through at various points in the game. End of the game story is the information of the professor that Kim has passed with her revised paper and can continue to study as planned.

Figure 2: Demo-scene (Drawing by Cybersquid)

Another part of the storytelling workshop was the description of the important characters in the game (hero, mentor, threshold guard, opponent, fool; Figure 3). On this basis, a script for the game with places, characters and actions was developed.

Figure 3: Characters (Drawing by Cybersquid)

Cybersquid received the script with a description of technical requirements. On this basis, they produced the game progressively and in regular consultation with the involved scientific staff. As a basic principle of user-centred design (Olsen, Procci and Bowers, 2011), game elements are continuously tested with target groups and stakeholders throughout the development process to receive feedback (formative evaluation, 3.2). Adaptation steps, for example in the design of characters, narrative texts or the game structure, can be incorporated into further development. This enables an agile and participatory process, which should be completed by October 2018. Completed means that a didactically based, entirely playable beta-version of the game will be provided. Target groups will test it with a focus on usability criteria and learning effectiveness. Figure 4 summarizes the described steps in the game development process:

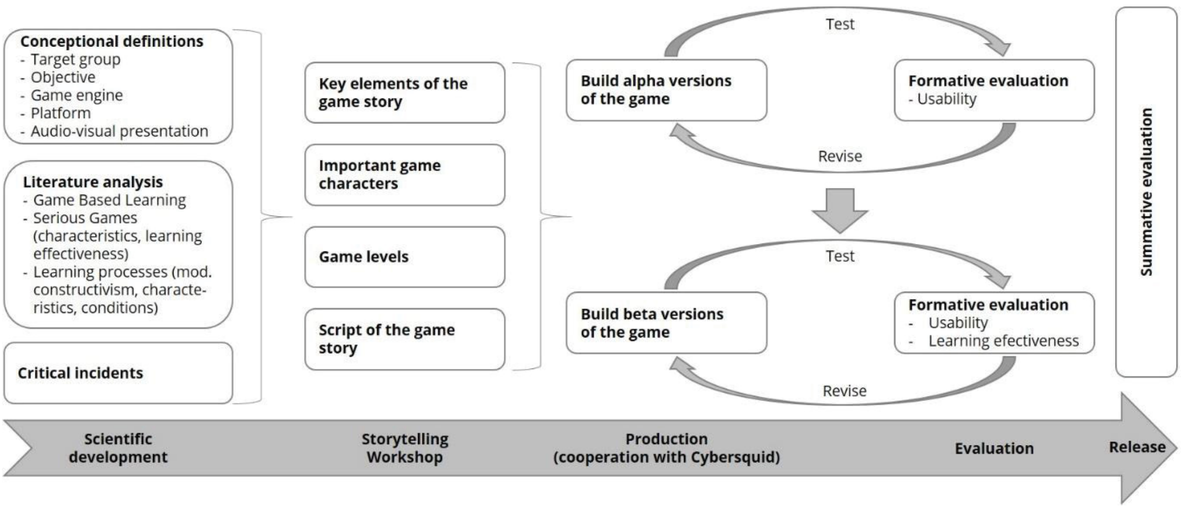

Figure 4: Game-conception

The game will be released as editable OER including program code and a tutorial for editing. Further developments and modifications are desired, including changing or translating dialogues, adding and changing game levels, exchanging learning materials, or adapting to different topics. The embedded OER can be used outside the game. Within the game, OER are interchangeable and can be adapted to different needs of learners or to university requirements.

3.2 Evaluation

The game is evaluated in the development and application. “Issues in usability can drastically impact user experience and thus the learning outcomes associated with serious games” (Olsen, Procci and Bowers, 2011, p. 625). Reasons include the fact that low usability leads to a decrease in motivation and an unnecessary cognitive load (Olsen, Procci and Bowers, 2011). In the development of the game, the focus is on usability, which includes playability, immersion and flow. Systematically collected feedback from test users will be integrated into further development of the game. This is a participatory and agile process based on formative evaluation results. The beta-version of the game, developed in this iterative process, will be reevaluated with a focus on learning effectiveness. The research design (3.2.1) and first results on the usability of the alpha-version of the game are presented (3.2.2).

3.2.1 Research context and methodology

There are few empirical findings on the use of game-based learning and serious games in higher education. This applies in particular to German-speaking countries, whose university systems differ from others such as those in Great Britain. Theoretical basis for game development are therefore mostly general insights into game characteristics. Available literature on the learning effectiveness of games deals in particular with children as target groups or simulations in vocational education (Niedermeier and Müller, 2016).

For the development and evaluation of the game "Homework with Horst", a design-based research approach was chosen. The practical development of the game is based on available theoretical insights. This allows the testing and research of new didactic concepts, even if they are used to a limited extent under real conditions (Hueber, 2016). For the game, this means exploring various aspects within the development process to derive design principles. Theory, design, practice and evaluation results are continuously compared and used for further developments (Hueber, 2016). Such iterative processes are based on in-process surveys with a formative evaluation design, which follows evaluation standards and quality criteria. The intended result of the design-based research on the game is the development and testing of what Euler (2014) calls a theoretically founded practical solution that allows situation-specific and generalizable findings. In terms of the game, it is not just about the usability and learning effectiveness of this specific game. The research questions rather include gaining empirical insights on the use of game-based learning and OER in higher education.

To obtain results for the mentioned research interests, the evaluation design is based on a mixed methods approach, triangulation. In this research strategy, different methods are applied to a phenomenon and/or different data sources are used to investigate it. This serves to increase the validity of the research results, to reduce systematic errors and to uncover unexpected causal relationships through a partially explorative approach (Flick, 2011).

The usability of the game is evaluated using qualitative and quantitative methods. The methods survey, observation and content analysis are combined to include objective circumstances, opinions, attitudes and actions in the analysis.

First, there is the observation of users who play a (typical) part of the game for the first time without prior instruction to analyze whether the game control is intuitive to use, tasks are solvable and information is easy to find and understand. In addition, aspects of game-flow and joy of use as well as challenges and difficulties of the players are documented (see for usability criteria Olsen, Procci and Bowers, 2011 and Frommann, 2005). An observation guide was developed based on these research interests. In an open non-participatory observation, interactions of users with the game are systematically recorded. For the evaluation of the observation protocols, the notes are clustered.

While users play the game, they should think aloud and verbalize their thoughts, impressions, feelings, intentions, and actions in the use of the game to understand how users approach the game and tasks in real time (Frommann, 2005). Focus is on ease of use. Insights into mental processes, especially with regard to problem-solving, should identify those aspects that may not be accessible with post-surveys. The interactions of players with the game and their verbal utterances are recorded with a screen capture program. Their feedback is transcribed and analyzed content-analytically with a coding scheme based on the research interests. Because verbalizations present cognitive challenges to players and can limit flow-experiences (Olsen, Procci and Bowers, 2011) the collected data is analyzed in combination with the other results.

After playing the game, the testers complete a written survey on usability criteria. A standardized and structured questionnaire is used to collect their feedback. In addition to the rating of the played sequence and the intended reuse of the game, the focus is on satisfaction with game elements and user experiences (Laugwitz, Schrepp and Held, 2006; Olsen, Procci and Bowers, 2011). The questionnaire contains mostly closed questions with response specifications (completely verbalized Likert scales and semantic differentials at ordinal scale level). Two open questions to substantiate ratings and questions on socio-demographic information are added. Results are analyzed using statistical methods.

Results on the usability of the game are summarized and recommendations for revision are derived. These are used for further work on the game.

After evaluating alpha-versions, a completely playable beta-version will be built. "Finally, it is essential that learning outcomes be measured for individuals during the testing phases of the game to ensure that the game achieves its primary objective before too much time, effort, and budget have been committed to the project" (Olsen, Procci and Bowers, 2011, p. 627). The beta-version will be evaluated with testers from the target group, focusing on learning effectiveness of the game in relation to defined learning outcomes. Influencing factors will be operationalized with Technology Acceptance Model 3 (Venkatesh and Bala, 2008) to design a questionnaire. This will be combined with pre- and post-game learning assessments to analyze prior knowledge (multiple-choice test) and learning achievements (transfer tasks that are part of the game's learning arrangement). Results will be summarized with recommendations for revision of the game in further development.

The final draft of the game and learning arrangement will be released as OER for free use and development. Users will be invited to participate in a summative evaluation (survey) to generate in-depth empirical evidence on the use of game-based learning and OER in higher education. At the same time, optimization potential regarding usability and learning effectiveness of the game will continue to be raised. Findings will be provided to OER-community to initiate a continuous improvement process.

3.2.2 Initial results and discussion

Feedback on character designs and usability evaluation results for the alpha-version of the game-demo is available from ten test users (n=10). They were between twenty-one and sixty-three years old, men and women in equal quantity and had different experiences with games. As part of the iterative game development with continuous evaluations, further results will be generated in the ongoing process.

The character designs (Figure 3) were rated positive. The testers associated the intended attributes with the characters and properly assigned them the intended functions in the game story. It is concluded that the character designs are suitable for supporting the game story. One user gave the hint to increase diversity. This is considered for further design. The professor (Figure 3, left-hand side) will be revised so that a southern European migration background can be associated with him. In addition, other characters appearing in the game will be designed diverse in terms of culture, age, worldview, dialects, and so on.

Testers also rated the game usability as good. They highlighted the liveliness of the game scene, the attractiveness of the graphic style as well as the comprehensibility and linguistic usage (6-mostly and 7-completely satisfied on a 7-step Likert scale). This is consistent with the results of the observation and think aloud protocols. The richness of detail in the game scene as well as humorous details and dialogues have supported the joy of use for players. This is maintained in the further design of the game. For three older testers the game control was not intuitive. The other users understood the functions immediately, although there was no explanation before. All players said the game was easy to learn and it was observed that they were able to solve the tasks of the game. It is assumed that the game control will not cause any problems for the target group. Nevertheless, a practice task for testing the game control will be added to the first game scene. There will also be a hint players can recall when needed.

For in-depth analyzes and statements, especially on the gameplay and user experience, further tests are necessary. For this purpose, a second alpha-version of the game is being built. Results of the first test will be implemented. This version will go beyond a demo, as the first levels of the game will be completely playable (although artwork and sounds will not be final).

4. Conclusion

Entertainment experiences are particularly important for generation Z and can increase motivation in problem-solving processes (Scholz, 2014). Playing games was therefore considered as a didactic approach to promoting active learning. Few research results are available on the use of (serious) games in higher education. For this reason, general characteristics of games and game-based learning were summarized. The project “HORST”, in which the game “Homework with Horst” is being built, was described. Intention of the project is to implement and explore game-based learning in higher education. As the game integrates OER as learning material and will be provided as OER itself, insights into the use of OER in this context are gained as well. Focus of the paper was on the description of the game-conception (3.1) and the evaluation design (3.2). The results shown may help others to plan and evaluate game development.

The chosen multi-level approach to evaluate the game development formatively enables an iterative process. Usability, including entertainment experiences, and educational merits are analyzed at different stages of the process. The regular integration of the results in the further work on the game ensures that a functional, enjoyable and learning-effective game will be developed. The test of the first alpha-version of the game with ten users has led to insights that are incorporated into further development. As supposed by Olsen, Procci and Bowers (2011), it has been confirmed that even tests with a few participants from an easily accessible population lead to an improvement of a serious game at an early stage. The first evaluation results have shown that users are satisfied with the “Look & Involvement” (Niedermeier and Müller, 2016, p. 197) of the game.

A second alpha-version of the game is currently under construction. In this version, game levels will be completely playable and allow detailed usability testing with the developed toolkit. The results will be included into the construction of the beta-version. Data will be collected on the learning effectiveness to discover further optimization potential. In addition, insights will be gained on the use of the game and game-based learning with OER in higher education. As OER, the game will be accessible to a large group of learners who will be chosen as participants in a summative evaluation. By providing a learning opportunity for teachers on how to use game-based learning in higher education, evaluation results can also be obtained from their perspective. At the same time, there are possibilities to change the game within the OER-community. An extension of user groups may be associated with other research questions.

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The Effects of Content Design and Usability on Acceptance of Proposed Cloud-Based e-Learning Framework

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Abstract: In this digital age where state-of-the-art technologies are evolving swiftly, innovative learning pedagogies have to be accelerated to empower more effective knowledge transfer and engage in lifelong learning. The conventional e-learning approaches have become insufficient to handle the requirements of upgraded learning processes especially in the higher education. The emergence of Cloud computing delivers a significant breakthrough and has gained considerable acceptance in e-learning field. However, despite the readiness of Cloud infrastructures for collaboration and wide accessibility such as Web 2.0 tools, the progress of redefining learning objects to suit e-learning in Cloud environment is not so encouraging. So far, there has been rather little activity being carried out to ensure that e-learning applications are being designed in such a way that promote flexibility use of the learning content. With the availability of Internet and Cloud computing, an e-learning framework utilizing Cloud technology is envisioned. This paper describes a study on the effects of content design and usability on the acceptance of proposed Cloud-based e-learning framework. The study was conducted on a group of 350 IT undergraduates in one of the private universities in Malaysia to evaluate the acceptance of the proposed frameworks. The students were given one trimester to experience the usability of the learning modules developed based on the proposed Cloud-based e-learning framework. As an instrument to analyse the effects of content design and usability on the framework acceptance, a questionnaire consisting twenty four questions was devised and used. There are two independent variables, namely Content Design (CD) and Usability (U), and one dependent variable, namely Acceptance (A), in the research instrument. The results were analysed and reported by running the data in a few statistical tests using SMARTPLS 3.0. The results from this study observed that Cloud-based e-learning modules developed based on the proposed Cloud learning framework is positively accepted by IT undergraduates in the private university. This implies that the proposed Cloud-based e-learning framework can be engaged in the development of a new e-learning infrastructure or application in the future.

Keywords: cloud learning framework, cloud-based learning, usability, acceptance study, SMARTPLS3

1. Introduction

Resulting from the swiftly evolving digital technologies, e-learning has been technologically advanced over the years. E-learning supports learning process through the Internet. Internet technology has been extensively used as an intermediate to design, implement and support learning process, especially in higher education (Wang, Lau, Lew, & Leow, 2015). The conventional e-learning approaches are no longer sufficient to cater for the requirements of upgraded learning processes especially in higher education. "Higher education is emphasising more on higher order experiences and outcomes which requires a major transformation in knowledge and communication-based society" (Thomas, 2011). The conventional approaches lack the ability in solving the challenges of optimizing the allocation of resources, handling the requirements for enormous storage growth of multimedia elements, and cost distribution (Wang, Lau, Lew, & Leow, 2016). Besides that, the learning content in conventional learning approaches is inflexible to contribute to the highly distributed learning resources. Reusability and shareability of the learning content is limited by its rigidity (Wang et al., 2015).

The readiness of the state-of-the-art Internet and Cloud technologies inspires the envisioning of an e-learning framework employing Cloud technology to promote the flexibility of learning content and to address the issues of the conventional learning approaches. This paper describes the proposed Cloud-based e-learning framework and its learning module development. Subsequently, the effects of content design and usability on the acceptance of proposed Cloud-based e-learning framework is assessed among IT undergraduates in a private university in Malaysia. A comprehensive Cloud-based learning module is designed and developed utilizing a wide range of Cloud learning tools and Web 2.0 tools. A group of 350 samples of IT undergraduates were selected to experience the usability of the learning module for one trimester. A set of 24-question Likert-scale questionnaire was devised and distributed for the acceptance measurement. The collected result was then compiled and analysed.

2. Background study for the proposed Cloud based e-learning framework

In the midst of rich literatures, numerous published Cloud learning frameworks serve as decent means and guidelines in the process of envisioning on the proposed Cloud-based e-learning framework. Among the notable frameworks, namely CloudIA (Sulistio, Reich, & Doelitzscher, 2009), BlueSky (Dong, Zheng, Qiao, Shu, & Yang, 2009), EUHC (Saidhbi, 2012), Academic Cloud (Madhumathi & Ganapathy, 2013), CEL (Kaur & Chawla, 2014), etc. offer innumerable benefits to their audiences by incorporating Cloud computing in e-learning landscape.

In one of the remarkable literatures for Cloud learning framework, a well private Cloud architecture along with its modules and components such as Monitoring Management component, Security component, etc. was presented (Sulistio et al., 2009). However, the implementation for the Cloud-based learning has not been discussed. In the same year, another similar e-learning framework called BlueSky Cloud framework was presented (Dong et al., 2009). Resource utilization and scalability issues in e-learning were resolved in the framework. However, the security aspect for the Cloud framework has not been addressed. Shaik Saidhbi (Saidhbi, 2012) presented Ethiopian Universities Hybrid Cloud (EUHC), which offers the joint benefits of public and private Cloud by adopting hybrid Cloud in Ethiopian universities. However, the framework proposed was very much customized to suit their IT infrastructure which may not necessarily be compatible for e-learning infrastructure in other countries. In 2013, an relatively complete academic Cloud framework was presented (Madhumathi & Ganapathy, 2013). However, detailed specifications on learning content in the Cloud have not been discussed. In the subsequent year, Kaur and Chawla presented a Cloud based E-learning as a platform to implement advance Java e-learning in Cloud (Kaur & Chawla, 2014). The frameworks described well-defined learning content in its Learning Application layer. However, the learning content was too customised for Java e-learning.

From the results of literature studies, the strengths of the existing Cloud learning frameworks are adopted as value added into the present research. A Cloud-based e-learning framework has been proposed for the shaping of a new education domain that shares the Cloud characteristics particularly reusability and shareability (Wang et al., 2016). The proposed Cloud-based e-learning framework, illustrated in Figure 1, consists of five layers, namely User Interface Layer, Application layer, Cloud Management Layer, Data Information Layer, and Virtual Infrastructure Layer. Each layer in the framework consists of various components.

- User Interface Layer: It acts as interface between learners and Cloud infrastructure. Web browser enabled devices can be used to access the Cloud-based e-learning objects.
- Application Layer: This layer comprises e-learning systems, content repository and learning tools. E-learning application provides the functions and interaction interfaces for learners to acquire knowledge and information.
- Cloud Management Layer: By the means of its four components namely Provision Manager, Common Services, Load Balancing, and Monitoring, it maintains and manages resources of the e-learning infrastructure.
- Data Information Layer: It mainly contains the e-learning content. The proposed Cloud-based e-learning objects which are flexible, reusable and shareable, are located and managed by this layer. Aided by wide availability of various Cloud and Web 2.0 tools, Cloud-based e-learning objects can be easily produced and stored in the Cloud.
- Virtual Infrastructure Layer: This layer enhances the transparency of hardware by virtualization, and realizes resources handling. There are two components in this layer namely Virtual Storages and Machines, and Physical Hardware.

3. Research methodology

To investigate the effectiveness of the proposed Cloud-based e-learning framework, an experimental research was conducted among a group of IT undergraduates in Multimedia University (MMU), Malaysia. Based on the proposed Cloud-based e-learning framework, a comprehensive learning module for a subject called TKM3151 Knowledge Management (KM) is designed and developed utilizing a series of Web 2.0 and Cloud learning tools. Google Apps for Education (GAFE) is the main approach in our Cloud-based learning module development. GAFE is a core suite of productivity applications offered free of charge by Google to education landscapes. In our Cloud-based learning module, Google Classroom serves as the platform to provide a flexible and personalized learning. Students will be able to personalize their own learning process according to their own pace and speed of mastering the learning content. Incorporated into Google classroom is the Blendspace, where all the learning content are compiled and shared to students. Multiple modes of learning through the varieties of Cloud-based learning objects are provided in multiple formats and modalities, for example, still infographics, animated diagrams, short videos, interactive web, etc.

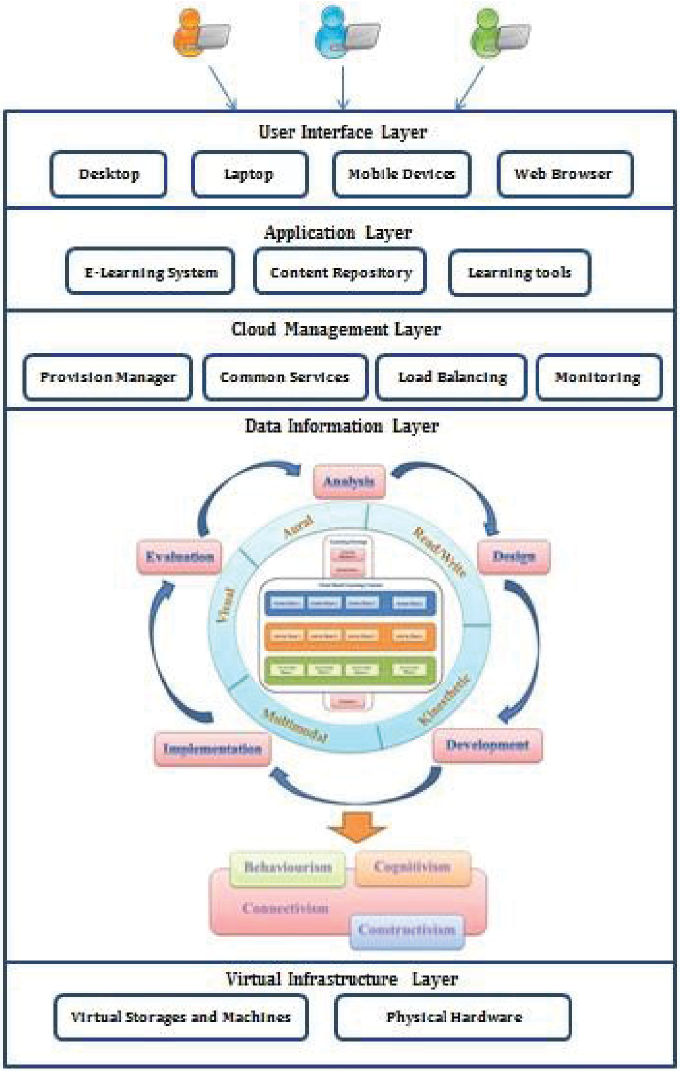

Figure 1: Proposed cloud-based e-learning framework (Wang et al., 2016)

Succeeding the proposed framework, learning objectives, introduction and summary are designed and incorporated into every lesson to produce a comprehensive instructional experience. Learning objectives serve as the hub of the lesson by describing the anticipated instructional outcomes after the learners have experienced the Cloud-based learning objects. Learning content, learning activity and assessment assist learners to achieve the learning objectives. The Assignment module which makes use of Google Drive in the Google Classroom, allows lecturers to create and share the assignments, and enables students to submit their assignments in a paperless way. Information sharing and collaborative learning can be achieved via GAFE. Students are able to collaboratively work on the same word document from different devices at the same time via Google Docs. Collaborative learning can be similarly achieved via Google Sheets, Google slides, Google Drawing, etc.

Subsequently, a group of 350 samples of IT undergraduates taking KM subject were selected to experience the usability of the Cloud-based learning module for one trimester, approximately four months. TKM3151 Knowledge Management is a core subject for IT Management major, at the same time, it is an elective subject for other majors in the IT faculty in MMU. Due to the theoretical nature of this subject, teaching KM in a conventional way can be very challenging. Therefore, the Cloud-based learning module was developed to facilitate an improved learning for this subject. Proper guidance was provided along the way to ensure learners' comprehensive experience on the learning module. For assessment purposes, a set of 24-question Likert-scale questionnaire was formulated. The questionnaire is set for self-perceived characteristics; therefore the questions are phrased to be of self-understanding of the respondents. Since the learning module is designed for IT undergraduates, the questions are also expressed in the context of IT undergraduates. The 5-scale Likert style questions are labelled from “Strongly Disagree”, “Disagree”, “Neutral”, “Agree” and “Strongly Agree”, scaled from 1 to 5 respectively. The instrument was designed to analyze the effects of content design and usability on the framework acceptance. A theoretical model and two hypotheses are devised, as illustrated in Figure 5.

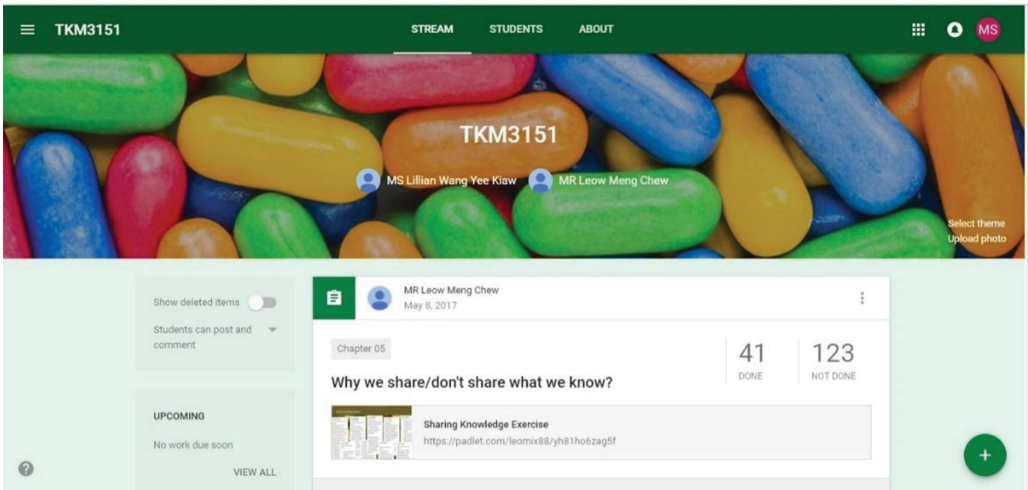

Figure 2: Assignment module in Google Classroom (Source: Screenshot from Google Classroom)

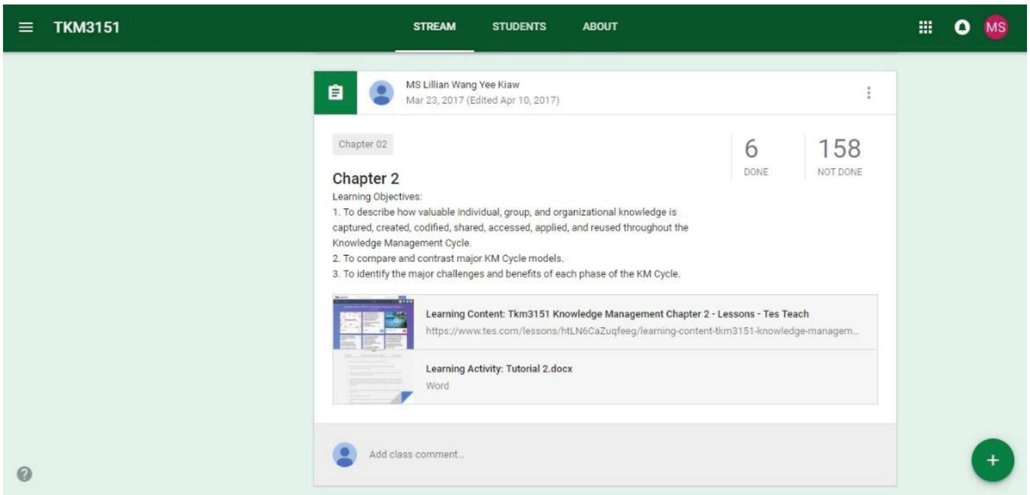

Figure 3: Learning module in Google Classroom (Source: Screenshot from Google Classroom)

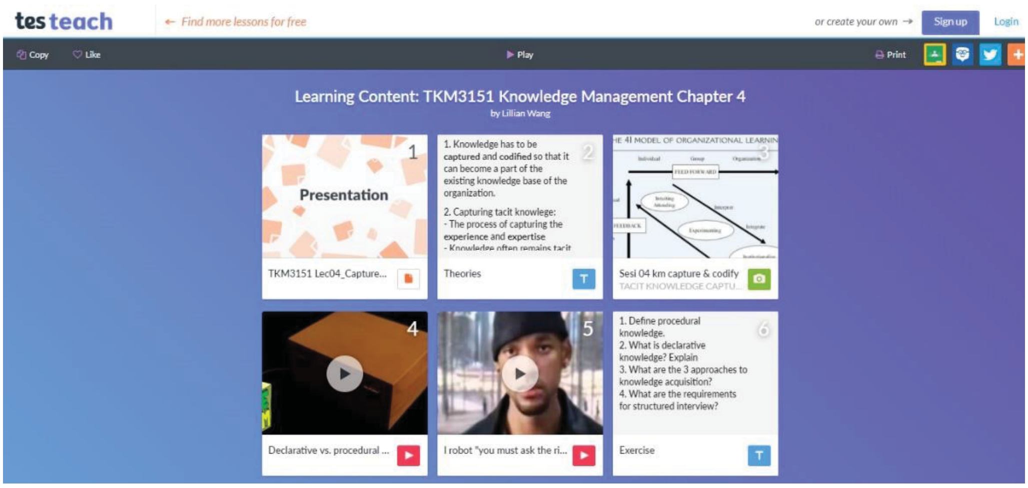

Figure 4: Compilation of learning content in Blendspace (Source: Screenshot from tes teach)

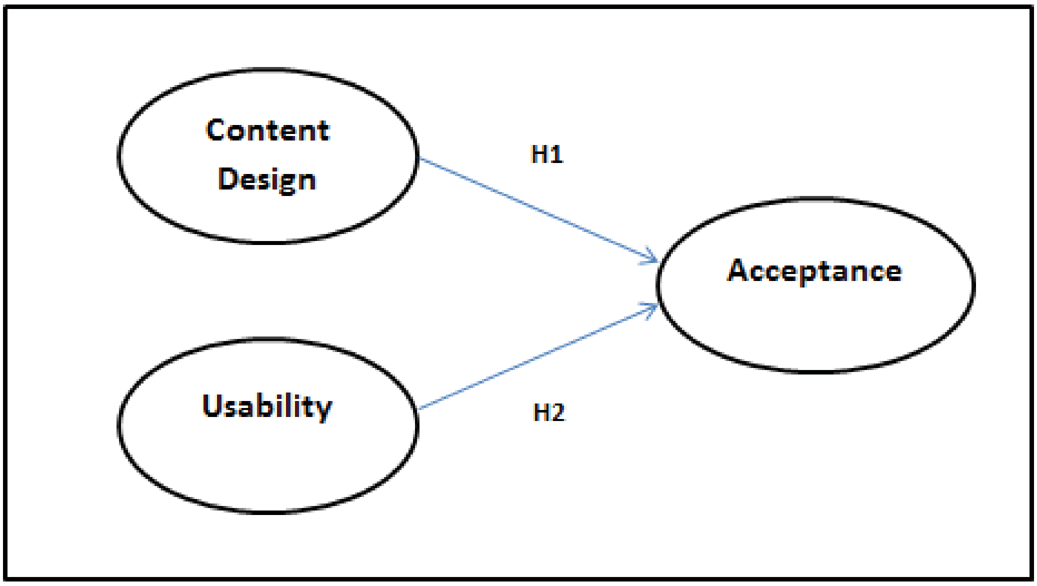

Figure 5: Theoretical model and hypotheses

> *Hypothesis H1: Quality design of Cloud-based e-learning content positively affects the acceptance of the proposed Cloud-based e-learning Framework*

> *Hypothesis H2: High usability of Cloud-based e-learning module positively affects the acceptance of the proposed Cloud-based e-learning Framework*

In this study, Structural Equation Modeling (SEM) is used to examine the relationship among the latent variables. SEM is considered as "the second generation multivariate data analysis method that gains popularity among social scientists because of its ability in testing theoretically supported and addictive causal models" (Chin, 1998; Haenlein & Kaplan, 2007). There are 3 latent variables in the model, namely *Content Design*, *Usability*, and *Acceptance*. *Content Design* and *Usability* are categorized as exogenous latent variables, which are identical with the independent variables because these variables are the casual factors to other constructs in the model (Ramayah, Cheah, Chuah, Ting, & Memon, 2018). On the other hand, *Acceptance* is the endogenous latent variable, which is identical with the dependent variable because the variable is directly influenced by the exogenous variables in the model.

At the end of the trimester, the questionnaire was distributed to the students after the lecture hours. A consent letter to participate the study was attached along with the questionnaire. The students were given a sufficient amount of time to complete the questionnaire. The collected data were subsequently compiled and statistically analyzed using SMARTPLS 3.0. Two examples of formulated questions from each category (Digital Content, Usability, and Acceptance) are presented in Table 1.

4. Results and discussion

A dataset named CloudLearning (n=350) is used to assess the effect of Content Design and Usability on the Acceptance of the proposed Cloud-based e-learning framework. The exogenous variables in the data are Content Design (consisting of twelve indicators: CD1, CD2, CD3, CD4, CD5, CD6, CD7, CD8, CD8, CD10, CD11, CD12), and Usability (consisting of five indicators: U1, U2, U3, U4, U5). Acceptance (consisting of seven indicators: A1, A2, A3, A4, A5, A6, A7) is the endogenous variable. The structural model along with the path coefficients are illustrated in Figure 6.

From the structural model, it is observed that the coefficient of determination, R^2 is 0.385 for the *Acceptance* endogenous latent variable. This means that the two exogenous latent variables, namely *Content* Design and *Usability*, moderately explain 38.5% of the variance in *Acceptance* (Chin, 1998). Besides that, the inner model suggests that *Usability* has the stronger effect on *Acceptance* (0.387), followed by *Content Design* (0.278). Based on the results, the hypothesized path relationship between *Usability* and *Acceptance* is statistically significant. The hypothesized path relationship between *Content Design* and *Acceptance* is also statistically significant. Thus, we can conclude that *Usability* and *Content Design* are both moderately strong predictors (Chin, 1998) of *Acceptance*.

Table 1: Examples of formulated questionnaire

Digital Content	
1	The digital content utilizes various formats of media (e.g., videos, graphics, and sounds) to enhances my learning.
2	The digital content is engaging and captures my attention.

Usability	
1	The learning module is easy to use.
2	The learning module is useful in assisting my learning.

Acceptance	
1	I will frequently use the learning module in the future.
2	I hope my lecturers will use similar learning module for future subjects.

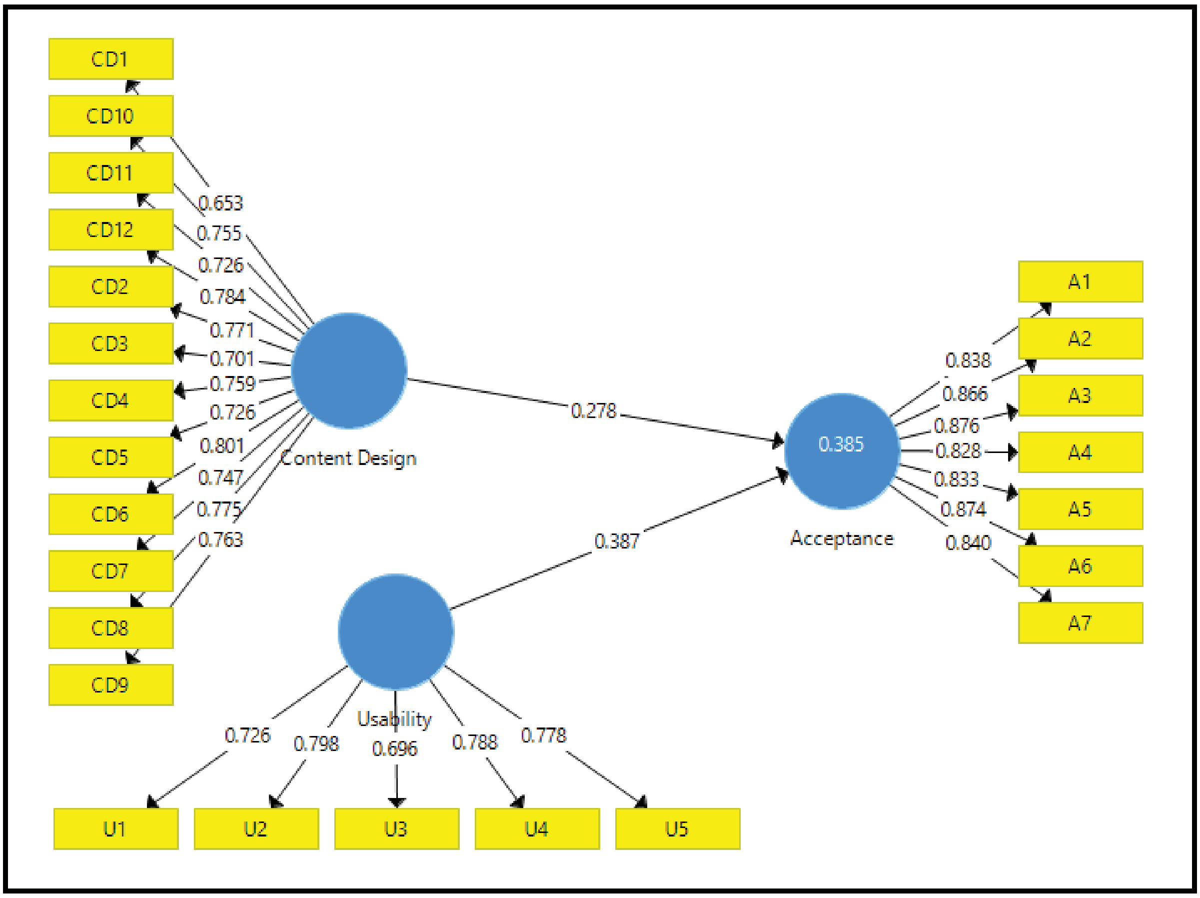

Figure 6: Structural model and path coefficients

In the assessment of the theoretical model, three main assessment criteria adopted. The three assessments are internal consistency reliability, convergent validity and discriminant validity. To assess discriminant validity, the Fornell-Larcker criterion and cross loadings are used (Hair, Hult, Ringle, & Sarstedt, 2014). Convergent validity is the extent to which a measure correlates positively with alternative measures of the same construct. To assess convergent validity, the outer loadings of the indicators, and the average variance extracted (AVE) are measured (Hair et al., 2014). The presentation of results is shown in Table 2.

All the indicators of the constructs are having the outer loading ≥ 0.5, which are considered to be acceptable (Hair et al., 2014). In other words, all indicators achieve the threshold value; hence, satisfactory indicator reliability is achieved. Average Variance Extracted (AVE) is evaluated for all constructs to check the convergent validity. It can be observed that all the constructs have met the satisfactory level of AVE result of ≥ 0.5; hence, convergent validity is confirmed (Hair et al., 2014). As for the internal consistency reliability, it is observed that all the constructs have also met the satisfactory level of CR result of ≥ 0.7, which are considered acceptable (Hair et al., 2014). It is concluded that the constructs meet reliability and convergent validity requirement at this stage.

Table 2: Convergent validity and composite reliability

Construct	Items	Loadings	AVE	CR
Content Design	CD1	0.653	0.559	0.938
	CD2	0.771		
	CD3	0.701		
	CD4	0.759		
	CD5	0.726		
	CD6	0.801		
	CD7	0.747		
	CD8	0.775		
	CD9	0.763		
	CD10	0.755		
	CD11	0.726		
	CD12	0.784		
Usability	U1	0.726	0.575	0.871
	U2	0.798		
	U3	0.696		
	U4	0.788		
	U5	0.778		
Acceptance	A1	0.838	0.724	0.948
	A2	0.866		
	A3	0.876		
	A4	0.828		
	A5	0.833		
	A6	0.874		
	A7	0.840		

Subsequently, discriminant validity of the model is assessed. Fornell and Larcker (1981) suggested that "the square roots of AVE in each latent variable can be used to establish discriminant validity if the value is larger than other correlation values among the latent variables". The results in Table 3 indicate that all constructs exhibit sufficient or satisfactory discriminant validity, where the square roots of AVEs on the diagonal are higher than the values of the inter-construct on the same columns and rows (Fornell & Larcker, 1981). In other words, there is no issue of high cross-loading among one another.

Table 3: Discriminant validity (Fornell & Larcker, 1981)

	Acceptance	Usability	Content Design
Acceptance	**0.851**		
Usability	0.591	**0.758**	
Content Design	0.562	0.732	**0.748**

Note: Values on the diagonal (bolded) represent square root of the AVE while the off-diagonals represent correlations.

The evaluation of the structural model is presented in Table 4 and subsequently discussed. It is crucial to address the lateral collinearity issue. In order to assess such collinearity issue, the same rule of thumb, VIF values need to be applied. All the inner VIF values for the independent variables are examined and the lateral multicollinearity is observed to be above 0.2 and below 5, indicating lateral multicollinearity is not a concern in this study (Hair et al., 2014). Besides that, the effect size of the predictor constructs is evaluated using Cohen's f^2 (Cohen, 1988) According to Cohen (1998) , f^2 for both constructs obtained in the results, namely 0.058 and 0.113 are considered as small and medium effect size respectively.

Table 4: Structural model evaluation

Hypothesis		Std Beta	Std Error	t-value	p-value	Decision	R2	f2	Q2
H1	Content Design -> Acceptance	0.278	0.093	4.427	0.003**	Supported	0.385	0.058	0.276
H2	Usability -> Acceptance	0.387	0.088	2.998	0**	Supported		0.113	

**p<0.01, *p<0.05

In this study, two direct hypotheses are developed between the constructs. In order to test the significance level, t-statistics for all paths are generated using SmartPLS 3.0 bootstrapping function. Based on the assessment of the path coefficient in Table 4, the structural model path coefficient for hypothesis H1 has a value of 0.278 and a bootstrapping standard error of 0.093. In this relationship, t-value is 4.427 and p-value < 0.01, indicating that the relationship between *Content Design* and *Acceptance* is positively significant (Hair et al., 2014). Therefore, we can conclude that hypothesis H1 is supported. Quality design of Cloud-based e-learning content positively affects the acceptance of the proposed Cloud-based e-learning Framework. This observation shows that a good quality in the design of e-learning content is essential to facilitate learning processes. Utilization of various formats of media such as videos, graphics and sounds significantly engages learners, and subsequently enhances learning processes.

On the other hand, the structural model path coefficient for hypothesis H2 has a value of 0.387 and a bootstrapping standard error of 0.088. In this relationship, t-value is 2.998 and p-value < 0.01, therefore the relationship between *Usability* and *Acceptance* is also positively significant (Hair et al., 2014). Therefore, we can conclude that hypothesis H2 is also supported. High usability of Cloud-based e-learning module positively affects the acceptance of the proposed Cloud-based e-learning Framework. This observation shows that perceived ease-of-use and perceived usefulness is crucial in engaging learners to learn via e-learning modules. Learners are more willing to embrace e-learning modules in their learning process when they find the learning modules are easy to use and useful to their learning.

5. Conclusion

In this paper, the issues of conventional e-learning approaches have been described. The inflexibility of learning content and the inability to handle rapid storage requirements are the issues that need to be consistently observed. The proposed solution have also been presented. The envisioning of an e-learning framework adopting Cloud technology comes in time to support the currently upgraded e-learning processes in higher education. Based on the statistical results obtained in this study, it is evident that the Cloud-based e-learning module developed based on the proposed Cloud framework is positively accepted by IT undergraduates in the private university in Malaysia. Utilizing a series of Cloud learning tools and Web 2.0 tools, the comprehensive e-learning module developed according to the proposed Cloud learning framework is proven to have certainly engaged the students in their learning process for Knowledge Management subject. Variety of formats in learning content, ease-of-use, and the usefulness of learning module play essential role for learning engagement. Good quality in the design of learning content and high usability of the developed learning module positively affects the acceptance of the proposed Cloud based e-learning Framework. This implies that the proposed Cloud-based e-learning framework can be employed in the development of a new e-learning infrastructure or Cloud-based learning application in the future. Similar methodology can also be applied to extended populations in other public and private universities to obtain more general inferences on the acceptance of the proposed Cloud-based e-learning framework.

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Teaching HCI Design in a Flipped Learning M.Sc. Course Using Eye-Tracking Peer Evaluation Data

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Abstract: This paper presents experiences from a flipped classroom M.Sc. course on Human-Computer Interaction (HCI). The students that finished successfully this course participated in twelve short (about two to three hours each) workshops, based on a flipped classroom model. Each workshop focused on a specific HCI activity, while before the workshops, a two-hour lecture was used to introduce the students in the flipped learning concept. This was the only lecture in this course, while all the rest of the educational material was offered to the students online before each workshop. Such material was mainly short lectures from the professor, in the form of videos uploaded in the course's YouTube channel and documents delivered using the university learning management system (LMS). For each workshop the students had to be prepared to participate, which was tested using brief quizzes before the start of specific workshops. The activity presented in this paper was the design and evaluation of an interactive system. The students were asked to form six groups comprising of three to four students each. Then a system's description, vague enough to stimulate creativity, was randomly assigned to each group. This activity presented in this paper was the longest activity of the entire course and it was conducted in four consequent workshops. The paper presents the setting of this experiment, the peer assessment method and the use of eye-tracking data collected and analysed to aid the students towards improving their design. The students created a working model of the system with limited functionality and improved this model using eye-tracking data from the peer evaluation of this model. The use of these data offered them the insight to improve their models and to undergo design changes. The paper presents samples of the progress made between various versions of the models and concludes presenting the preliminary positive results of the students' qualitative evaluation of this experiment.

Keywords: flipped classroom, blended learning, human-computer-interaction, eye-tracking, higher education

1. Introduction

Nowadays the boundaries between in campus and distance education are not as distinct as they used to be, especially in higher education. Today, higher education in-campus students have a plethora of online tools in hand, that vary from tools used for communication and socialising to pure e-learning tools. Using such tools transforms their learning experience from a typical in campus-based education model to a blended learning model (Garrison and Kanuka, 2004). In fact, we argue that most campus-based learning today has changed into blended learning since the use of online tools is not a novelty, but a commodity in almost all higher education programs.

Within this frame, a flipped classroom model (Bergmann and Sams, 2012) was used to teach Human-Computer Interaction (HCI) in an M.Sc. program. To the best of our knowledge, this is the first time a flipped classroom is used in an M.Sc. engineering course in Greece. The novelty of this approach is that we have used workshops focusing on the design of interaction and on the usability evaluation of these interaction designs, using real evaluation data derived from eye-tracking recordings of peer evaluation sessions. The participating students were able to follow all the steps of designing a system, starting from mock-up screens, creating a prototype and adding interactivity to their system. Furthermore, they switched roles and evaluated the systems developed by their peers and, finally, they used the evaluation data to improve their own prototypes. All these activities were organised into four workshops. In this paper, we present the setting of this course, the workshops details, and samples of the progress made between various versions of the models. Finally, we conclude by presenting the preliminary results of the students' qualitative evaluation of this experiment.

The rest of the paper is structured as follows. Section 2 presents a brief literature review of similar educational models for teaching HCI and for using eye-tracking data for the evaluation of interaction design, as well as within a learning process. Section 3 presents the course and the "Software Quality and Human-Computer Interaction Laboratory" that hosted the peer evaluation, while section 4 presents the activities that took place in the four workshops in detail, illustrated with examples from students' designs. Finally, section 5 summarizes the conclusions from applying this educational process and presents the preliminary results of the students' qualitative evaluation of this process.

2. Literature review

While blended learning is not something new, the more the technology infiltrates into everyday practices the more all campus-based learning programs are moving towards blended learning. Therefore, although blended learning was initially considered as the mean to move learners from traditional classrooms to e-learning in small steps making change easier to accept (Driscoll, 2002), nowadays blended learning is a common practice for most campus-based programs, especially in higher education. This is happening because higher education institutes have the infrastructure to combine web-based technologies and the appropriate pedagogical approaches with face-to-face lectures. Today, most campus-based higher education courses offer the course material online, handle submission and assessment of students work through an LMS, facilitate an online community through e-fora and messages, even scheduling online office hours. Furthermore, blended learning is not mostly about the tools and the approaches, but it is about the concept that learning is not something related to a one-time event (i.e. during the lecture), but a continues process (Singh, 2003). This concept is acknowledged in most higher education institutes today, leading to the implementation of various blended models (Drossos et al., 2008).

One of the most effective blended learning strategies is flipped learning (Bergmann and Sams, 2012) where the lecture is moved outside of the classroom and inside the classroom the students perform activities. These activities are mostly group-based collaborative activities following learner-centred learning theories (Vygotsky, 1980). This flipped classroom, therefore, uses a learner-centred model in which the activities into the classroom explore topics in greater depth that students have already studied online. On the one hand, the problem of flipped learning is that it requires a lot more effort from the educator, compared to the traditional lecture preparation, since it is an expansion of the curriculum, rather than a mere re-arrangement of activities (Bishop and Verleger, 2013). On the other hand, if used appropriately and if the educator took the time and effort to prepare the online lectures videos and design the in-classroom activities, flipped learning is a powerful educational method.

Using the flipped learning strategy in an HCI course was an obvious choice since HCI is a multi-discipline field that requires collaborative learner-centred activities. A definition of HCI is "*Human-computer interaction is a discipline concerned with the design, evaluation, and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them*" (Hewett et al., 1992) and, therefore, teaching HCI is a difficult practice that has to evolve in response to changes in the technological landscape (Churchill et al., 2013). Following our choice of flipping the classroom the creation of all the required online material (video lectures) and the design of the activities took an entire year of preparation. The educational material used for the course was mostly videos from the professors and a limited number of selected online short videos, enhanced with reading material and, in some cases, software tools. These online videos were developed using detailed principles (Pierrakeas et al., 2003) and following specific quality guidelines.

One of the activities we have selected for this course was the use of peer evaluation, based on eye-tracking data since eye-tracking allows recording and analysing detailed eye gaze data, offering insight on how users spontaneously react to visual stimuli and overall interaction design. The basic measure is the gaze point, which equals one raw sample captured by the eye-tracker. Fixations aggregate a series of gaze points and represent a period in which the eyes are locked towards a specific point. Between fixations, there are quick movements called saccades. The ordered set of fixations points (depicted by circles) connected by saccades (depicted by lines) is called a 'gazeplot' (or 'scanpath', or 'gazetrail'). A 'heatmap' is another visualization offered, where colours or opacity vary with the density of the number of fixations or their duration. Eye-tracking metrics can also be extracted based on a sub-region of the displayed stimuli (e.g., specific images, blocks of text, calls to action, etc.), defined as an area of interest (AOI). AOIs can be defined during the analysis process as the most relevant areas of the stimuli.

Despite the limitations of eye-tracking technology (sensitive to head positioning, thick glasses or contact lenses and inability to capture peripheral vision) there is significant research concerning this technology or based on it, in numerous application domains. By adequate interpretation of eye-tracking data, scientists can measure attention, interest, and arousal, and reach interesting conclusions for human behaviour research applied in a variety of fields such as Cognitive Studies and Education, Psychology, Medicine, Neurology, UX and HCI, Marketing, Engineering and more. In the cognitive studies and educational research, several visual psychologists have concluded that eye movement is an objective indicator for thoroughly monitoring and analysing the cognitive processes of learners (Baker and Loeb, 1973, Rayner, 1998, Salvucci and Anderson, 2001). Sung and

Tang (2007) found that eye movement such as gaze time is a reliable index to observe cognitive processing in sentence reading, while Sanders and McCormick (1987) concluded that more than 80% of human beings manage to process cognitive information through visual processes. Thus, eye movement is an essential source of information in the cognitive processes and has been used in several studies to examine learning processes, study visual attention as well as social interaction in various learning settings. Research has indicated that eye-tracking can contribute to studying information gathering, problem-solving, learning strategies, interaction patterns between teachers and students or among students, as well as the effectiveness of various educational resources (Koc-Januchta et al., 2017, Kohlhase et al., 2017, Lai et al., 2013, Lin et al., 2016, Lin et al., 2017, Merkley and Ansari, 2010, Rosch and Vogel-Walcutt, 2013, Tien et al., 2014). In the domain of Computer Science teaching, Obaidellah et al. (2018) surveyed the use of eye-tracking in assessing the underlying cognitive processes of programming and Busjahn et al. (2015) conducted an eye-tracking study of the way students read programming code compared to natural language text and also surveyed the use of eye-tracking in computing education (Busjahn et al., 2014).

3. The HCI course and the equipment used for the activity

The activity presented in this paper took place on the “Computer Science and Engineering” M.Sc. program and in particular in the course “Human's Interaction with Computers, Robots and Smart Devices”. The evaluation took place in the “Software Quality and Human-Computer Interaction Laboratory”. The course and the laboratory equipment are presented in brief in this section.

3.1 The HCI course

The course “Human's Interaction with Computers, Robots and Smart Devices” is part of the “Computer Science and Engineering” M.Sc. program. This M.Sc. program is an 18-month (3 semesters) program offering 90 ECTS (30 ECTS per semester) available at the Computer Engineering and Informatics department of the University of Patras. The students participating in this program are required to complete 12 courses and a thesis. The “Human's Interaction with Computers, Robots and Smart Devices” course is a core (i.e. compulsory) course for the students of the division of “Computer Software” and an elective course for the students of the other two divisions (“Hardware and Computer Architecture” and “Applications and Foundations of Computer Science”) of this M.Sc. program. This course was offered to students for the first time on the academic year 2016-2017. During the second semester, starting on February 2017 to May 2017 of this academic year, 24 students registered in this course and 22 of them finished it successfully. Since the two students that haven’t finished haven’t participated in the activities presented in this study, the course population is 22 students and is called hereinafter in this paper “the students”. These students represent a typical Computer Science (CS) population, 4 female and 18 male, with mean age around 27 years.

The course outline of the “Human's Interaction with Computers, Robots and Smart Devices” included design and evaluation techniques for contemporary interactive devices such as cars, appliances, smartphones, robotic devices and multimodal computer interfaces. The students that successfully completed this course participated in 12 short (2-3 hours each) workshops, having to perform a specific activity in each one of them. Activities that are not presented in this paper included teamworking, debates, card-based activities, using specific software, and presentations. The first lecture of the course was a short (about two hours) lecture, which was used to introduce the students in the flipped learning concept. No further lectures were given, and the rest of the educational material was offered to students to study it before each workshop, following a typical flipped classroom model. This material was mostly short video lectures that were uploaded in the course’s YouTube channel, as well as documents and tools that were offered through the university’s LMS, which allowed collecting learning analytics (Koulocheri and Xenos, 2013) for the material used. The use of videos was not limited to the lectures only. Short videos were used to deliver the professors’ comments on the students’ projects between workshops. Students were required to be prepared to participate in the workshops and in some of them, a short quiz was introduced before the workshop started, to evaluate their level of preparation.

The activity ‘from mock-up screens to interaction design’, presented in detail in section 4, was the longest activity of the entire course and it was conducted in four consequent workshops, from the 4th workshop to the 7th workshop of this course. These workshops are called workshop A, B, C and D for the rest of this paper, in order not to confuse the reader with the ones that are not presented hereinafter. The other activities included debates on open HCI issues at the 1st and the 2nd workshop, using the IoT Toolkit (Mora et al., 2017) and cards to stimulate creativity at the 3rd workshop, improving the efficiency of the user interface based on the keystroke level model (Card et al., 1980) and using the KLM-FA tool (Karousos et al., 2013) at the 8th and the 9th workshops, using the Greek version (Katsanos et al., 2012) of the standard usability scale (SUS) questionnaire (Brooke, 1996) and focus groups to evaluate their prototypes' usability at the 10th workshop, and students' presentations of selected Human-Robot Interaction (HRI) papers at the 11th and 12th workshops.

To the best of our knowledge, this is one of the first courses offered using the flipped classroom model in an M.Sc. course in Greece and the first on HCI that combines such a variety of activities in an engineering M.Sc. course.

3.2 The laboratory and the equipment used

The "Software Quality and Human-Computer Interaction Laboratory" lab at the Computer Engineering and Informatics Department is configured in two separate adjacent spaces with visual contact, a testing room and an observation room. The laboratory offers equipment for collecting eye-tracking data and physiological signals to measure users' stress (Liapis et al., 2015, Liapis et al., 2017). The test for this assignment was conducted in the testing room using the Tobii T120 Eye-tracker integrated in a 17-inch TFT monitor. Test scenarios were set up in Tobii Studio software which was also used for data analysis and visualization. Users were recorded on video and were encouraged to express freely their thought and opinion concerning their current task (think-aloud).

4. From mock-up screens to interaction design

The activity presented in this paper is the iterative design and evaluation of an interactive system. This activity was the longest one of the course and was conducted in 4 consequent workshops (A, B, C and D) presented in this section. During the preparation for these four workshops, and while studying the educational material that was available online for them, the students were asked to form groups of 3 to 4 persons. They were totally independent on how to form the groups and they could use the course's e-forum and messaging tools, as well as any other means of communication they choose. The only thing requested from them was that the names of the students of each group to be available before the start of the first workshop of this series. They were also informed that studying the corresponding material was essential for the successful completion of the workshop, so they should make sure that no members of their team would show up unprepared, since this would have a negative impact on the entire team's performance.

Following our instructions, the students formed 4 groups of four persons and 2 groups of three persons, while we prepared six folders each one having a system's description which was vague enough to stimulate creativity. To balance the groups' effort, two systems that according to the professors needed less effort were prepared for the 3-persons groups, while four systems estimated to require more effort were prepared for the 4-persons groups.

The systems were selected to address a variety of users with diverse needs, to allow the design of interaction based on various modalities and to emphasise on several aspects of the interaction, such as efficiency, error prevention, perceived satisfaction, etc. Therefore, the six folders included the following system descriptions:

- 1. A game for small children that would be played inside the classroom in pairs, where children could learn basic arithmetic operations.
- 2. A system supporting an anaesthesiologist during a surgery that would require as input the drugs and their dosage, using multimodal interactions and it could monitor the patient and report to the anaesthesiologist during the operation.
- 3. A smartphone application for small children that could control a teleoperated toy car, but that would be probably played by their parents as well.
- 4. A system for the captain of a large ferryboat that allows the operator to open and close hatches on various car docks, while using security mechanisms to prevent human errors.
- 5. A system for elderly people that would serve as information desk at a hospital they visit for a routine check, after reading their social security card, to inform them about the options they have and to schedule appointments.
- 6. A subsystem of the previous system that provides directions on how to find their next destination (e.g. the office they should go next).

The systems 1 and 6 were the ones aimed for the smaller groups. The folders included details on what is required from each system but did not reveal any information about how this is going to be designed, or what features could be included, or what modalities might be the important ones. The students were told that they could consider all contemporary technologies to their disposal, but the goal of the activity is to create something that the users would find attractive, useful and efficient, rather than impress them with the use of state-of-the-art technology.

4.1 Workshop A

This was a three-hour workshop that started with students selecting their systems. Since all systems descriptions were hidden into folders of the matching size, the selection among groups of the same size was random. Firstly, the two small (3-persons) groups chose their folders and then the rest of the groups did the same. Then, the students divided into groups and they to discuss about their system and to define the basic personas. When all teams were ready, the class was regrouped, and each team presented their personas to the class, where they received feedback from the professor and their peers. Following this, the students separated once again in groups and they had to design basic mock-up screens and user interactivity using pen and paper. Figure 1 shows two mock-up designs for two of these systems created during the workshop. For this activity, they also received feedback when the class was once again regrouped.

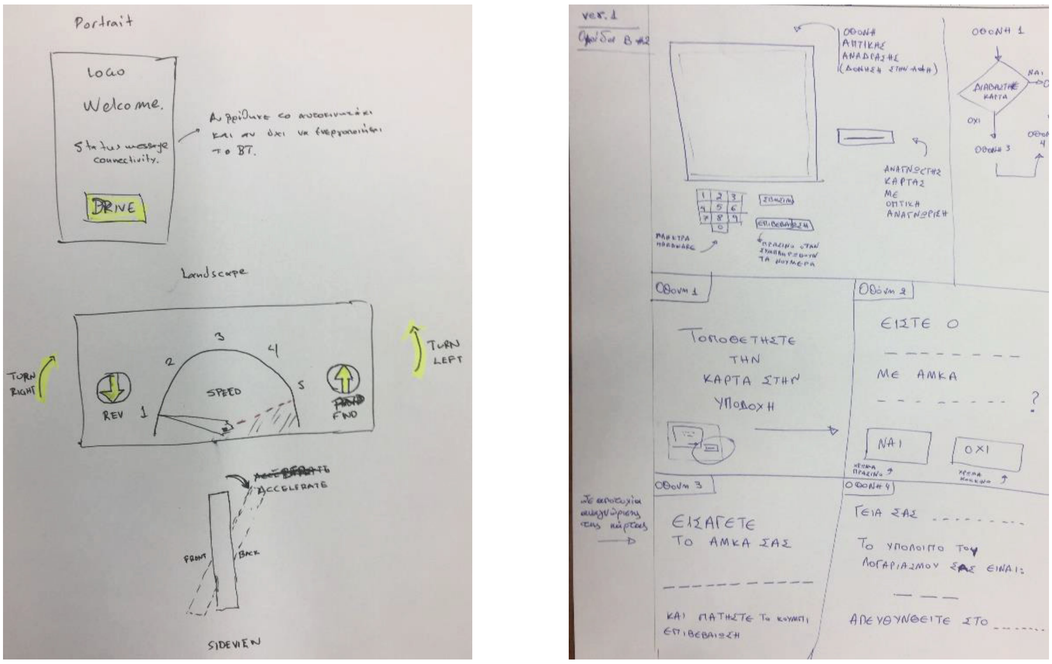

Figure 1: Two samples of the mock-up designs for system no. 3 and 5 respectively

Figure 2: A persona created by the group working on system no. 6

After this workshop and while preparing for the next one, the students had to present their personas online and to design a rapid prototype (with adequate interactivity) based on their mock-up screens and the feedback they had received. A sample of a persona submitted by a group is shown in Figure 2, where the students have enriched their personas with personal details, a short CV, personality details and problems related to the technology and the system they investigated. Finally, the students had to provide detailed scenarios of the interaction and to submit all these online before the beginning of the next workshop.

4.2 Workshop B

Workshop B was a 3-hour workshop where each student used all the other teams' prototypes, based on the prepared scenarios, using eye-tracking. Following workshop B, students received the data from the eye-tracking process for their prototype and the outlined scenario (individual user and grouped heatmaps and gazeplots, as well as statistical data on AOIs students specified) and were also given the option to return to the eye-tracker to watch recordings and access all available metrics for more thorough interpretations and better redesign decisions. Figure 3 depicts one test scenario in Tobii Studio, Figure 4 presents the heatmap and Figure 5 the gazeplot (with mouse clicks) corresponding to user gaze data when asked to turn off the sound on the mobile car control application (users should click on the Settings icon placed at the top centre part of the screen).

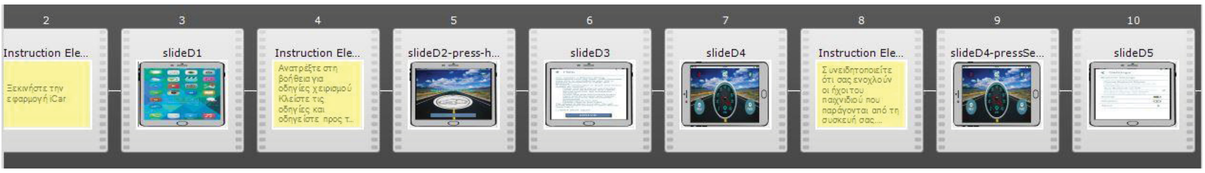

Figure 3: Test scenario in Tobii studio for system no. 3

Figure 4: Heatmap annotated with mouse clicks (all users) for system no. 3

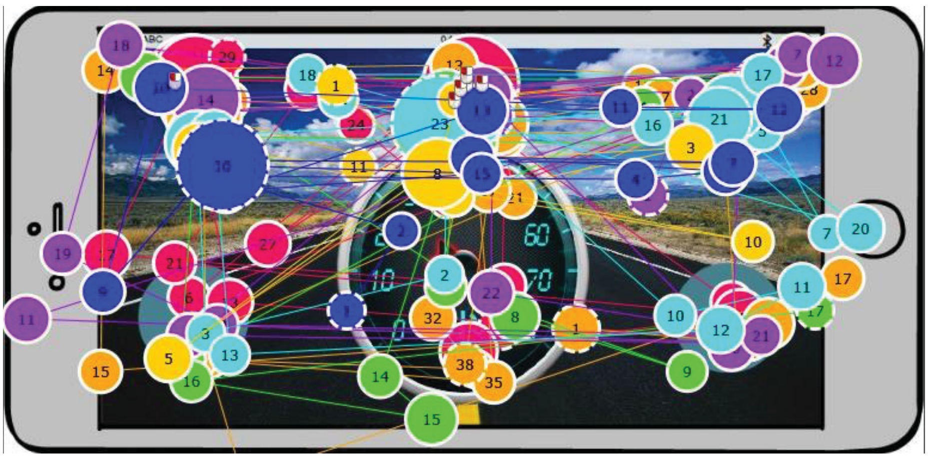

Figure 5: Gazeplot annotated with mouse clicks (all users) for system no. 3

4.3 Workshop C

This was a two-hour workshop, where the members of each group had the chance to discuss with the evaluators their comments and their actions during the interaction with the system based on the scenarios they used. Therefore, students played both the roles of the designer and the evaluator, since all of them participated in the design of their system and in the evaluation of other systems. This workshop involved a lot of students moving from their group to other groups, allowing them to have a global view of how all teams approached the design of their assigned system. After this workshop, and while preparing for the next one, the students used all these data to redesign their prototype and to improve their design.

Figure 6: A sample of a final design, following the results of the evaluation

4.4 Workshop D

This was a three-hour workshop where all student groups had about 25 minutes each (including questions) to present their systems design and to discuss with the professors and peers the concept, the process and the improvements they made throughout the entire activity. Figure 6 presents a final system as presented by the students in this workshop (this design was based on the mock-up depicted in Figure 1, left side). In this example, as observed by both visualizations in Figure 4 and Figure 5 most users managed to locate the required option (Settings) but their visual attention was also drawn by option Help, as well as Exit (colored in a visually dominating red) and one user clicked on Exit rather than Settings. This led students to the assumption that the recognisability of Settings option needed to be enhanced so a label was added in the redesign of the game central screen (Figure 6). Moreover, students decided to use a less vivid colour for Exit.

5. Results and conclusions

The students that participated in this course had the opportunity to work both as designers of an interactive system and as usability evaluators. This setting serves well the learning objectives of the course, as students gained valuable practical and analytical experience and they should be able to design eye-tracking testing sessions from now on according to their needs. In addition, their experience with evaluating the designs of other students provides them with good and bad examples of UI design which also contributes to their HCI learning.

Furthermore, students responded enthusiastically to how this course was conducted. On the formal online assessment tool, used by the University of Patras, where students evaluate all courses they attend anonymously, this course had scored from 4.00 to 4.59 in each evaluation category (in a typical Likert 1 to 5 scale) with the lowest score being related to course difficulty (4.00) and the highest score related to the content delivery and collaboration with the students. This is a very high score compared to similar scores of other courses. Furthermore, the qualitative comments were also very positive, i.e.: "*…it was the first time that I have participated in such a well-organised course…*", "*…I loved the activities since most of these were both useful and fun to participate…*". Finally, this work is not without limitations. To effectively measure the educational value of these activities we should be able to compare learning gain measured in comparison to a traditional lecture-based classroom. A between-subjects experiment to investigate this is a future goal. Another future goal is to offer to the participating students more measurements (e.g. physiological measurements).

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Supporting the Learning Design Process: Insights Into Pre-Service Teachers' Perceptions

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Abstract: Learning design (LD) research accounts a diverse collection of technology-based tools aiming at supporting the design process. Despite these efforts LD research and development is still at its infancy whilst there is no clear understanding of teachers' perceptions of these tools or of their features that could appeal most to the teacher community. Aiming at contributing empirical evidence to the research agenda of the LD support tools, this paper reports on a study carried out with 35 pre-service teachers utilizing *the Learning Designer* tool. Quantitative and qualitative data about the participants' perceptions of the design experience using *the Learning Designer* were collected and analysed. Data analysis followed the rationale of the research team that developed *the Learning Designer* towards supporting effective pedagogy adapted to the features of the specific version of Learning Designer used in the research. Findings suggest that the graphical representation of a learning design provided by the LD tool supports designers to structure a learning design. Highly valued were the graphical means of design analysis towards enhancing the designers' reflection on the nature of the activities included in the learning design. The components of a learning design incorporated in the LD tool such as the learning outcomes, the type of a learning activity according to a typology and how learners are organized scaffold the LD process and pedagogy articulation. Nevertheless, the designers propose that such features should be customizable. Last, components supporting the designers to synthesize pedagogy and content with appropriate technology were requested.

Keywords: learning design, learning designer, teacher education, technology enhanced learning

1. Introduction

In recent years several systems have been developed that provide computer-aided support to learning design aiming at making pedagogical decisions explicit and providing computer-interpretable representations of the designs (Prieto et al, 2014). Thus, the Learning Design (LD) research accounts a diverse collection of technology-based tools/environments aiming at supporting the design process and the creation of online repositories to share design examples and practices. Indicative examples of LD tools focusing on various aspects of the LD process include *the ILDE* (Integrated Learning Design Environment) (Hernández-Leo et al, 2014), *the Learning Designer* (Laurillard et al, 2013), *the CADMOS* (Katsamani and Retalis, 2013), *the LDTool* (Agostinho, 2011), *the CompendiumLD* (Brasher et al, 2008), *the Cloudworks* (Conole and Culver, 2009), *the Learning Design Studio* (Mor and Mogilevsky, 2013), *the WebCollage* (Villasclaras-Fernández et al, 2013) and *the PeerLAND* (Peer Assessment of LeArNing Designs) (Papanikolaou et al, 2016). Despite these efforts LD research and development is still at its infancy (Bennett et al, 2015) with only a few LD tools to have moved beyond being a prototype system in the stage of development to being widely used (Dalziel, 2013).

A literature review by Celik and Magoulas (2016a) exploring what has been done regarding teachers' perceptions, practices, and needs of LD and LD tools concluded that "although many projects aimed at developing an information system platform for LD, there is still limited understanding of teachers' perceptions of these platforms and of their design practices" and therefore recommending "further research in this area". There is no clear understanding of the reasons behind the lack of adoption among teachers (Mor and Mogilevsky, 2013) or of the platform features that could appeal most to the teacher community (Prieto et al, 2014). Focusing on teacher training, the way these tools can be incorporated in pre-service teachers' studies to support the development of common understanding of LD issues remains a challenging issue (Papanikolaou, Makri and Roussos, 2017).

Aiming at contributing empirical evidence to the research agenda of the LD tools area, we conducted a study with pre-service teachers who, while on a course in Education Technology, had to develop a learning design in Moodle. We decided to ask pre-service teachers to first design at a particular LD platform and then implement the learning design in Moodle; as we agree with Mor, Craft and Maina (2015) that the design activity entails dealing with ill-defined problems subject to evolving constraints. We assumed, thus, that specific guidance would benefit designers; particularly novice designers. Focusing on the phenomenon of novice designers having a tendency to jump prematurely to design solutions without deeply exploring the pedagogical rationales behind them (Ronen-Fuhrmann and Kali, 2015), we chose *the Learning Designer* as the LD tool for our study due to its simplicity and expressiveness and the fact that it was one of the first available online. We were also intrigued by the rationale of the research team that developed *the Learning Designer*, as described in Laurillard et al (2013), towards supporting effective pedagogy (David et al, 2009) in terms of (a) fostering both individual and social processes and outcomes, (b) promoting the active engagement of the student as learner and (c) converging learning with assessment.

The goal of our research is to provide empirical evidence for pre-service teachers' perceptions of the features of the LD tool in terms of supporting the LD process; in particular about features supporting effective pedagogy. Moreover, we report on the participants' perceptions of their overall experience of utilizing *the Learning Designer*. In this line, the research questions addressed were:

RQ1: What are the pre-service teachers' perceptions of the LD tool for supporting effective pedagogy?
RQ2: How do pre-service teachers assess their experience of utilizing the LD tool?

2. The learning design support tool

The Learning Designer (https://www.ucl.ac.uk/learning-designer/) is an "authoring and sharing tool" (Celik and Magoulas, 2016b; Laurillard et al, 2013) based on the categorization of tools proposed by Persico and Pozzi (2015) since it allows for the representation of learning activities and it is rooted in a specific pedagogical model. Indeed, its design approach aims at supporting and scaffolding teachers' engagement with learning design based on user requirements and on pedagogic theory (Laurillard et al, 2013). Its pedagogic properties are based on the Conversational Framework (Laurillard, 2012), which represents the didactic, experiential, constructivist and collaborative theories of learning as cycles of interactions between teacher and learner, and between learner and peers, on both the concept and practice levels of experience (Zhang and Laurillard, 2015). The cycles of interactions that together constitute the complete teaching–learning process are defined as six types of learning: learning through acquisition (i.e. read/watch/listen), inquiry (i.e. investigation), practice, production, discussion and collaboration (Laurillard, 2012).

The tool's interface facilitates teacher–designers to create a design as a sequence of Teaching–Learning Activities (TLAs) while defining the components that they involve i.e. aims, learning outcomes (or objectives), curriculum topics, teaching and learning activities, and assessment (Laurillard et al, 2013). Moreover, the tool provides a pie-chart for each design representing the proportions of the six different learning types that TLAs may include. These analytics about learning design allow teacher-designers to view designs from various perspectives, e.g. the social dimension of activities, the collaborative dimension of activities, individual practice and the proportion of the time spent on production (Charlton, Magoulas and Laurillard, 2012). The feedback given to teacher-designers is, therefore, expected to stimulate them to reflect on and make changes in their designs (Zhang and Laurillard, 2015).

The design approach described above aims at providing teacher-designers with a theory-informed means of representing the critical characteristics of good pedagogy so that they adopt, adapt, and experiment with learning designs, as they discover how to optimize learning technologies (Laurillard et al, 2013).

Figure 1 shows an instance of *the Learning Designer's* interface while developing a learning design in Greek on the topic of Migration. It provides an insight into how the design approach is actualized in the tool's interface. At the top-left corner [1] the designer defined the design's name, topic, learning time, class size and provided a short description. The designed time that is the total time defined in the learning activities, is also provided. At the top centre [2], the designer filled in the aims of the design and added the expected outcomes by describing them as well as selecting their category according to Bloom's taxonomy. At the top-right corner [3], one can see the pie chart that the tool has calculated which depicts the proportions of the six different learning types included in the TLAs of this learning design. At the centre [4] several tools for creating a new design and importing a design as well as exporting, sharing and saving the current design, are provided.

The half bottom of the screenshot is occupied by the TLAs. Visible are 3 out of 4 TLAs designed. Focusing for example at the structure of the first TLA [5], it is comprised of 3 elements (a) the description [5.1], (b) the learning activities [5.2] and (c) some notes [5.3]. The representation of each learning activity consists of several components. For instance, in the 1st learning activity of the 1st TLA [5.2] the designer has selected among the 6 predefined learning activities types that this learning activity aims for the learners to practice [5.2.1]. The designer has also defined that this activity is planned for 20 minutes and learners participating will work individually without the presence of a teacher [5.2.2]. Moreover, the designer has attached one learning resource to be used in this activity [5.2.3] and provided a description of the activity [5.2.4]

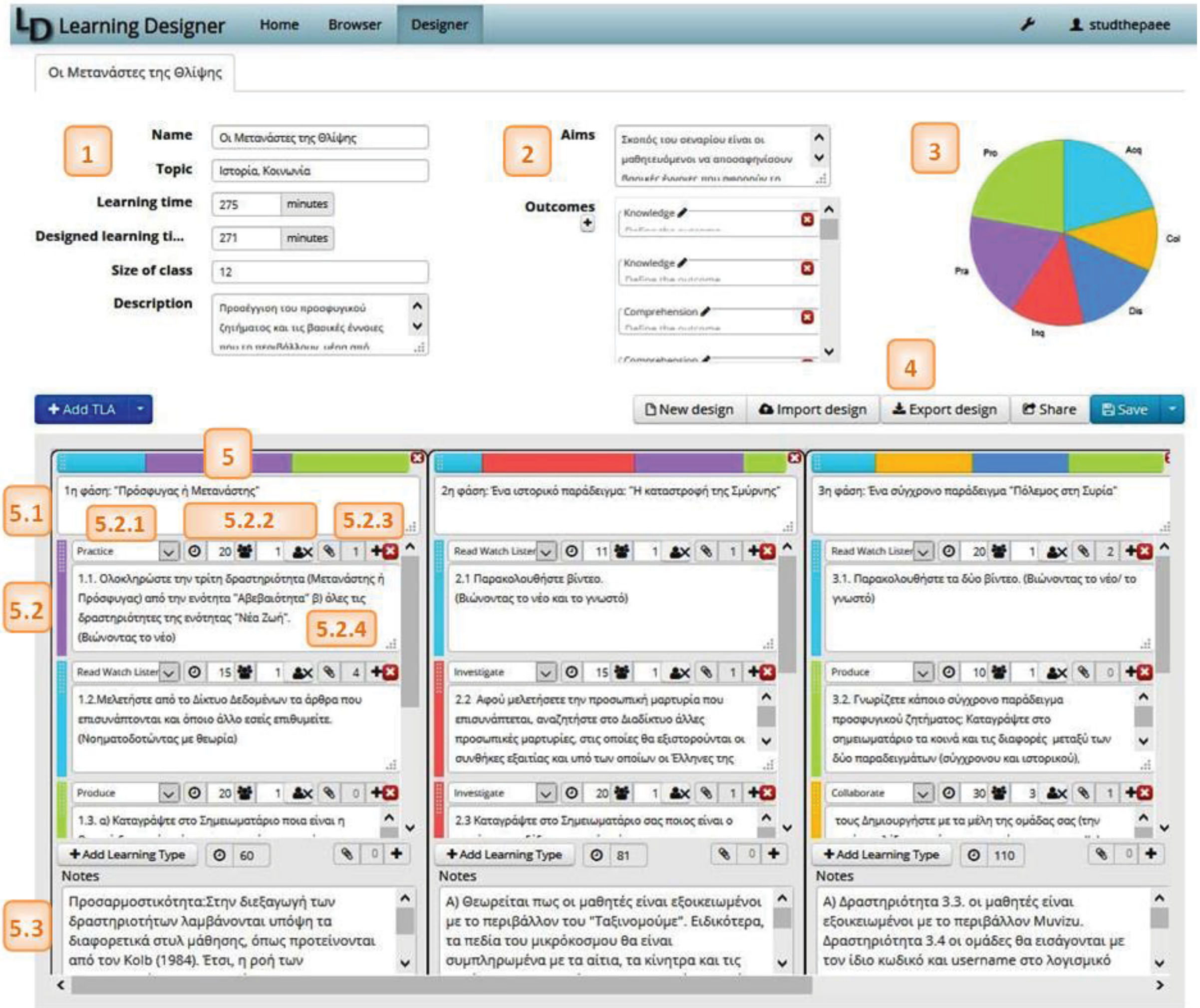

Figure 1: Sample learning design (in edit mode) in *Learning Designer*

3. Methodology

3.1 Participants

The study took place in the context of a course in Digital Technologies and Distance Learning. The course is offered in a postgraduate program in Education at the University of Athens. It is a full-time program with a duration of four semesters and the specific course is realized at the third semester. Data were collected from 35 pre-service teachers who attended the course in 3 consecutive academic years (2014-2017). Although their background was from several diverse academic fields such as Computer Science, Electronics, English language, Greek language and Philosophy, Music, Primary Education, etc., they all had prior experience in LD in terms of structuring lesson plans. Moreover, during their studies in the postgraduate program, they had developed learning designs in a narrative form following an empirical framework introduced during the Odysseia - Hellenic Schools in the Information Society Programme (Makri et al., 2006). However, none of them had previously used a LD support tool for designing technology enhanced learning.

3.2 Organization

During the three academic years (2014-2017) the course was organized in the same way. In the first part of the course (three weeks), the participants were introduced to the main concepts of distance learning, current trends in web-based learning, adaptive learning environments and learning theories that could support the design of educational content for distance or blended learning. Afterwards, throughout the second part of the course (eight weeks), students were familiarized with *the Learning designer* and Moodle in order to complete the main assignment of the course. In particular, students were initially assigned to collaboratively (in groups of two or three) design a learning design in *the Learning Designer* and then participated in a peer review activity in order to get feedback and redesign their design before the final stage of implementing it in Moodle. The main requirements for the learning design included:

- topic selection from one discipline or ideally interdisciplinary,
- technology integration into the design, such as web 2.0 tools,
- adoption of principles for developing distance learning content,
- supporting personalized learning by considering the learners' individual characteristics.

3.3 Data collection and analysis methods

Quantitative and qualitative data were collected at the end of the course in a survey questionnaire structured in 5 sections including 28 questions, of which 23 were Likert-scaled and 5 were open-ended. To explore the pre-service teachers' perceptions of the LD tool for supporting effective pedagogy (Research Question 1), the first three sections followed the extract from the "characteristics of effective pedagogy" mapped to the features of *the Learning Designer* as described in Laurillard et al (2013) and adapted to the main features of the version of Learning Designer used. Therefore, these sections included questions exploring how pre-service teachers perceived LD tool's features that:

- *foster both individual and social processes and outcomes* i.e. features aiming at supporting designers to organise individual or collaborative activities as well as provide feedback on the nature of the learning setting designed (Figure 2, Section A),
- *promote the active engagement of the student as learner* i.e. features aiming at supporting designers to design various types of activities and reflect on the proportion of time devoted to each type – in this way designers are expected to assess whether the learning setting they designed does actively engage learners (Figure 3, Section B),
- *converge learning with assessment* i.e. features aiming at supporting designers to define the learning outcomes and overview if they are congruent with the teaching and learning activities designed (Figure 4, Section C).

The last two sections of the questionnaire include 6 Likert-scaled and 5 open-ended questions providing both quantitative (Figure 5, Section D) and qualitative (Section E) data about the participants' perceptions of their overall experience of utilizing the LD tool for designing learning (Research Question 2).

4. Results

4.1 RQ1: What are the pre-service teachers' perceptions of the LD tool for supporting effective pedagogy?

Figures 2, 3 and 4 show the distribution of the pre-service teachers' responses to the Likert-scaled questions of sections A, B and C respectively. This was the part of the survey questionnaire addressing their perceptions of the LD tool for supporting effective pedagogy.

4.1.1 Effective pedagogy: Fostering of both individual and social processes and outcomes

As seen in Figure 2 the participants expressed their appreciation of the tool's features in terms of fostering both individual and collaborative processes and outcomes and considered the potential of the tool to provide more means of analysis as useful.

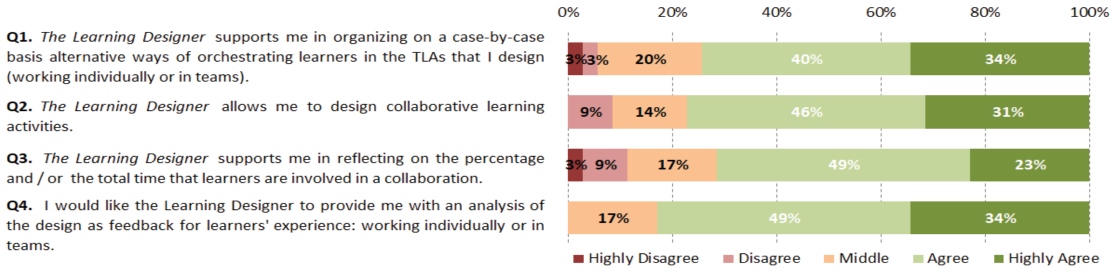

Figure 2: Distribution of responses in section A of the survey questionnaire

Specifically:

- 74% of participants appreciated the LD tool for facilitating them to organize learners' work individually or in groups, (Figure 2, Q1),
- 77% endorsed the LD tool for allowing or stimulating the design of collaborative learning activities (Figure 2, Q2),
- 71% considered that the LD tool stimulated reflection on the percentage or/and the total time that learners are involved in a collaboration (Figure 2, Q3),
- 83%, considered the option of having feedback on the proportion of individual to collaborative learning activities included in the learning design as useful (Figure 2, Q4).

4.1.2 Effective pedagogy: Promoting the active engagement of the student as learner

As shown in Figure 3, the LD tool was highly endorsed for promoting the design of student-centered learning settings. This is realised by features that stimulate reflection on the nature of the learning setting such as:

- 86% of the participants found the predefined types of learning activities as supportive (Figure 3, Q5); 74% of the participants considered that these types promote learners' active participation (Figure 3, Q6) but responses were equivocal regarding their adequacy since 54% responded positively, 20% negatively, while 26% seemed not to have made up their mind yet (Figure 3, Q7),
- 77% and 66% of the participants respectively found supportive the LD tool's features of providing resources and designing teaching and learning activities without teacher's presence; thus, promoting learners' autonomous learning (Figure 3, Q8 and Q9),
- the overwhelming majority (94%) valued the feedback provided by the LD tool in a form of a pie analysing both the time planned for each type of learning activity and the learning activities' types incorporated in the design (Figure 3, Q10 and Q11),
- 75% of the participants would appreciate it if analysis was also provided regarding the teacher's presence at the learning activities (Figure 3, Q12).

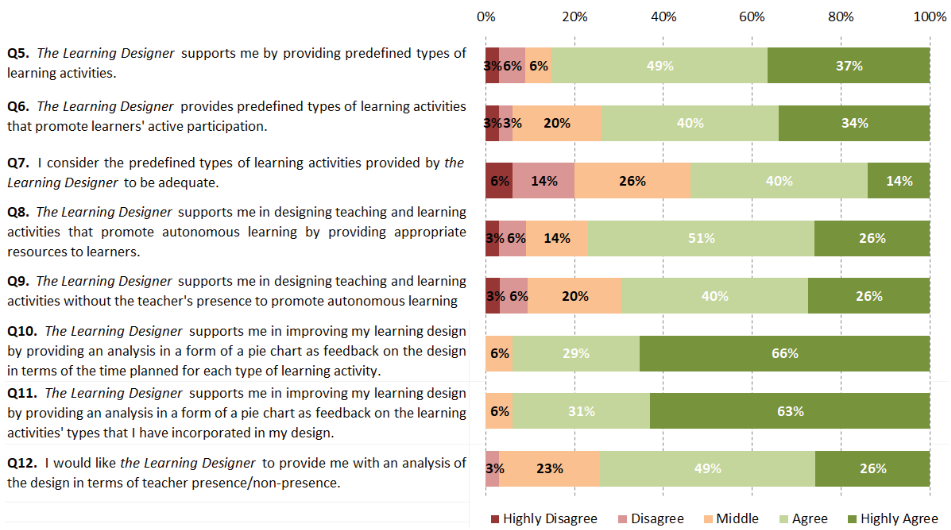

Figure 3: Distribution of responses in section B of the survey questionnaire

4.1.3 Effective pedagogy: Converging learning with assessment

The participants' responses were mixed regarding the features of the LD tool that allow designer to converge the learning experience designed with learners' assessment (see Figure 4):

- the categorization of the expected outcomes provided by the tool was considered supportive for the definition of learning objectives by 83% of the participants (Figure 4, Q13),
- all the participants valued the LD tool for organising a series of teaching and learning activities and establishing a clear timetable for them (Figure 4, Q14),
- it is worth-reporting that half of the participants responded positively for the LD tool regarding its support in combining the types of learning activities, while the other half was divided in negative and neutral responses (Figure 4, Q15),
- participants' responses were divided with regard to the LD tool's predefined types of learning activities that engage learners in evaluation and self-assessment processes. 43% responded positively, 40% negatively and 37% were neutral (Figure 4, Q16),
- 86% of the participants found the information provided by the LD tool about the duration of the activities planned as supportive towards improving the timetable of their learning design while there were no negative responses (Figure 4, Q17).

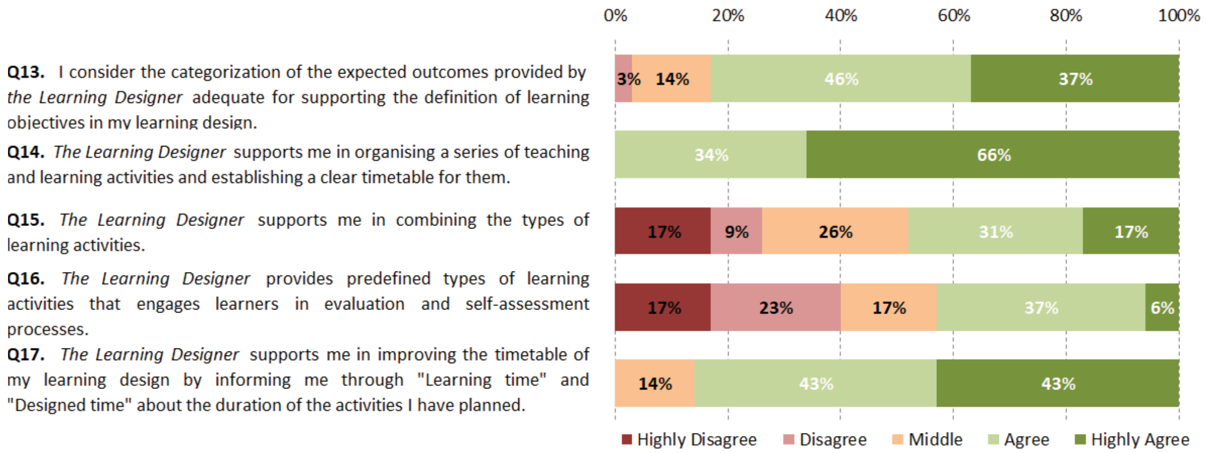

Figure 4: Distribution of responses in section C of the survey questionnaire

4.2 RQ2: How do pre-service teachers assess their experience of utilizing the LD tool?

The last two sections of the survey questionnaire addressed the participants' overall experience of utilizing the LD tool. In Figure 5 there is the distribution of responses to Likert-scaled questions of section D.

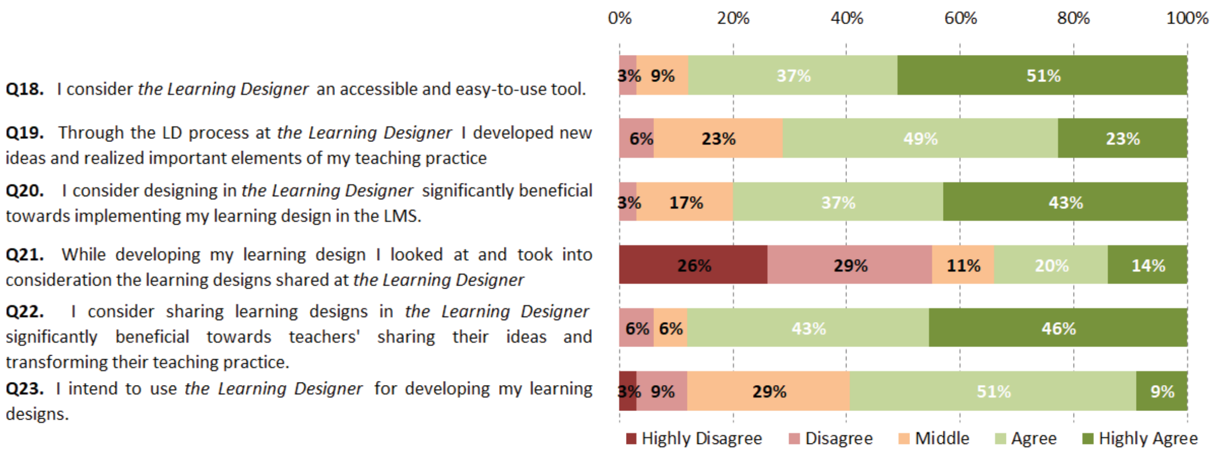

Figure 5: Distribution of responses in section D of the survey questionnaire

The participants described their experience as follows:

- the LD tool was found accessible and easy to use to 88% of the participants (Figure 5, Q18),
- the LD process actualized at the LD tool was considered by 72% of the participants to have contributed to developing new ideas and realizing important elements of their teaching practice (Figure 5, Q19),
- designing in the LD tool was considered beneficial towards implementing their learning design in the LMS by 80% of the participants (Figure 5, Q20),
- the participants' responses about browsing and considering learning designs shared in the LD tool while they were developing their own learning design were mixed with 34% responding positively, 55% negatively and 11% being neutral (Figure 5, Q21),
- 89% reported that they consider the tool's option of teachers' sharing their learning designs beneficial in terms of sharing their ideas and transforming their teaching practice (Figure 5, Q22),
- 60% declared that they intend to use the LD tool for developing their learning designs in the future (Figure 5, Q23).

Below the participants' responses to the open ended questions of section E are presented. At the open-ended question asking how far the LD tool was useful and in which way(s) it was helpful for the LD process:

- responses were dominated by positive comments on the pie chart representing the proportions of the learning types included in the TLAs of the design for depicting either the time distribution of the activities' learning types or the proportion of the different activities' learning types. The pie chart intrigued the participants' reflection on what they had actually designed. This process inspired corrections in cases they realized that their learning design was not adequate for the learning experience they had in mind,
- over one third of the participants mentioned two aspects: (a) the LD tool was considered supportive in terms of turning the pre-service teachers' ideas into a learning design by scaffolding the structure as well as the description of the learning experience planned for the learners, (b) the LD tool scaffolded the articulation of the learning design focusing on describing the learning outcomes and the learning activities,
- a few participants mentioned the option to design according to predefined learning activities' types as supportive,
- a few participants expressed their appreciation for the visualization provided by the LD tool, compared to their previous experience of designing in a narrative form.

At the open-ended question asking about the difficulties that the participants experienced during the LD process, related to the LD tool:

- half of the participants reported having no difficulties; on the contrary they thought that the LD tool facilitated the LD process (50%),
- most of the other half felt "limited" by the tool as they would prefer to parameterize the LD tool by adding their own learning activities types or by defining more than one type for each learning activity,
- just a few participants mentioned difficulties related to (a) the limitation of attaching only web resources to learning activities and (b) using the predefined types of activities i.e. they needed support by the LD tool in order to define the type of each activity and, furthermore, to design particular types of activities such as collaborative or personalised ones.

The participants' responses to the open-ended question, asking for the positive impact of the initial LD process in the LD tool towards the implementation of their learning design in Moodle, were dominated by a simple straightforward statement: "*It supported turning my ideas into a structure which I also followed in the implementation*". In particular, most of the participants noted that the LD tool helped them:

- realize the proportion of learning activities included in their learning design and adjust it in their implementation,
- become aware of the several components of their design that were either applicable in the implementation (e.g. resources to be given as learning material) or non-applicable but essential toward planning the learning setting e.g. defining outcomes related to the learning activities designed.

An insightful response given by a participant was: "The structure and the components provided by the Learning Designer, in relation to the non-existence of such support by the LMS, were quite helpful. I think that if I had developed the learning design in the LMS without designing it first in the Learning Designer, I would be "lost" and have not realized what I had actually been designing. Moreover, I wouldn't have thought of including information such as the learning outcomes or the time distribution of each task."

Accordingly, the participants' responses to the open-ended question asking for the difficulties they experienced in the implementation of their learning design in Moodle were split in 3 recurrent patterns:

- no difficulties; students declare that they consulted their learning design in the LD tool while developing the Moodle course,
- difficulties in turning the initial representation of the learning activities in the LD tool into a Moodle course and selecting appropriate tools provided by the LMS,
- difficulties in matching the components of the learning design represented in the LD tool with adequate tools of the LMS (e.g. Moodle does not provide a specific option in none of its tools to declare the time frame of the activity or the presence/non presence of the teacher).

Finally, the following items were included in the participants' wishlist of what they would like the LD tool to have:

- in accordance to the pre-mentioned favourable responses for the design analysis provided by the LD tool, 37% of the participants suggested that more means of analysis of the learning design should be provided,
- 1 out of 4 participants argued for the LD tool to provide support for defining / choosing appropriate teaching techniques, technological tools and resources,
- regarding learning activity types, 17% of the participants proposed that the LD tool should allow their parameterization so that the designer defines custom types such as assessment that is not currently included in the predefined learning activities types,
- 14% of the participants asked for the LD tool to support synchronous co-authoring of the learning designs,
- although the LD tool was acknowledged to support teachers sharing of learning designs, there was criticism for its lack of features supporting a teachers community. 14% of the participants suggested that the LD tool should extend the support of teachers sharing of learning designs by promoting a teacher community allowing communication among the platform users.

5. Discussion and conclusions

The results of this study report on pre-service teachers' initial experience with a LD tool. The research findings suggest that a LD tool like *the Learning Designer* has the potential to support teacher-designers through the LD process. The participants' perceptions of *the Learning Designer* are valuable to the research agenda of the LD tools underlining the tool features that appeal and are beneficial to teacher-designers as well as proposing extensions to it.

With regard to supporting novice teacher-designers to form and articulate the pedagogical rationale of a learning design, we evaluated the LD tool's features that have the potential to support teachers towards practicing effective pedagogy. The findings suggest that features that foster organizing learners in both individual and collaborative activities with teacher present or non-present are appreciated. Moreover, various means of analysis that stimulate the designers' reflection on the learning design in terms of promoting collaborative learning are valued. The pedagogical characteristics of a learning design that need to be defined by the author are considered to scaffold the LD process towards promoting the active engagement of learners.

In the case of *Learning Designer*, the feature of choosing among six predefined learning activities according to the activity typology proposed by Laurillard (2012) was considered helpful, although designers propose that such features should be customizable. Highly valued are the graphical means of a design's analysis that enhance the designers' reflection on the nature of the activities included in a learning design. The participants not only valued the pie chart included in Learning Designer but also requested more means of analysis. For the designer to converge learning with learners' assessment, a feature of a LD tool such as the categorization of the expected outcomes provided by the Learning Designer is deemed as highly supportive. Components that assist the establishment of a clear timetable for the learning activities planned, as well as providing feedback on their total duration are also valued.

The pre-service teachers' perceptions of their overall experience of utilizing the LD tool are dominated by favourable statements for the visual approach provided by the LD tool as quite supportive towards structuring a learning design. The graphical representation of the design, in terms of various TLAs, scaffolds the design of a well organised sequencing of activities. Moreover, it seems to stimulate the designers into developing new ideas and realizing important elements of their teaching practice. Designing in a LD tool prior to implementing the learning design in Moodle was regarded beneficial towards considering components of the learning design that are applicable in the implementation. Nevertheless, the fact that components of the learning design represented in a specific LD tool may not match the elements available in a LMS is an issue that provokes designers to reconsider aspects of their design during the implementation phase. As for the synthesis of pedagogy and content with appropriate technology, the findings suggest that the participants request components supporting the design process in this direction.

The fact that the participants of this study were pre-service teachers who had prior experience of developing a learning design only in a narrative form allows an insight into the novice designers' perceptions of a LD tool for supporting the LD process. Future research will aim at the exploration of experienced teacher-designers' perceptions in order to compare them with the ones of novice designers and strengthen the validity of the results.

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PhD Research Papers

Text Message Based Patient e-Learning in Developing Countries

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Abstract: Having doctor-patient communication after treatment can help improve medication compliance. For example, patients often fail to take their medications as prescribed simply because they forget or don't understand the importance of taking the medication as prescribed. Our E-learning approach, involves delivery of learning materials after diagnosis and treatment by the healthcare professional to the patient. This is done through Information and Communication Technology using a text message instructional design and format. The expected benefit in our approach is to improve patient outcomes, increased medication adherence and increased healthy behaviors. The contents of patient e-learning are determined by the diagnosis result, individual needs, symptoms and physical condition. We facilitate learning by organizing our learning materials in such a way that clinicians can easily find the materials related to patient conditions, prescriptions and drug information. This helps patient understand their medical condition, procedures they need to follow and eventually improves patient outcomes. The communication between doctor and patient can be recorded in HL7 CDA for the cloud storage in electronic health record system (EHRS). Its content can be referenced to treat the patient better in the future.

Keywords: e-learning, text message, SMS, developing country, EHRS, message server, CDA

1. Introduction

E-learning using SMS technology as a communication tool to manage patient care can have a positive impact in developing countries. Fong Ha et. al (2010) indicated that effective doctor-patient communication is a central clinical function in successful patient treatment. However, such communication is still a challenging task even in developed part of the world. In most developing countries, such communication is very hard to establish, if not impossible, due to many factors such as lack of clinicians, poor communication infrastructure, no efficient way to contact doctors, etc. The importance of the communication lies in the fact that it will improve patient outcomes. There can be many different ways of improving patient outcomes. One such way is to educate patients so they are aware of the disease they are suffering from and be able to understand the instructions of the medicine they are taking. When there is no efficient communication infrastructure between doctor and patient, patient education is harder to achieve. However, if the communication is done by less resource consuming manner such as text messaging, it can reach the patients who are even in remote areas as most of developing countries covered by 2G/2.5G. This way, patients in a remote area may be able to receive follow-up instructions, guidelines on how to take the medicine or possible side effects on the medicine, if any. In addition, patients need to be reminded of their treatments, nutrition requirements, dietary needs, and any other supplements. As a result, patients will respond to treatments more efficiently and effectively. According to pew research, as shown in Figure 1a. and Figure 1b. Most developing countries are using SMS text messaging systems as a means of communication. About 80% of the people in Africa, for example, are using text messaging, which means it has much higher penetration ratio than any other forms of the communication devices.

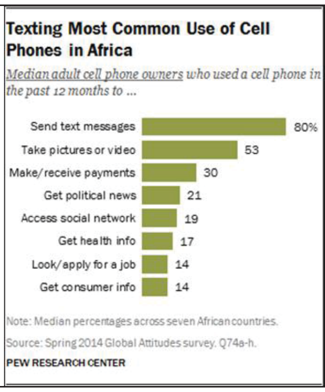


Figure 1a: Shows use of text messaging in Africa

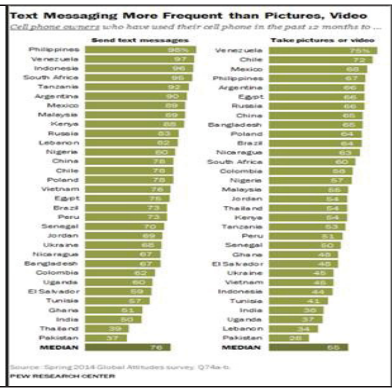


Figure 1b: Frequently used mobile technology

Hence, it is ideal to take advantage of this technology for patient education. With text messaging, it is possible to guide patients with their treatments, medications, and disease information, i.e., enabling doctor-patient communication. According to Cumbler et al (2010) 96% of patients omitted at least one prescribed hospital medication and 44% of the patients believed that they were receiving at least one hospital medication that was not actually prescribed. To avoid any potential medication error, it is essential for the patients and their guardians to learn about their medication so they can protect themselves from such errors and also improve patient outcomes. Healthcare professionals are looking for technological ways to provide easy-to-understand patient education that can help complement care providers instructions. The issue is how effectively they can deliver the learning materials to the targeted patients. The ultimate goal of patient education is to prepare themselves to be ready for self-care management. The purpose of the study is to explore an effective delivery mechanism for patient education from the perspectives of developing countries. The availability of healthcare providers is always limited in developing countries so it is compulsory to find a way to use their time efficiently such as sharing. Carefully prepared e-learning materials for text messages can be used for that purpose. They can be used to provide patients with treatment instructions, reminders, diagnosis result, physiological and/or pathological condition, instructions on medication, and learning materials for diseases. Since each patient may have their own specific conditions, aforementioned information can be used in a certain combination that may differ by patient. In this way, patients can understand their own clinical information their doctor is trying to deliver and be able to initiate self-care management. For this to happen, doctors or nurses must make significant effort to simplify their medical knowledge into a form that can be delivered through text messaging. Text messaging is by far the most popular communication technology due to the fact that it is simpler and economical than any other types of messaging and requires less infrastructure. We also know that information sent via text message can be quickly read by the patient and does not require the patient to access the Internet, log-in to an e-mail account, or download any document; this fast-paced style appeals to patient/doctor communication. The rest of the paper is organized as follow: literature review section covers various approaches in text messaging, section learning by text messaging covers our approach in delivering patient education through text messaging and we finally conclude our approach at the conclusion section.

2. Literature review

Applying text messaging and multimedia services in patient education provides excellent insights in communication between patients in remote areas and the caregivers. Recent reviews of text message e-learning literature in diverse patient education contexts reveal similar findings. However, these studies have limitations, especially they concentrate on specific aspect of healthcare and the variability in their research design. Badawy et. al (2017) aimed to systematically evaluate evidence for the efficacy of text messaging and mobile phone app interventions to improve adherence to preventive behavior among adolescents and describe intervention approaches to inform intervention development. Zhuang et al (2016) studies that improved health outcomes through the delivery of health educational interventions using cell phone or text messaging were included in the review. Déglise et. al (2012) described the characteristics and outcomes of SMS interventions for disease prevention in developing countries. Amanda Chatel et. al (2015) talked about text messaging application that connects teens with sexual health educators as an effective tool for delivering sexual health information. Fischer et. al (2012) assessed the feasibility of engaging adults using patient education with diabetes in self-management behaviors between clinic visits by using cell phone text messaging to provide blood sugar measurement prompts and appointment reminders. Franklin et. al (2003) developed a novel support network ("Sweet Talk"), based on a unique text-messaging system designed to deliver individually targeted messages and general diabetes information to patients. Militello et. al (2012) reviewed evidences using text messaging as a tool to deliver healthy lifestyle behavior intervention programs in pediatric and adolescent populations. Neville et. al (2004) proposed mobile phone text message service consisting of daily reminders to use an inhaler, health education tips, and safety messages. Atun et. al (2006) reviewed the characteristics and benefits of SMS in delivering healthcare patient education. Zurovac et. al (2011) assessed whether text-message reminders sent to health workers and patients using mobile phones could improve and maintain their adherence to treatment guidelines for outpatient pediatric malaria in Kenya. Horner et. al (2017) assessed participants' attitudes regarding their experience with text messaging. The participants received text messages twice daily for 6 months that were tailored to the participant's stage of behavior change as defined by the trans theoretical model of behavior change. The response rate was 67%, which is considered very responsive considering the duration and this also gives us the motivation to use text messaging for effective patient education. These researcher's contributions centers on specific disease and their approach falls short of the integration with existing electronic health record system (EHRS) for medical history and for future reference. Our approach looks this issue from a number of different perspectives includes: customized patient learning by text messaging, improving patient doctor communication, text message prescription, storing text messaging in HL7 CDA format in the cloud so it can be referenced for future treatment.

3. Medical standards

Data quality and the consistency among data items are critical factors for ensuring patient safety, doctor/patient communication, delivery of health services, coordinating care, and healthcare reporting. We try to use all applicable medical data standards so as to ensure interoperability and to promote data quality. Some of the standards includes:

- HL7 Clinical Document Architecture (CDA) provides an exchange model for clinical documents such as discharge summaries and progress notes. By leveraging the use of XML, HL7 Reference Information Models (RIMs), and coded vocabularies, the CDA makes documents both machine-readable (so they are easily parsed and processed electronically) and human-readable (so they can be easily retrieved and used by the people who need them). CDA documents can be displayed using XML-aware Web browsers or wireless applications such as cell phones.
- ICD-10 International Statistical Classification of Diseases and Related Health Problems, The ICD-10 version of the disease classification system was developed by the World Health Organization and is used to report morbidity and mortality information worldwide.
- SNOMED CT Systematized Nomenclature of Medicine Clinical Terms SNOMED CT is a comprehensive clinical terminology and infrastructure that enables a consistent way of capturing, sharing, and aggregating health data across specialties and sites of care.
- RxNorm is a clinical drug nomenclature that provides standard names for clinical drugs (active ingredient, strength, and dose form) and for dose forms as administered

Learning material server contains the learning materials regarding the above topics. It is searchable by keywords or standard medical codes. It is doctor's responsibility to determine kind of learning materials for each patient based on their medical condition using the learning material server.

4. Implementation of patient e-learning

Our approach consists of a few major components – Electronic health record system, message server, session manager, and HL7 CDA module. We demonstrate the interactions between patient and other entities using UML diagram as shown in the Figure 2.

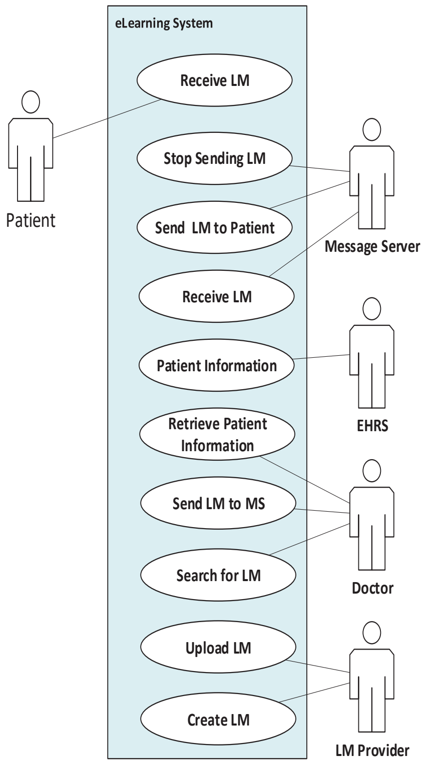


Figure 2: UML diagram for text-based patient e-learning system

4.1 Text messaging as customized patient learning

Patient understanding of their medical condition can lead to enhanced patient satisfaction, better compliance with treatment instructions, improved outcomes, and decreased treatment times and costs. Patients can take more active role in treatment as they know what to do and what not to do in their treatment. The e-learning contents may differ by the symptoms and diseases they are suffering from so, to be meaningful, it is necessary to know the patient's specific condition. According to PracticalNursing.org, there are five tips for providing effective patient education. They are 1) use of information technology, 2) determine the patient's learning style, 3) stimulate the patient's interest, 4) consider the patient's limitations and strengths, and finally 5) include family members. As an application for the tips, we mapped our approach to the above tips:

- We use text messaging for the doctor-patient communication and learning material delivery. This process is achieved by the use of text messaging server, interface with electronic health records through HL7 CDA, and cloud-based storage. Standard medical codes such as ICD-10 are used to provide patient education.
- We know that in developing countries, formal education may not be easily achieved so the learning content should be simple and easily accessible. We attempt to deliver relevant text messages repeatedly in a systematic way so the contents can be easily understood and easily accessible.
- In our approach, we enable the communication with physicians and prescription drugs so patients can receive text message-based learning materials regarding their symptoms and medical condition.
- We do not assume any prior medical knowledge of the patients in understanding text message-based learning contents.
- As our approach employs systematic text message generation, family members or guardians can be easily included.

The sequence diagram, shown in the Figure 3, represents the communication among the participating elements in customized patient education. All the text message-based communication must go through message server and there will be no direct communication between doctor and patient. The reason for this to record treatment related text messages in a standardized medical record format called HL7 CDA (clinical document architecture) to be used for later references.

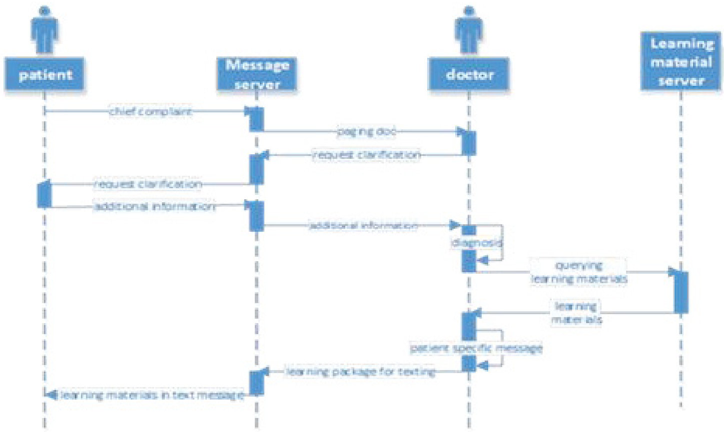


Figure 3: Customized learning package generation for patient

After consulting with the patient over text messaging, the doctor may be able to diagnose patient with disease name and prescription. The general description of the disease and prescribed drug are queried and added to the learning package for texting. Patient specific messages can be added to the package in addition to the learning materials. The prepared package is then go through the texting configuration to determine duration, frequency, and list of recipients including guardian if needed. The complete package will consist of the following attributes:

- Disease related learning material
- Drug related learning material
- Prescription
- Patient specific message

Table 1: Disease related learning material: Example

Learning material ID	Symptoms in SNOMED CT	description
Malaria(B50.9)	5767002 (joint pain) 274640006 (fever with chills) 271737000 (anemia – low blood cells) 16932000 (nausea and vomiting)	An infectious caused by a parasite. It is spread by the bite of an infected female mosquito. People catch malaria when parasite enters the blood.

Table 2: Dosage instructions learning material: Example

Learning material ID	Description	How-to-take
Aspirin	Aspirin is a salicylate (sa-LIS-il-ate). It works by reducing substances in the body that cause **pain**, **fever**, and inflammation. Aspirin is used to treat pain and reduce fever or inflammation. It is sometimes used to treat or prevent heart attacks, strokes, and chest pain (angina).	Take with food if aspirin upsets your stomach. Do not crush, chew, break, or open an **enteric-coated** or **delayed-release** pill. Swallow it whole. The chewable tablet form must be chewed before swallowing. If you use the orally disintegrating tablet or the dispersible tablet, follow all dosing instructions provided with your medicine.

4.2 Delivering learning materials as text messaging

Standard SMS is used to deliver education package or study plan to the patients possibly in remote areas. Apart from its widespread usage, SMS also has many other characteristics that make it appropriate for patient education. The one-to-many feature of SMS systems means that messages can be sent by the caregiver to many recipients simultaneously including patient guardian, etc. The education package includes disease related and/or drug related learning materials that are prepared specifically for a particular patient i.e., customized. Text messages may include prescriptions and patient specific messages from the doctor to improve patient outcomes.

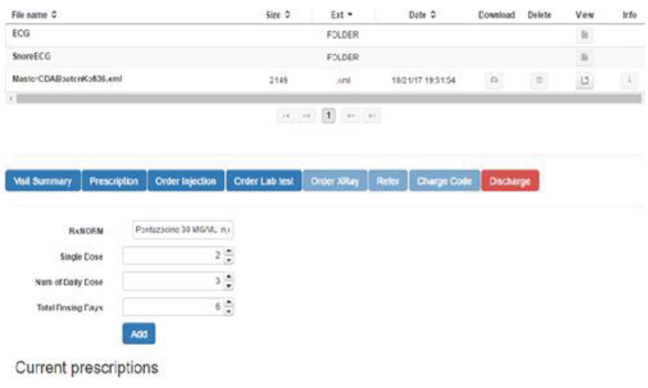


Figure 4: Prescription creation for a patient in Electronic Health Record System (EHRS)

Our proposed text-based patient education system interfaces with an EHRS for prescription and consultation recording. The prescription can be prepared by using the EHRS we developed in the previous work as shown in the Figure 4 and the result is added to the patient package for texting. The communication between doctor and patient is saved to a standard electronic health record format called HL7 CDA (clinical document architecture) for uploading to a cloud storage for the seamless communication with the EHRS. In the Figure 6, the text message communication on the left is converted into HL7 CDA file on the right for uploading to the cloud storage in the EHRS.

Figure 5: Converting text-based communication into HL7 CDA

4.3 How messages are sent to the patient

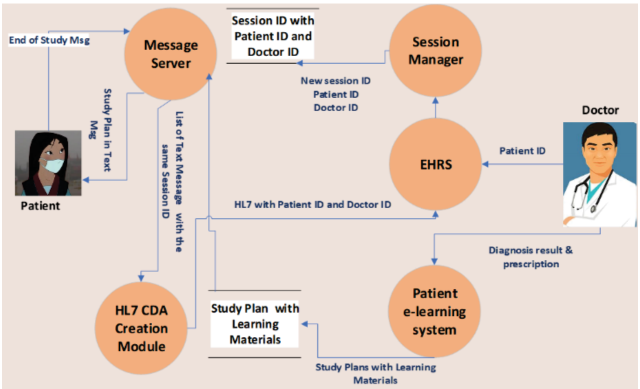


Figure 6: A diagram of patient e-learning using SMS

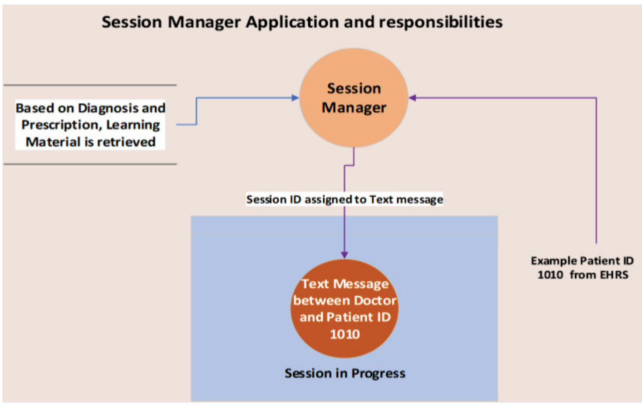
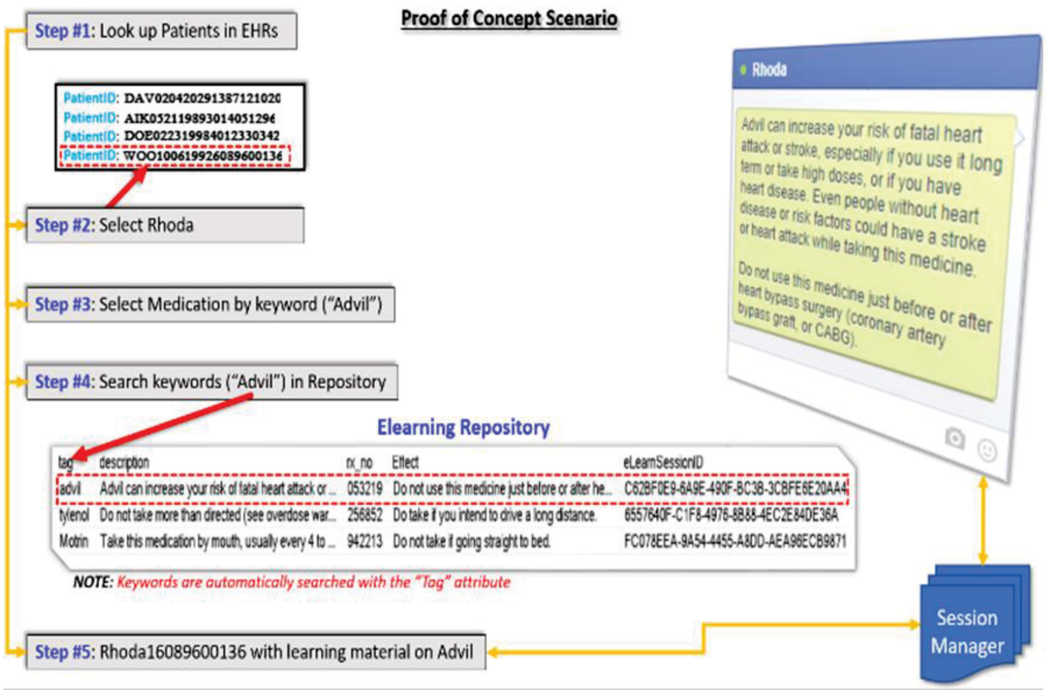


Figure 6.1: Diagram showing the session manager responsibilities

Our approach enables the patient using mobile phone to send a short message to the doctor about his/her illness. After text-based consultation is complete, patient record can be retrieved by the doctor from EHRS. If the retrieval is successful, the patient ID is sent to the session manager as shown in the Figure 6.1 The session ID is assigned to the text messages between the doctor and the patient to keep track of their communication. The consultation result diagnosis and prescription are used to retrieve learning materials in the patient e-learning system. The relevant learning materials are then retrieved and the result is then stored in the study plan for the patient. The study plan is then converted to text messages in the message server. The converted study plan is now put into text message scheduler for the repeated delivery to a particular patient. Once the end of study message is received by the patient, the message server then sends the list of text messages between patient and doctor with the same session ID to the HL7 creation module for the creation of HL7 CDA file. The file is then sent to the EHRS for the future consultation and treatment.

4.4 Proof of concept – testing

We demonstrate our ideas in principle and verify that our e-learning concept or theory has the potential. Our concept is based on Figure 6 as shown above.



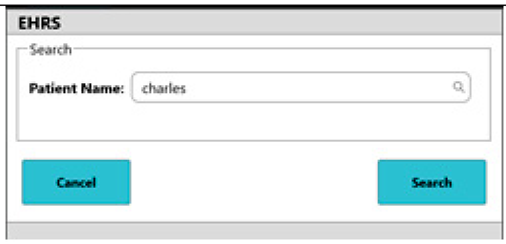
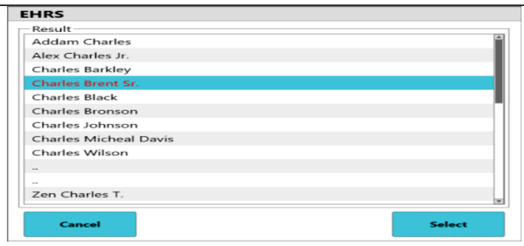
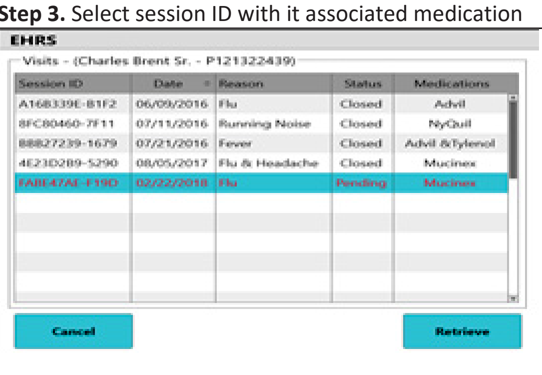
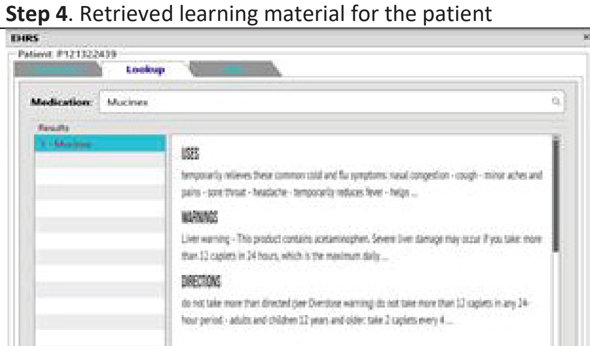
Step1. Search for patient by name, phone number or session id	**Step 2.** Select patient form the list
	
Step 3. Select session ID with it associated medication	**Step 4**. Retrieved learning material for the patient
	
Step 5. Create CDA and send patient e-learning material	**Step 6**. Summary of patient information

Figure 7: Procedure for searching e-learning materials for a patient

Table 3: E-learning material search results

From	To	PatientID	Msg	eLearning	SessionID	DateCreated
+13014337115	+16089600136	W00100619926089600136	Take Advil and drink lots of water	Outbound	682DC07B-6EEE-4054-B63F-BA21D36359FC	2018-04-20
+13014337115	+16089600136	W00100619926089600136	Advil can increase your risk of fatal heart attack or stroke, especially if you use it long term or take high doses, or if you have heart disease. Even people without heart disease or risk factors could have a stroke or heart attack while taking this medicine.	Outbound	50B89F35-9437-410C-8D7E-0430594612E0	2018-04-20 09:
+13014337115	+16089600136	W00100619926089600136	Do not use this medicine just before or after heart bypass surgery (coronary artery bypass graft, or CABG).	Outbound	2D89E3C6-D5E3-4608-B7B0-7B03A54E0A41	2018-04-20

Messages are sent to the patients by using patient ID, package ID, and or phone number as shown in table 4. Patient is queried to check if the patient exists in the database before the education package is put into the scheduler. We do this by patient last name, date of birth, and phone number. Chief complaints, which are short statement describing the symptoms and medical conditions. A learning package is then sent to the patient on a schedule bases as shown in the Table 4.

Table 4: Text message scheduler

Recipients table			Texting Schedule					
Patient ID	Package	Phone number	Patient ID	Package	Duration	Frequency	Start Date	Prepared by
K001	P1234	3013456666	K001	P1234	3 month	weekly	3/12/2018	Dr. John Smith
K001	P1234	1231231234						

5. Conclusion and future work

In this paper, a customized patient learning system that consists of cloud storage, message server, session manager, text messages, and learning materials is introduced. It is used to deliver customized patient education to improve patient outcomes especially in developing countries. Text message-based patient education was considered due to unstable or unavailable Internet services in some remote areas in developing countries. Because of the limited space of the text messages, learning material contents were reduced to contain only the essential information about the disease(s) patients are suffering from, patient specific education materials, and drug related instructions. Patient specific education packages are sent to each patient and/or guardian multiple times based on pre-determined schedules for some specified periods to improve effectiveness of the education. Text message-based patient education can help connect doctor and patient in developing countries, especially in rural areas. The communication between patient and doctor for diagnosis and treatment was saved into HL7 CDA file to be uploaded to some electronic health record system for later references. As a future work, the data analysis on the text-based communication in HL7 CDA will be performed to determine popular symptoms and diseases by regions and the demographics of patient population. The interface with local pharmacy will also be considered and integrated into the proposed framework.

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An Exploration of Experiences and Determinants of Blended Learning Adoption Among Students in Higher Education Institutions: A Case Study of Ghana Technology University

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Abstract: This paper presents the experiences and determinants of blended learning adoption among students in a higher education institution in Ghana. As students are increasingly being exposed to teaching and learning deliveries in which both traditional classroom and online methods are employed to deliver instructional content through blended learning (BL), the indications are that blended courses offer them convenience and flexibility that face to face delivery alone may not. However, while both classroom-based and fully online instruction are well understood, little is known about the students' BL experience. This paper uses the blended learning initiative at the Ghana Technology University College (GTUC) as a case study to investigate the perception of blended learning adoption among students. The population comprised of 57 students who participated in a BL course at the Faculty of Computing and Information Systems. Thematic analysis was used to analyze the data. The three categories identified from the data were: student BL perspective, student BL adoption determinants and BL challenges. The findings of the study contribute to a better appreciation of student's experiences of the BL approach. This is against the backdrop that student perception and experiences are captured in the personal utility and pedagogical significance that students derived from BL and the challenges thereof that they face. It is envisaged that this study will assist administrators planning on implementing BL initiatives offer tailor made deliveries to the satisfaction of users.

Keywords*:* blended learning, e-learning, qualitative interviews, adoption, higher education institutions, Moodle

1. Introduction

Tertiary education has experienced a large influx of students all over the world (Hanson and Asante, 2014). This increase in the number of students coupled with inadequate resources is some of the issues confronting educational systems. These challenges have led universities (in developing countries) to integrate information and communication technology (ICT) into their teaching and learning delivery (Sarfo and Yidana, 2016). Currently, blended learning (BL) is viewed as effective in promoting learning as it decreases the distance and increases the interaction between students and faculty and has a positive effect on reducing dropout rates and in raising examination pass rates (Ocak, 2010; Lopez -Perez,2011). BL is becoming more popular as the most effective method of teaching and learning and disseminating information and knowledge in institutions of higher education (Noh *et al.,* 2012).

Despite its promise, BL is far from gaining wide spread acceptance in developing countries (Unwin, et al., 2009). The reality is that most African educators have little knowledge about, or interest in its usage (Unwin, 2009). In Ghana, for example, there exists programmes that have been created to integrate ICT into teaching and learning, Sarfo & Ansong-Gyimah (2010) by adopting the combination of the traditional classroom setting and the ICT enabled teaching and learning platform (Gyamfi and Gyaase, 2015).

Significant barriers exist which impact on Higher Education Institution (HEIs) adopting BL. Instructors in developing countries are confronted with issues of poor Internet connectivity, inadequate infrastructure, poor facilitation conditions and lack of technical support among others. All these adversely affect the implementation of this approach (Antwi-Boampong,2018). Similarly, students taking BL courses often experience frustration due to lack of communication and technological problems (Shantakumari and Sajith, 2015). Therefore, student satisfaction is the most important factor which needs to be considered when implementing BL (Chang, 2003). With scholarship on BL progressing towards more comprehensive understanding of effective blended course design practices (e.g. Napier, Dekhane, and Smith, 2011) little attention has focused on evaluating how these practices foster learning from student's perspectives (Voegele, 2014).

Evaluation of the success of BL courses largely relies on students' attitudes, expectations, and satisfaction, (Akkoyunlu,2008). The feedback of students who are among the key stakeholders is essential to ensure a successful implementation of teaching learning methodology (Shantakumari and Sajit, 2015). This paper therefore evaluates the perceptions of students by asking how students who are used to face to face classroom teaching perceive BL. The paper builds on a series of qualitative interviews with students from Ghana Technology University as a basis for understanding students' perceptions on BL.

The paper is organized as follows: section 2 provides a literature overview of other papers evaluating students' perceptions regarding blended learning. In section 3, the methodology of the paper can be found. Section 4 describes the findings of the qualitative interviews while section 5 presents the analysis made of these. Finally, section 6 presents the conclusions.

2. Literature review

There is a high degree of utility, motivation and satisfaction perceived from blended learning, which could lead students to have a positive attitude towards learning, (Lopez-Perez, 2010). According to Gyamfi and Gyaase (2015) students show positive perceptions towards BL as it reinforces students' understanding of the subject in question as well as enhances and supports the learning process, Lei, (2010). Advantages of BL includes increased students' satisfaction, (Shantakumari and Sajith, 2015, Gyamfi and Gyaase, 2015,) reduced staff workload (Dorrian and Wache, 2009), increased student retention and achievement (Garrison and Kanuka, 2004).

Studies on student's perceptions about BL indicate that perceptions have been positive. Aydin *et. al*., (2015) investigated relationships between perception of the online learning, students' approach to online learning, and students' perceptions of online learning. They found out that participants did not perceive negative attributes of technology to be inherent in the technology, but they explained some troubles about its use and implementation. The basic expectation of the student was that communication technologies would be used in ways familiar to them and in providing a response to their educational needs. Additionally, they report that the main reasons for students taking online education were flexibility of time management, gaining independence, self-control and self-directed learning. Nonetheless, they observed that this learning approach created some communication problems with instructors.

Shantakumari and Sajith (2015) found students to hold a positive perception of the BL courses being offered in the Gulf Medical University. They found students to perceive Moodle to be easy to use with learners' age and gender not being significant factors affecting their perceptions of BL. However, perceptions of BL differed with course enrolment and recommend that the BL format offered needs modification according to course content.

A stream of research over the past decade that identifies predictors of BL success suggests several critical success factors (CSFs). Eom and Ashill (2016) examined the determinants of students' satisfaction and perceived learning outcomes in the context of university online courses and found that instructor-student dialogue, student-student dialogue, instructor, and course design significantly affects students' satisfaction and learning outcomes. However, both extrinsic student motivation and student self-regulation had no significant relationship with user satisfaction and learning outcomes. The findings suggest that course design, instructor, and dialogue are the strongest predictors of user satisfaction and learning outcomes.

Similar studies by Wu, Tennyson and Hsia (2009) proposed a model that examined the determinants of student learning satisfaction in a blended learning system environment and found computer self-efficacy, performance expectations, systems functionality, content feature, interaction and learning climate as the primary determinants of students learning satisfaction with BL. These findings provide insights into the antecedents of factors that need to be considered in planning a blended learning course to enhance students' satisfaction.

3. Methodology

The paper is based on a case study carried out at Ghana Technology University College (GTUC), a 4-year undergraduate multi-campus institution with main campus in Accra, Ghana. As a technology-oriented university, GTUC has over 6000 students from the West Africa sub region. The Management of the University took the decision to adopt a BL approach with the intention of full online delivery by 2021 (GTUC, 2013). Adopting Moodle, allowed the GTUC Strategic Plan to integrate educational and technological opportunities into its programs. Prior to this, GTUC had employed traditional teaching methodologies and commonly used print-based resources and face- to- face delivery approaches (Antwi-Boampong, 2018).

3.1 Research design

Ten students who participated in a BL course at the faculty of computing and information systems were purposively selected and interviewed. The students were selected in consultation with the instructor of the course. The face- to- face interviews with study participants were conducted by the researcher using a semi-structured, open ended set of questions in line with (Kvale and Brinkmann, 2008). Each interview session lasted between forty-five minutes to an hour and was conducted between October – December 2017. All interviews were audio taped and transcribed, verified and accepted by participants before being analyzed.

3.2 Data analysis

All data were transcribed, and transcripts were e-mailed to each participant, who had the opportunity to confirm or adjust the notes taken before providing research consent. Thematic analysis described by Burnard (1991) was used to analyze the data. The data was thematically coded, this involved reading and re-reading the transcripts and assigning open codes, axial codes and tentative categories. Rigor was maintained using the principles of reliability, trustworthiness and credibility (Lincoln and Guba, 1985). For reliability purposes five transcribed interviews were randomly selected for testing of coding reliability. The intra-coder reliability was checked by re-coding five interview transcripts two weeks after the first coding. During these two weeks no interviewees were studied. The five selected transcripts were sent to an external coder to code them independently before a coding framework was agreed on. The external coder was a lecturer with qualitative research competences and was familiar with the content of the research.

To enhance credibility, a copy of the findings was presented to the participants to comment on the accounts and the researcher's interpretations. All participants agreed and confirmed the findings to be representative of their experiences. A record of the research strategy, data, analysis and findings were also kept for conformability and dependability purposes.

4. Findings

A total of 10 students were interviewed. They were chosen from an undergraduate class, which comprised of 57 students. The interviews took place at GTUC. Generally, the students were asked about their perception and interest in blended learning. The details of the interview guide used can be found in the annex.

Overall the students had a positive and good perception about the BL approach. The learning experience which BL provides through learning within a community of learners which hitherto is absent in a normal traditional classroom was highlighted. This being that BL enabled students to communicate more with their colleague students and get access to lecture materials from lecturers. According to an interviewee: 'there is more communication between all of us because everything is online, everyone is on social media, so it makes getting information much easier and getting access to lecture notes'.

Ultimately, the respondents believed that the BL approach enhances student learning in diverse ways. Addressing this, participants indicated that the BL approach was a good complement to teaching and learning process as captured by this sentiment of an interviewee: "well as we've been saying the blended learning is a further enhancement to the regular classroom learning, suffice to say that if the classroom learning should have been a 100%, it's been added a 150% because I see it as an addition to what you've gotten from the classroom".

The personal utility of the BL approach to the students and the system's effectiveness as a pedagogy tool for teaching and learning emerged as the main themes. These and their accompanying sub-themes are discussed in the following section.

Respondents indicated that the BL approach was flexible and convenient because through this approach, they could submit assignments at their own pace and convenience. The flexibility this provided was articulated against the backdrop of what would pertain in a traditional classroom set up where lecturers would set timelines for collection of assignments and take them in class, taking away the flexibility to adjust and submit at the pace of the student. One interviewee said, "Especially when the deadlines are convenient like you can easily submit your assignment at your own pace compared to a lecturer coming to class to collect it".

Interviewees also mentioned that the BL approach provided the opportunity to recall assignments that are submitted online for the purposes of correcting mistakes or adding new material. This opportunity is not available when assignments are submitted in hard copies to the lecturer in class. This point is illuminated by an interviewee as follows: "in terms of like I mentioned the deadlines and when you submit an assignment and you realize oh I made a mistake before they assess it you can easily take it back and then as compared to when you hand a paper and you can't take it back. Sometimes assignments get loaded there you might miss it in class but then it's always online for you to get it".

Respondents revealed that the BL approach gave them a unique and enriching learning experience as it provided the opportunity for them to have access to videos and online material and in instances recorded lecturers which are stored online. Acting as a repository the BL system enabled the students to recall material that has been taught in class, which hitherto is unavailable in the face to face class. An interviewee posited that "Because maybe sometimes periodically maybe he might teach something you might not really get it so maybe he might refer a video or maybe audio or a slide that might actually give you more understanding of what he is teaching. So, it really helps us a lot".

Additionally, the practice of lecturers uploading lecture materials in advance and providing reading list for the students to engage in self-research in advance of the class was mentioned by the respondents as a determining factor in the adoption of the BL approach. Similarly, they mentioned the presence of other students on the platform as providing an opportunity for interaction and discussing uploaded content, sharing ideas well in advance even before the class starts as a key determining factor for adoption of BL. This view is captured by a respondent as follows: "I will be able to receive my lecture notes for my entire semester that has been uploaded on the platform so it has afforded me the opportunity to being able to read ahead and I have always had access to fellow colleagues online and to some extent the platform makes it very interactive such that even if you and I are not within the same classroom".

The BL approach was viewed by respondents to be an effective pedagogy tool as discussed in the following sections.

Participants indicated that learning through the BL approach provided a much broader scope for learning by utilizing multiple sources of getting information given that most of the materials are online. One interviewee pointed out that, "when it's online you can also get information from so many sources because it's online not only the teacher teaching you in the class but from wide sources".

As a pedagogic tool, respondents emphasized the usefulness of the BL approach to them in terms of how they use it to advance learning, how lecturers can equally reach out to the community of learners available on the platform and engage them in a socially constructive manner that stimulates learning through the interaction of all the students enrolled on the platform. Emphasizing this, one respondent argued that "even if am home and having issues I can either create a post or forum group and other colleagues who are also logged online, and we can exchange ideas there".

The opportunity to get prompt feedback from lecturers and students was mentioned by some students as one of the determinants for their adoption. Similarly, they did indicate that the BL approach availed them the opportunity to extend the classroom sessions and to reach out to lecturers on an irregular basis any time they were studying and needed clarification on topics. Expressing this, one interviewee said, "we have an online platform for students sometimes the assignment is loaded up there and our tutors use it, lecturers use it to get feedback. I am reading through and if I am not getting something right I could message my lecturer from that platform and ask him with regards to a particular subject or topic that I don't understand, and he can also respond back at the same time, so my experience has actually been wonderful".

For most of the respondents, the learning process transcended the boundaries of the classroom. Through the BL approach they emphasized that teaching and learning was endless as it afforded them the opportunity to engage in the process beyond the confines of the classrooms as captured by one interviewee as thus, "the Moodle platform, it affords you the opportunity to learn outside the classroom because lecturers will be able to upload your lecture notes even ahead of time so you can go on the platform and download your lecture notes and you can read ahead".

Students reported that Internet connectivity on and off campus was a challenge often resulting in the lack of access to the platform. According to a respondent, "yes because there was a time we had to submit, I run out of data and we had to submit this online assignment but the Internet was really slow it was taking time and there is a deadline you have to submit before the deadline and if you don't have a fast Internet it's going to take you time to be able to submit you might have done the assignment but due to slow connectivity of the Internet you can't be able to submit at that particular time".

Some participants commented that the approach could be very distracting for their studies. Additionally, focusing and paying attention during the self-learning process which BL approach offers was mentioned as reflected in the interview response of on respondent as this, so there is this focus but when you're online or maybe it's a video call, you might get distracted by things around you maybe if you're in your room or something you have a roommate that might be playing music or something and really take your mind off what you're studying but when you're in the classroom.

Additionally, students complained of the lack of adequate user support in the form of orientation on how to use the system. One respondent said, "I think with that coupled with the day to day interaction of the service by the students it's possible to find a way through but if you just enroll me and say I have uploaded an assignment: go and download the assignment how do I get along?" So, the students need to be orientated on how to use the system.

System design and security concerns were among the issues respondents complained about as being challenges they face in the adoption process. Notable among these are: Prompt and notification issues- Some of the students mentioned their frustration in not getting prompts or notification pop ups anytime the BL platform was uploaded with content or new information from the lecturer or students. As expressed by one interviewee as thus; "currently I feel if we would be getting notifications part of the platform because normally not everyone has been checking in on the platform all the time but if it is so get a notification that lets say maybe there is an assignment given or maybe there is something to do there should be sort of notification to remind you'"

Some respondents were particularly concerned about the integrity of the system and how quality was ensured in terms of verification of students and the assignments they submit. They held the view that with the current status quo it was easy for cheating to take place through impersonation. One respondent said, "one thing is it is easily cheated. You can use someone's login details to do assignments for you not very secured".

5. Analysis

This section presents the three categories that emerged from the study with their accompanying predominant themes and sub themes concerning the perceptions, determinants and challenges of the participants as in Table 1.

5.1 Description of coding and categories

The researcher developed a coding scheme that emerged from reading the transcripts and grouped the data into three categories. The categories were abstracted from the themes and sub-themes, emerged from the analysis of the data as described by (Burnad 1991).

In this regard, for the student perspective on BL category, the student perception concerning BL emerged as the theme with the following as sub-categories- community of learners, student's engagement, contribution towards discourse, enhanced student learning, complementing teaching and learning.

Similarly, for the student BL adoption determinants category, two themes emerged namely, Personal utility of BL to students and Effective pedagogy tools. The former had the following as sub-themes flexibility, convenience, retrievable by providing room for correction of mistakes, opportunity for recall, fore reading and preparation and interactivity while the latter had the following as sub-categories; -Continuous learning, extended learning scope, extended teaching and learning presence, community of learners and feedback.

Finally, for the BL challenges category, three themes emerged namely, Technological challenges, Student centered challenges, BL system use challenges. With respect to sub-themes for technological challenges the Internet and infrastructure inadequacies emerged. Again, for students centered challenges these sub-themes of distractions and focusing issues, inadequate user support services and inadequate accessories access BL platform issues emerged. Similarly, for the BL system use challenges, the sub-themes included System prompt and notification issues and system integrity concerns respectively.

Table 1 Themes and sub-themes of students' perspective of BL

Categories	Themes	Sub-themes
Students BL Perspective	Students perception concerning BL	- Community of learners - Students engagement - Contribution towards discourse - Enhanced student learning - Complimenting teaching and learning
Student BL adoption determinants	Personal utility of BL to students	-Flexibility -Convenience -Retrievable by providing room for correction of mistakes -Opportunity for recall - Fore reading and preparation -Interactivity
	Effective pedagogy tools	-Continuous learning -Extended learning scope -Extended teaching and learning presence -Community of learners -Feedback
BL challenges	Technological challenges	- Internet and infrastructure inadequacies
	Student centred challenges	-Distractions and focusing -Inadequate user support services -Inadequate accessories access BL platform
	BL system use challenges	-System Prompt and notification issues -System integrity concerns

Field work, Antwi-Boampong, (2018)

The findings of the study contribute to a better appreciation of students' experiences of the BL approach. This is against the backdrop that their perception and experiences are captured in the personal utility and pedagogical significance that students derived from BL and the challenges thereof that they face. Significantly, participants expressed positive views about the BL approach - an outcome that finds support in previous studies (Shantakumari and Sajith, 2015, Gyaase and Gyamfi, 2015).

The study revealed that student's positive perception is underscored by the flexibility, and convenience that BL presents. The need to update knowledge by the working class, and the need to keep pace with dynamic occupational challenges, enhanced career prospects, have stimulated a new thinking by the stakeholders (Adu et al.,2013). New trends such as BL are therefore welcomed for the working student as it provides flexibility and convenience in the acquisition of knowledge for those working and schooling at the same time.

Perceived as a pedagogic tool in students' view, the utility that the BL approach affords the lecturer to plan, design and deliver courses in a socially constructive and stimulating manner underscores the fact that the learning process transcends the class room. Good teaching practices need to be governed by pedagogical tools or principles. As such, the success of e-teaching is not a function of technology alone. Wall (2012) posits that a poor understanding of relevant learning theories, inability to identify learning styles of different learners or poor combinations of instructional design will undoubtedly lead to failure in e-teaching and learning. Therefore, viewed as providing an instructional platform that creates opportunity for student community of learners to engage in a socially constructed manner, BL extends the learning process from the class room, and provides the opportunity for continuous students and lecturer engagement.

BL is not without problems, and for many HEIs recurrent issues of inadequate infrastructure, technological challenges that have to do with slow Internet connectivity have been reported (Antwi-Boampong, 2018). This served as a barrier that impacted on the student's ability to access and engage in meaningful online deliberations, accessing content and so on. Equally so are system design and user challenges that have to do with navigation, prompt and notifications as and when messages and materials are uploaded among others. As a results of these challenges Volery and Lord (2000) indicate that ease of access and navigation of any virtual learning management system is crucial in the effectiveness of the BL educational approach.

6. Conclusions

This study sought to explore student's experiences, determinants and perception in a BL class. Using an exploratory case study approach, the study confirms that students have a positive perception of BL as a new teaching and learning approach at GTUC. The findings of the study relative to the determinants of BL by students provide key insights into student's perceptions and understanding of the BL approach. Based on the findings of this research, it is recommended that institutions that plan on implementing BL should adequately provide a blended environment that considers the personal utility of the approach to the students in terms of flexibility, convenience and a platform that ensures that a community of learners can interact. Faculty members in this regard should adequately engage students and provide them with the necessary feedback as these are key considerations for students as they adopt BL.

Annex: Interview guide

- 1. What kind of technological systems does your institution use for teaching and learning purposes?
- 2. Describe how you use this system for your academic purposes in your university?
- 3. Describe to me the teaching and learning process that involves the use of technology as a mediating medium. (i.e. How the lecturer / student engagement is)
- 4. Describe your learning experiences using this approach.
- 5. How does this learning approach compare to the face to face in terms of achieving learning outcomes?
- 6. Describe what influences your decision to use this approach?
- 7. Kindly share your experiences if any in terms of challenges using this learning approach?

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Computational Thinking and Online Learning: A Systematic Literature Review

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Abstract: This paper introduces research concerned with investigating how Computational Thinking and online learning can be successfully married to help empower secondary teachers to teach this subject. To aid this research, a systematic literature review was undertaken to investigate what is currently known in the academic literature on where Computational Thinking and online learning intersect. This paper presents the findings of this systematic literature review. It outlines the methodology used and presents the current data available in the literature on how Computational Thinking is taught online. Using a systematic process eight hundred articles were initially identified and then subsequently narrowed down to forty papers. These papers were analysed to answer the following two questions: 1. What are the current pedagogical approaches to teaching Computational Thinking online? 2. What were the categories of online learning observed in the teaching of Computational Thinking? Our findings show that a wide range of pedagogical approaches are used to teach Computational Thinking online, with the constructivist theory of learning being the most popular. The tools used to teach Computational Thinking were also varied, video game design, playing video games, competitions, and unplugged activities, to name a few. A significant finding was the dependency between the tool used and the definition of the term Computational Thinking. Computational Thinking lacks consensus on a definition, and thus the definition stated in the literature changed depending on the tool. By considering a significant body of research up to the present, our findings contribute to teachers, researchers and policy makers understanding of how computational thinking may be taught online at second level.

Keywords: computational thinking, online learning, pedagogy, secondary education

1. Introduction

There are two challenges to integrating Computational Thinking into the classroom 1) the lack of consensus regarding a definition and 2) the shortage of qualified teachers that can teach this skill (Menekse 2015; Curzon et al. 2014). This lack of agreement was highlighted in 2009 when a workshop organised by the US National Research Council with the goal of establishing “The Scope and Nature of Computational Thinking” failed to reach consensus among its participants concerning the content and structure of Computational Thinking (National Research Council (NRC) 2010, p.65). Computational Thinking has its beginning with Seymour Paper (1980) and his much citied book “Mindstorms: Children, Computers, and Powerful Ideas” but it was Jeannette Wing, who popularised Computational Thinking more widely. She defined it as follows: “Computational thinking involves solving problems, designing systems, and understanding human behaviour, by drawing on the concepts fundamental to computer science” (Wing 2006).

This definition of Wing’s has significance for compulsory education in that it states that Computational Thinking is fundamentally a thought process, i.e. independent from technology and that its solutions can be executed by either a human or computer, or both (Bocconi et al. 2016, p.15). Notwithstanding Wing’s definition, other subsequent definitions and views have arisen such as Aho (2011), Barr and Stephenson (2011), Royal Society definition (Fuber 2012), Computing At Schools Barefoot Organisation (2014), Bocconi et al. (2016) and Shute et al. (2017). What is interesting about these definitions is that there is no explicit mention of programming languages. Wing’s 2006 paper was very specific about this stating that Computational Thinking was about conceptualisation, not programming. It was concerned with ideas, not artefacts. This is not a universal belief. At the aforementioned workshop organised by the US National Research Council in 2009 Roy Pea, Ursula Wolf, Mitchel Resnick and Eric Roberts all voiced opinions concurring that programming is essential to Computational Thinking (NRC 2010, pg. 13). Ioannides et al., (2011) provide a definition that relates to Computational Thinking Patterns and Scalable Game Design. Alternatively, Brennan and Resnick (2012) proposed a definition of Computational Thinking that revolved around the Scratch language. The above discussion highlights that no simple answer is forth-coming for the question what is Computational Thinking, thus illustrating one of the challenges to integrating Computational Thinking into the classroom.

The second challenge to integrating Computational Thinking in the classroom is the shortage of qualified teachers that can teach this subject (Meknes 2015; Curzon et al. 2014). An online course or platform may aid in helping overcome this challenge. This online course/platform may be used to support the teaching and learning of Computational Thinking inside and outside the classroom, self-directed or teacher lead. This research proposes investigating what is known in the literature about online courses and platforms in relation to the teaching and learning of Computational Thinking. Note, online was defined based on the Online Learning Consortium (OLC) definitions (Sneer 2015) (web-based courses were included if part of the teaching was performed online or if the tool was self-contained, i.e. could be used without the presence of a teacher).

2. Methodology: Systematic literature review

A systematic literature review was undertaken with the initial aim of investigating what is currently known in the academic literature on the intersection of Computational Thinking, online learning and secondary students. This research is underpinned by a pragmatic worldview (specifically the teachings of John Dewey), and thus a systematic approach to the identification of the literature was taken with the goal of providing a transparent and accountable methodology that can be replicated (Gough et al. 2012, pg. 18).

The PICO (Population, Intervention, Comparison and Outcome) framework was used to guide the specification of the research questions and the inclusion strategy for the review. With respect to Secondary School students: **Q1** What are the current pedagogical approaches to teaching Computational Thinking online? **Q2** What were the categories of online learning observed in the teaching of Computational Thinking? The intention was to ensure that the returned literature was concerned with all three topics: Computational Thinking, online learning and secondary school students (Gough 2012 chapter 4, pg 103). The PICO elements used were as follows:

- **Population**: K12 children age 12-18
- **Intervention**: Teaching of Computational Thinking online without using a programming language
- **Comparison**: Teaching of Computational Thinking online using a programming language
- **Outcome**: Effectiveness and extensiveness of the teaching medium and the effectiveness of the pedagogical approach

A search strategy was developed with the purpose of choosing search terms that would strike a balance between sensitivity (finding all articles on a subject) and specificity (finding relevant articles) (EPPI Centre 2006). The PICO framework provided the keywords ("K12 students," "Computational Thinking" "Online" "Teaching") that were used to generate synonyms that were Boolean ORed together. For example, the term algorithmic thinking and logical thinking were used as synonyms for Computational Thinking, as they can be considered a subset of Computational Thinking (Syslo (2015) cited in Buitrago Flórez et al., 2017). The final search string was constructed by ANDing the OR lists of synonyms for "Computational Thinking", "teaching", and "online", which was then run against six databases (Inspec, Compendex, ACM Digital Library, Education Research Complete, ERIC and British Education Index.) The K12 synonyms were removed to broaden the search criteria and return more literature. In total 800 articles were returned and subjected to the study selection process.

2.1 Study selection process

As recommended by Kitchenham and Charters (2007), inclusion and exclusion criteria were developed, with the abstract and title of each of the 800 articles being screened against these criteria. Full details of the selection process are depicted in Figure 1. The final result saw 46 articles being eligible for the literature review, and thus screened for quality against the five prompts provided by Dixon-Woods et al. (2006).

The papers were analysed to answer the following two questions:

- 1. What are the current pedagogical approaches to teaching Computational Thinking online?
- 2. What were the categories of online learning observed in the teaching of Computational Thinking?

This paper deals specfically with the answering of the first research question. To aid in this task, the reviewed literature was grouped into categories related to the teaching tool type. These categories were Visual programming languages, Playing Video Games, Programming Languages (excluding visual), Unplugged Activities, Competitions, Collaboration Tool and Other.

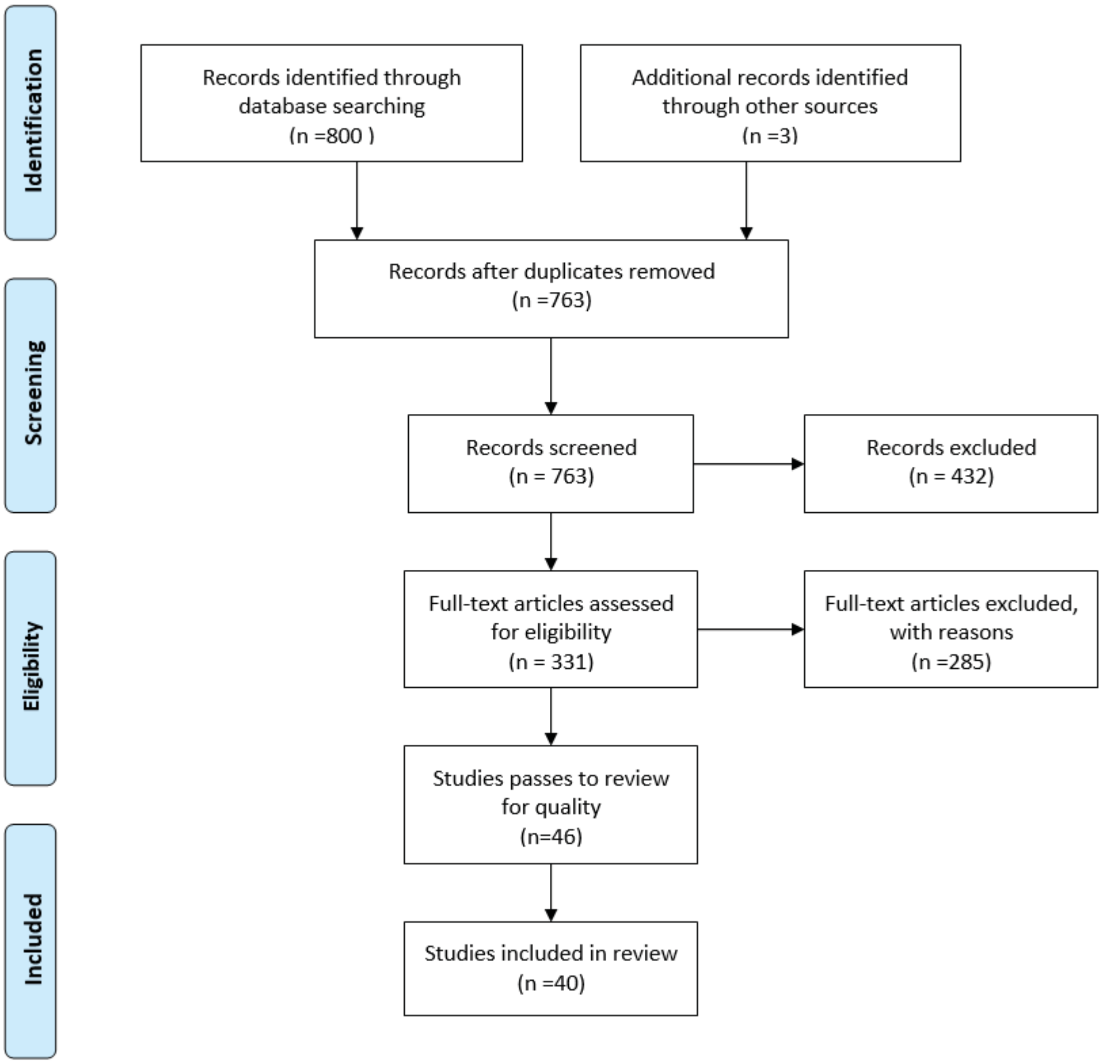

Figure 1: Study selection process. Diagram Adapted from Prisma Group (Moher et al. 2009)

To facilitate comparison, each category is presented and discussed using the same structure, 1) tools 2) theories and techniques used in the teaching of Computational Thinking for example (collaboration, remixing etc.) and 3) notable points. Literature outside the reviewed forty papers was included in the discussion when required to aid in the explanation of the aforementioned content.

2.2 Findings

2.3 Visual Programming Language (game design)

Visual Programming Languages were the most popular approach observed in the literature, appearing in seventeen papers. The languages used in the teaching of Computational Thinking in these papers can be essentially broken down into two categories, Scratch and Agent modelling, i.e. AgentSheet derivatives. AgentSheets is a drag and drop programming language that facilitates the creation of agent based games and simulations (AgentSheets, 2014).

Constructionism is the pedagogical approach most usually associated with visual programming languages especially as the learning is concerned with building an artefact, for example, a game (Ahmadi et al. 2012; Marcelino et al. 2017). This too was found to be borne out in the selected game design literature, with constructionism being the most common approach used (Marcelino et al. 2017; Pellas and Peroutseas 2016). An explicit dependency between this pedagogical approach and the aforementioned tools (Scratch and AgentSheets) was expected but what was unexpected was the dependency that existed between the pedagogical approach, the teaching tool and the definition of Computational Thinking. This dependency was found to be present in the majority of game design papers, thus highlighting the transferability and utility of how Computational Thinking is taught The AgentSheet research drew on a definition of Computational Thinking that incorporated the use of Computational Thinking Patterns (Marshall 2011; Ahmadi et al. 2012; Ahmadi and Jazayeri 2014; Koh et al. 2014; Basawapatna 2016). Computational Thinking Patterns are based on the mechanical phenomena that are relevant to both game design and science simulations, for example, collisions, pushing, pulling etc. (Ioannidou et al.. 2011). This enables students to transfer the knowledge learned from creating abstracted programming patterns in the game design tools to model physical phenomena (Basawapatna et al. 2011). The majority of the papers that were concerned with the Scratch environment revolved around Brennan and Resnick's (2012) mapping of Scratch blocks to Computational Thinking concepts, for example, sequences, conditionals etc. (Dasgupta et al. 2016; Xie and Abelson 2016; Marcelino et al. 2017). Jenkins (2015) questioned how synonymous Computational Thinking (taught using Scratch) is with problem solving when teachers are assessing it by programming concepts of loops and sequences etc. (Jenkins 2015). Transferability was also a concern of Grover et al. (2015) and was discussed as part of their Foundations for Advanced Computational Thinking (FACT) framework.

While constructionism was the dominant learning theory, it was not the only framework observed. The following frameworks were also adhered to: Zone of Proximal framework (Basawapatna et al. 2013; Koh et al. 2014; Escherle et al. 201), Foundations for Advanced Computational Thinking framework (FACT) and Five Flow of Inspiration Principles (Repenning et al. 2009). The Zone of Proximal Framework is concerned with engagement. The FACT framework is concerned with students learning strong, transferable knowledge and skills (Grover and Pea 2016; Grover et al. 2015). The five flow of inspiration principles (Repenning et al. 2009) was devised and used in the indirect teaching of Computational Thinking using an online homework submission system, which was developed to encourage peer to peer interaction.

Of particular mention in relation to visual programming languages, are the studies which documented how the environment (or process) was the "sole" teaching tool for Computational Thinking. Two studies in this category used this strategy: Ahmadi et al. (2012) and Ahmadi and Jazayeri (2014). The purpose of Ahmadi and Jazayeri (2014) study was to research if a complete novice could learn Computational Thinking skills independently online over a 2.5 hour interval. Using a top-down approach, students were scaffolded to explore the proposed problem first and to gain the programming skills in the course of solving the problem. Their study was successful in meeting this aim, i.e. 90% of tasks were completed in full by students.

Collaboration was an essential pedagogical approach observed in many of the game design studies in this review (Basawapatna and Repenning 2010; Ahmadi and Jazayeri 2014; Marcelino et al. 2017). This approach was greatly aided by the online environment in that it provided both synchronous and asynchronous communication among participants and their teacher. Of particular note are the studies by Repenning et al. (2009) and Basawapatna and Repenning (2010), where they employed an online homework submission system called the Scalable Game Design Arcade (SGDA). The study by Repenning et al. (2009) documents how the Scalable Game Design Arcade was set up to replicate the interactions of a Middle School computer club following the aforementioned Five Flows of Inspiration Principles. The project was created using AgentSheets, but the SGDA provided a supplementary, albeit, indirect way of teaching Computational Thinking using peer to peer interactions. Students learned from each other, by viewing and running each other 's code.

Remixing was another approach used to learn Computational Thinking, and very much in keeping with the constructivist theory of learning, as the constructed is made more meaningful by being placed in a social context (Dasgupta et al. 2016).

2.4 Playing video games

The visual programming languages demonstrated how constructing artefacts, for example, a videogame was a vehicle for teaching Computational Thinking. Seven studies demonstrated how simply playing a video game can also be an effective way to practice Computational Thinking, thus enabling students to learn Computational Thinking outside of the classroom. Two of the studies incorporated game design with game playing (Pellas and Peroutseas 2016; Weintrop et al. 2016). Constructionism again was the dominant theory observed. The majority of the games were designed with a "constructionist" activity as core to the game play, for example, Blockyland is a city building game, Make World is concerned with making worlds to teach STEAM concepts. There was only one other theory of note in the papers, that of Computational Encoding (Holbert and Wilensky, 2011), but various techniques such as collaboration remixing, and immersion were also observed (Guenaga et al. 2017; Dhatsuwan and Precharattana 2016; Pellas and Peroutseas 2016). Debabi and Bensebaa (2016) built on Futschek (2006), by proposing the AlgoGame, which allows participants to focus on solving problems rather than learning the syntax of a programming language. They reported that after playing the AlgoGame, an experimental group had better results in writing a selection sort algorithm that a control group.

2.5 Programming language (not visual-based)

Three studies analysed the teaching of computational thinking using tools/languages that do not fall specifically/exclusively into visual based programming language category. Constructivism was once again the most dominant theory observed (Krugel and Hubwieser 2017; Grandell 2005; Berland and Wilensky 2015), but Grandell (2005) course was also influenced by a new conceptual model known as ActiWe (Active on the Web), where the guiding principal is active learning. An interesting didactical dilemma was highlighted by Krugel and Hubwieser (2017) regarding the teaching of Object Oriented Programming. They advocated teaching in a "real life context" but to do that with reference to programming; one has to learn a lot of difficulty concepts quickly. To overcome this difficulty, they initially hid advanced topics, used a strictly object first approach, and ensured fundamentals covered before serious programming covered.

2.6 Un-Plugged activities

Three articles looked at activities that teach Computational Thinking without using a computer. Two of these articles employed computational creative exercises (Miller et al. 2013; Shell et al. 2014). The goals of these studies were to investigate if the learning of Computational Thinking can be improved if it is combined with creative thinking. These exercises were all hand-ons, and required problems to be solved collaboratively using written analysis and reflection. These computational creative exercises were designed to include the four competencies from Epstein's Generativity Theory on creative thinking, i.e. capturing novelty, challenging accepted norms, broadening knowledge and surrounding oneself with inspiration (Shell et al. 2014).

One study was concerned with teaching Computational Thinking using a mixed approach, i.e. unplugged and programming (Vivian et al. 2014). Programming was introduced after Computational Thinking concepts were understood. Vivian et al. (2014) study was predominantly concerned with the theory behind the development of a Mass Open Online Course for teaching Computer Science. The following online frameworks were discussed: online teacher professional development (oTPD) (structured internet based learning) and technology-mediated professional learning (TMPL). The pedagogical approach taken was a combination of oTPD/extended Massive Open Online Course (xMOOC) and TMPL/connectivism Massive Open Online Course cMOOCs. This enabled them to deliver relevant content knowledge sequentially, but also have a collaborative space where teachers can share knowledge and work together.

2.7 Competitions

Two articles referred to the Bebras competitions (Dagiene and Stupuriene 2016; Izu et al. 2017). The Bebras competition was initially set up to introduce information technology and informatics to students. Its purpose has now changed with it becoming an approach for developing Computational Thinking and for deeper learning of informatics. These competitions can be considered informal learning-by-doing, as students engage in solving both engaging and challenging tasks (Haberman et al., 2011). They can also be used as an innovative way of assessing Computational Thinking (Dagiene and Stupuriene 2016).

2.8 Collaboration tool

Two particular studies, formed their own category as they were specifically about how the tool is used to develop Computational Thinking using collaboration. The study of Othman et al. (2015) investigated cognitive enhancement in introductory programming through online collaboration. The intervention used a Think-Pair-share approach, i.e. a collective cortex method with the aim of enhancing logical thinking. Wilkerson-Jerde (2014) study also focused on collaborative environments. Her tool, called the Categorizer, allowed 11-14 year old students to construct, share and categorise computational artifacts that they developed based on fractals.

2.9 Other

Six papers fitted into this last category. Two discussed the teaching of Computational Thinking using the application software Excel (Tsai and Tsai 2017; Tsai et al. 2017) with mixed results. One study focused specifically on what pre-service teachers need to know to teach Computational Thinking outside Computer Science, i.e. in different disciplines, for example, mathematics, science and literacy (Mouza et al. 2017). Liao and Liang's (2017) study focused on learning approaches. Their study sought to research if blended learning can promote computational thinking, and finally, the study by Korkmaz et al. (2017) was concerned with assessment and Computational Thinking Scales. A notable point, is that once again the importance of the Computational Thinking definition was evident. In both Tsai et al. (2017) studies Computational Thinking was defined based on Excel using the definition by Yeh et al. (2011).

3. Conclusion

This paper set out to review the current pedagogical approaches to teaching Computational Thinking online. It identified visual programming languages as the most popular means, thus confirming a change in practice, i.e. visual programming languages are now being used for students to learn and practice Computational Thinking (Ahmadi and Jazayeri 2014). Constructionism was the most common pedagogical approach observed, with a surprising find being that the playing game category showed games having a "constructionist" activity as core to the game play. Collaboration was also an important approach observed. Two significant findings are 1) the importance of the Computational Thinking definition, and how it differs depending on the teaching tool used, and 2) the relative dearth of research into the teaching of Computational Thinking online using self-directed means.

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The Impact of Lecture Recordings on HE Student Approaches to Learning

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Abstract: The impact of lecture recordings on HE student approaches to learning Note-taking as a study-skill amongst students in Higher Education (HE) is acknowledged as a fundamental component of academic success. Intrinsic factors such as cognitive capacity, motivation and epistemological beliefs effect note-taking quantity and quality (e.g. Kiewra, 1985). However, this study looks at the extrinsic influences of the provision of lecture recordings and lecture slides. There is little published research into the impact of lecture recordings on student approaches to note-taking during lectures, although, previous studies have suggested that that the ubiquitous availability of lecture slides has a material effect on the quantity of notes-taken during lectures (Loughlin, 2015). This ongoing mixed methodology study set out to observe the influence that the availability of lecture recordings has on: student note-taking practices, revision strategies and learning outcomes. Students at a Higher Education Institution in the UK were observed during twelve, two-hour long, lectures. These lectures were recorded, and the recordings made available to students on the VLE later the same day. The whole Cohort were asked to complete an online. The usage data from the lecture recordings were then analysed and compared with student note-taking practices and module test scores. Early results from this pilot study indicate, predictably, that lecture recordings are accessed predominantly just after the lecture itself and again during revision periods. The availability of lecture recordings appears to have less of an impact on approaches to studying than the availability of lecture slides. However, the combined effect on note-taking during the lecture itself is considerable, and it is these student behaviours, which are the result of emerging technologies, that will be discussed in this paper.

Keywords: lecture recording, lecture capture, lectures, note-taking, notes

1. Introduction

Note-taking as a study-skill amongst students in Higher Education (HE) is acknowledged as a fundamental component of academic success. Intrinsic factors such as cognitive capacity, motivation and epistemological beliefs effect note-taking quantity and quality (e.g. Kiewra, 1985). However, this study looks at the extrinsic influences of the provision of lecture recordings and lecture slides.

There is little published research into the impact of lecture recordings on student approaches to note-taking during lectures, although, previous studies have suggested that that the ubiquitous availability of lecture slides has a material effect on the quantity of notes-taken during lectures (e.g. Loughlin, 2015).

The working hypothesis was that students would take fewer notes during lectures and make more complete notes while watching the lecture recordings. The interim results of the pilot study suggest a more nuanced situation, where engagement with note-taking in lectures is less than might be expected due to the provision of lecture slides, and a lack of evidence to support students' claims that the majority expand their lecture notes while watching the lecture recordings.

2. The study

This ongoing mixed methodology study set out to observe the influence that the availability of lecture recordings has on student note-taking practices, revision strategies and learning outcomes.

A cohort of 161 second year psychology Students at a Higher Education Institution in the UK were observed during twelve, two-hour long, lectures. The audio and lecture slides were recorded, and the recordings made available to students on the Virtual Learning Environment (VLE) later the same day. The whole Cohort were asked to complete an online survey. The usage data from the lecture recordings were then analysed and compared with student note-taking practices and module test scores.

3. Results

Although we were able to access the usage data for the lecture recordings and compare that with assessment outcomes for the whole cohort (n=161), only 33 students chose to complete the online survey (Appendix 1), which obviously limits any conclusions being drawn from their responses. However, the range of responses in the online survey were sufficiently varied to suggest that it is worthwhile to pursue a similar survey instrument with a larger sample size in the main study later this year.

While the statistical analysis is ongoing (and exam results not available at the time of writing), early results indicate that lecture recordings are accessed predominantly just after the lecture itself and again during revision periods, with usage gradually falling off as the semester progresses. From observations, student attendance at the lectures ranged from 68 to 98 (39-60%). Access to the lecture recordings was similar to lecture attendance itself (i.e. around half the cohort) and we are currently establishing the relationship between lecture attendance and viewing patterns. At this time, it would appear that a large proportion of students who did not attend the lecture also did not watch the recordings. Furthermore, that relationship appears to extend to the overall VLE usage. The module VLE was well provisioned with resources (at least four or five items of additional reading or activities for each week), yet, the proportion of students accessing them was quite small and again, the students who did not engage with the Lecture or Lecture recording also engaged with far fewer of those VLE resources than the rest of the cohort.

3.1 Online survey responses

The self-reported note-taking media was 60% laptop and 33% handwritten (see Figure 1), which was in line with the split observed during the lectures.

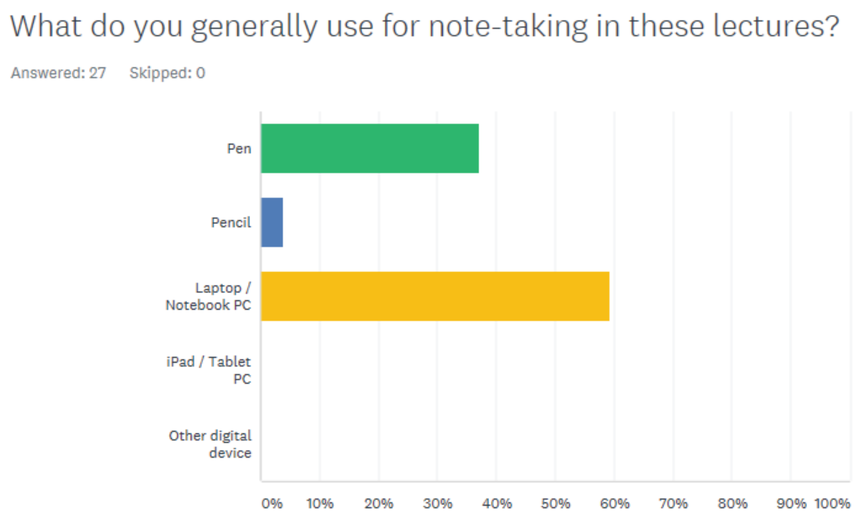

Figure 1: Results

On the survey question, “Where would you place the notes you make in these lectures on a scale from 'word for word/verbatim' to 'summarised/paraphrased’?” (which was on a scale 0 – 10); laptop users averaged 3.4 and handwritten note-takers 5.2.

On the survey question, “Where would you place the quantity of notes you make in these lectures on a scale from 'none' to 'several pages’?”; laptop users averaged 7.5 and handwritten note-takers 6.4.

On the survey question, “Does the availability of lecture recordings affect the way you make notes?”; 62% of laptop users and 55% of handwritten note-takers said that they augmented their lecture notes while watching the recordings. Small numbers of both sub-sets said that they either took fewer notes during lectures as a result or, did not watch the recordings at all.

Attendance at lectures was high within both groups with 88% claiming to attend 7 or more of the 12 lectures, only two respondents said that they attended 3 or fewer lectures. This, despite our best efforts to engage with those who chose not to attend lectures, there was only one respondent in that group.

3.2 Lecture recording data and VLE analysis

The difference between some of the self-reported behaviour of students and the data available is considerable, and we will have to modify the survey instrument and data collection for the main study to ensure consistency and accuracy. For instance, one student said that they attended only between 1-3 lectures but made notes based on their viewing of the lecture recordings, but according to the VLE and lecture recording data they accessed only 2 of the 12 lecture recordings. A number of others claimed that they wrote 'many pages' of notes in every lecture, this was not observed during the lectures, there were brief periods of frantic typing but nothing consistent with generating 'many pages' of text.

Just under half the cohort viewed the first two lecture recordings (of 12) dropping to under one-third for the remainder. The amount of time each individual spent watching the two-hour long recordings remained at a constant 45-50 minutes. This is possibly because the lecture recording software has the facility to run at double speed. The Virtual Learning Environment (VLE) usage was also interesting, in that, lecture slides were accessed at a consistently high level (115 on average from the cohort of 161), i.e. many more than attended the lectures or viewed the recordings. As might be expected, previous exam papers and items specific to the assessment were accessed extensively; but, the 'additional resources' provided accessed only sporadically and in small numbers, typically by between 5-20 students. This is an area that will be explored more fully in the main study.

4. Discussion

At the time of writing the final exam scores for this module have not been released and we are therefore unable to provide the correlation between note-taking media, lecture recording usage and learning outcomes.

The availability of lecture recordings appears to have less of an impact on approaches to studying than the availability of lecture slides, which have been used extensively in most HEIs for many years now, and cited by students as the primary reason they take fewer notes during lectures (e.g. Loughlin, 2015). From the observations made during these lectures, it was apparent that the vast majority of students used the lecture slides as a base for their note-taking, either on a computer screen for those using laptop or as a paper printout for those making hand-written notes (some had both electronic and paper copies). With one or two exceptions the quantity of notes observed being made ranged from a few words to a few paragraphs, and certainly not the 'many pages' claimed by 14 of the respondents. The observations of the lectures contradict student claims about the quantity of notes made and this discrepancy will be scrutinised further in the main study. Is it that students respond with what they feel is the 'correct' answer? Or is their perception of what they are doing simply different from the reality? The survey answers support existing literature (Ward and Tatsukawa, 2003) which suggests that laptop users (7.5/10 on the scale 'none' to 'several pages') can type more than can be handwritten (6.4/10) in lectures, and therefore they are more inclined to write out what they hear verbatim rather than the handwritten note-takers who lean more towards paraphrasing or summarising (laptop users 3.4/10, handwritten note-takers 5.2/10 on the scale 'verbatim' to 'paraphrased'). The existing literature has claimed that this ability of laptop users to type faster and record more of the lectures leads to a 'mindless' transcription of lecture content which adversely affects their learning (Mueller and Oppenheimer, 2014). The interim results of this module fail to support that finding, with no significant difference found in assessment scores between laptop and handwritten note-takers.

As mentioned above, the availability of lecture recordings in this module appears to have had only a limited impact on student approaches to learning. Only one-third of the cohort accessed the recordings regularly (mostly those who had attended the lectures) and then, for relatively short periods of time (less than half the duration of the lecture on average). Behaviours observed in the lectures and usage data for the VLE both support the notion that lecture slides are far more important in the learning strategies adopted by students. An average of only 33% of the cohort accessed the lecture recordings whereas an average of 72% accessed the lecture slides across the duration of the module. The interesting thing here is that at least 28% of the cohort accessed neither, and it's likely that a large proportion of those also did not attend the lectures. This raises some important questions regarding the motivations, approaches to learning and outcomes for those students who avail themselves of few, or none, of the resources provided as part of their module. This is another area that will be explored further in the main study later this year.

5. Conclusion

There are several caveats to the conclusions drawn from this pilot project, firstly that the sample size of those who completed the online survey was too small on which to perform any meaningful statistical analysis; and secondly, that the students from this cohort are all high achievers and therefore generalising the findings is problematic. The mid-term results for this module were universally high, with no significant difference between the groups of note-takers, which runs counter to, well publicised and influential, randomised control trial research (e.g. Carter et al., 2017). This is an important finding, and if replicated in the main study, has far reaching implications for the current understanding of the impact of laptops in lecture theatres. The impact of lecture recordings in this study appears to be limited, with a minority of students watching the recordings, although, the statistical analysis based on the exam results will give a better indication of which groups of students, if any, benefit most from its use. The existing literature in this area also suggests that the impact is minimal, particularly for a second-year cohort (Nordmann and Mcgeorge, 2018). There is a sense that students view it as a valuable safety net, but the extent to which students' assertion that the recordings are used to augment notes made during the lecture are undermined by the data usage reports and requires further investigation.

The final aspect of the data usage analysis which requires further scrutiny, is the unexpectedly large number (possibly as many as 20%) of the cohort who do not attend lectures, watch lecture recordings or engage with any of the resources provided by the course team, yet pass the module with high grades. A concerted effort will be made in the main study to access these students to find out what their learning strategies are and how the feel about their university experience. This pilot study has validated much of the online survey, provided some interesting data points and posed some intriguing questions to be pursued in the full-scale study which will take place next semester on a similar sized cohort.

Appendix 1

* 1. All data will be anonymised prior to any publication of this research.

I understand the information I give may be used for research purposes and/or future publications.

- ◯ Yes
- ◯ No

2. First name

* 3. Last name

* 4. What do you generally use for note-taking in these lectures?

Other (please specify)

5. Where would you place the notes you make in these lectures on a scale from 'word for word/verbatim' to 'summarised/paraphrased'?

Word for word / verbatim — Summarised / paraphrased

6. Where would you place the quantity of notes you make in these lectures on a scale from 'none' to 'several pages'?

None — A few paragraphs — Several pages

7. Does the availability of lecture recordings affect the way you make notes?

- ◯ No
- ◯ I don't watch the recordings
- ◯ Yes, I add to my notes while watching the recording
- ◯ I take fewer notes because I can watch the recording
- ◯ Other (please specify)

8. Lecture attendance: How many lectures did you attend?

- ◯ 0
- ◯ 1-3
- ◯ 4-6
- ◯ 7-10
- ◯ All of them

* 9. I would be happy to be contacted to take part in follow-up interview for this study.

- ◯ Yes
- ◯ No

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Weblog-Storytelling: A Socio-Cognitive Framework for Enhancing Student Writing Efficacy and Autonomy

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Abstract: Weblog as a pedagogical tool has recently emerged as an interactive and authentic learning setting where independent and active learning can be promoted, particularly within English as a foreign language (EFL) context. This exploratory study aimed to investigate the effectiveness of using blog-storytelling on the writing efficacy among Algerian EFL 'Master Students' from a socio-cognitive theory perspective. This study is based on a qualitative research methodology. Data were embraced from two different instruments: interviews, and research observation log. The findings suggested that the participants showed a positive attitude towards weblog-writing, and more importantly, their writing efficacy and autonomy were promoted.

Keywords: weblog-storytelling, self-efficacy, autonomy, interaction, EFL

1. Introduction

According to Richardson (2010), weblog is an online journal where an author can frequently update the website and instantly post comments and thoughts and it usually includes hyperlinks. Weblogs provide teachers and students with an innovative teaching and learning environment where deep and active learning are promoted (Aydin, 2014). Thanks to the nature of this online forum, students can have an abundance of venues to experience analytical and critical reading and achieve a clear writing. Interestingly, due to the interactivity of blogging, students can develop their social skills through interacting with tutors, peers, and experts within weblog setting (Zhang, 2009 and Richardson, 2010). Peer- feedback that blog embodies is also conceived as a pertinent component in developing students' critical thinking (Mali, 2015). Blogging approach has increasingly gained the attention of many academics and embraced by various practitioners, as a supportive tool to facilitate learning and attain a positive learning outcome (Richardson, 2011). In addition, weblog is also perceived as an effective tool in language learning since the students can collaboratively engage in this platform outside the borders of the classroom and can take charge of their own learning (Namwar and Rastgoo, 2008).

This online medium has a great potential for fostering community building, self-expression, and creativity (Taki and Fardafshari, 2012). Blogging is applied as a beneficial approach within EFL context for writing development (Ghani and Ahmet, 2014). Nowadays, web 2.0-based storytelling is considerably integrated as a new genre by different educators (Strahovnic and Mecava, 2009). Specifically, weblogs provide numerous opportunities and new spaces for personal storytelling (Hoffmann, 2010, p. 79). Frazel (2010) claims that it can enable the learners to discover their own voice, produce a high-quality work, have access to a wider audience, and promote language skills within a meaningful educational environment. Through storytelling, individuals can give meaning to their experiences, build identities, exchange knowledge, and engage in a cultural dialogue (Langellier and Peterson, 2004).

However, it is undeniable that this online method could have some drawbacks in terms of its application in teaching and learning English in higher education. Ayao-ao (2014) identified six key issues which are related to the internet / computer access restriction and time-constraint due to the curriculum workload, the demand of tedious maintenance of the web-page chat, students' lack of technological literacies, the absence of students' independency, passivity in commenting others' work, and the students' unfamiliarity with the concept of blogging as a whole. Following this line of thought, it is notable that the main challenge discerned in earlier research in this area (Zhang, 2009; Sim and Hew, 2010; and many others) is mostly student-oriented which includes the students' difficulties to maintain a blog because of their unawareness towards online learning and time-consuming. At this level, in order to mitigate the related-problems mentioned above, it is necessary from educators to make a careful plan by administering a discursive survey that evaluates the learners' needs and their digital literacies level in the purpose to detect the potential difficulty that might be faced before taking any action. Moreover, it is important from the teachers to train and prepare the students to this innovative method of teaching and learning, especially for the instructors who are about to shift from a very traditional paradigm to a new one. The last and not the least, the complexity and the dynamic of writing as viewed by social constructivists (Lee, 2011), necessitates the mastery of various skills that might be tricky to be developed in traditional classrooms. Hence, the blogosphere pedagogy could be used as a time-saving tool where the learners have plenty of opportunities to practise the target language writing and develop the essential 21st century skills inside and outside the educational institutions.

2. EFL Weblog-autonomous writing and writing efficacy

Writing is viewed as the most complex skill to master, particularly when it is constrained by time as it necessitates a careful organization and this may engender anxiety for the EFL/language students (Cheng, 2004). This concern is not an exception among Algerian EFL learners as observed by Bouyakoub (2012), maintaining that the majority of the Algerian EFL students struggle to express themselves neither fluently nor accurately in productive skills, including English writing and speaking. Accordingly, this poor writing achieved might be linked to the lack of student-directed learning and the workload in classrooms. In other words, students' lack of autonomy may disengage them in the writing process. Blogging approach can be suggested as a remedy to overcome these issues due to its collaborative and authentic nature. The peer-feedback that blog generates enable the students to be more self-directed, develop a sense of community, promote collaborative learning, and encourage students' involvement by having more opportunities to use English writing (Warschauer, 2002). Due to the layout of blog, scaffold approach can be spontaneously evolved throughout this process in which tutors guide the students and, in turn, students support each other in a meaningful discussion. Likewise, this material can be used by the students at their own pace (Richardson, 2011). Thus, both cognitive/meta-cognitive and social skills can be promoted through the integration of blog writing along with face-to face instruction.

With regard to the concept of self-efficacy, Bandura's (1989) social cognitive theory suggested that learning is constructed through outer influences and its acquisition involves people who actively participate in modelling their own improvement through self-regulation and self-reflection. Behaviour, cognition, social influences, and other extrinsically determinants operate as affiliating elements that influence each other. Bandura (1997) stated, "People's level of motivation, affective states, and actions are based more on what they believe than on what is objectively true" (p. 2). This means that self-efficacy of the learners and their writing outcome are interrelated in language learning in the way that learners who embraced a positive thinking, they tended to achieve a good writing performance (Wu, 2005; Hetthong & Teo, 2012; and Tola & Sree, 2016). Although self-efficacy has got the attention of many educationalists in different areas, there is still a lack of corpus Vis-a Vis its development in EFL writing through an online setting. A plethora of studies focused on examining the relationship between self-efficacy and writing performance (Pajares & Johnson, 1996; Bruning & Horn, 2000; Pajares and Valiante, 2001; Pajares, 2003), but there is an absence of research on the impact of blogging on EFL learners' writing efficacy in higher education and Algeria is not an exception. Consequently, the particularity of the context of this current study may expand or bring novel knowledge to the preceding literature in the field of EFL composition and digital education. In addition, while most of the studies investigated earlier focused on intermediate students' perceptions by exploring how the web-based tools affect their writing in English (Vurdien, 2011; Absalom & De Saint Léger, 2016; and so on), this study tended to examine the advanced EFL students to profoundly understand their previous and recent struggle in writing skill as well as to get their viewpoints on their experiences on the blog. In the same vein, most of the Algerian researchers attempted to examine the Algerian difficulties in writing either empirically or descriptively. Interestingly, Amel's (2014) research project entitled 'Students' insights and experiences of Web-Based Learning Support: The case of Second Year Students of the University of Batna-Algeria' and the work of Bennacer and Kaouache (2018) who explored the views of the Algerian EFL students towards the use of Facebook with respect to their writing development are the most reliable research which were conducted qualitatively within Algerian setting on par with the effectiveness of Web-Based Forums on EFL students' writing. However, this study can be distinct in the way that it is based on blogging and narrative writing, instead of academic writing. Hence, this article sought the Algerian EFL students' perceptions regarding weblog-storytelling and its effect on their writing efficacy.

3. Socio-cognitive theory to writing

There were prevailing paradigms shift in second language writing pedagogy; the movement shifted from a very traditional product approach to post-process model (Trimbur, 1994). The core emphasis of the product approach is on the belief that writing is a well-polished written product where importance is inclined to the rules that govern language use (Punctuation, syntax, and spelling) and the style of the production (Young, 1978). This approach is assigned under teacher-driven theory, whereby, the students are restricted in terms of negotiation and interaction (Mourssi, 2013). As such, the interest shifted to a process approach in the late 1970s and the early 1980s (Flower and Hayes, 1981). Pullman (1999) exemplifies the continuous establishment of the process pedagogy as 'the inevitable result of the search for coherence and unity among disparate texts and practices – the inevitable oversimplification that language always performs on experiences' (pp. 21-22). Hence, the supporters of process-approach made further progress by blending the traditional perspective to the ineluctable complexity of writing system. In this frame, writing is acknowledged as a non-linear process of constructing meaning with a central concentration on the inner thought or cognitive processes of the individual writer (Zamel, 1983). Planning, translating, reviewing, goal-setting, evaluating, and revising are among the activities that are included in the process of writing. Although the process orientation incorporated two more significant notions including cognition and self-discovery, some critiques have been asserted by the last half of 1980s (Matsuda, 2003). This approach looks at the writer's mental processes separately from the external and contextual elements that may affect the shape of compositions (Flower, 1994 and Van Lier, 2000).

Thereafter, sociocultural theories came out to complement the previous paradigms and highly impacted education and Second Language Teaching in particular (Prior, 2006). The sociocultural theory is based on the belief that social interactions which are intermediated by external elements (semiotics, animals, people, objects, plants, and devices) plays an important role in the development of higher order thinking (Prior, 2006). Vygotsky (1978) who is considered as one of its pioneers posited that relationships and conversations with other individuals are key for the evolution of human. Thus, knowledge is first developed socially and then transmitted to the internal mechanism of brain. From a socio-cognitive perspective, written-production is the result of the writer's social connections, in other words, writing is considered as a social act, rather than solitary (Slavkov, 2015). Since writing contains the feature of collaboration, a plethora of activities can inform the process of writing, such as planning, collaborative problem-solving and peer-feedback (Tsui, 1996).

The concept of mediation originated from Vygotsky's work was later expanded to Activity theory (Engeström, 1987) by positioning people's behaviour in homogeneous activities. All the latter components are interconnected to each other. This theory concerns the dynamics of contexts and the way several aspects of the contexts are perceived holistically. Within an EFL writing context, Lei (2008) used the element of mediation and the model of Activity Theory to investigate the writing strategies adopted by Chinese EFL learners in higher education and she identified four kinds of mediated techniques which are as follow: artifact-mediated strategies (computer and languages), rule-mediated strategies (e.g., norms and sanctions), community-mediated strategies (e.g., disciplinary community and discourse community), and division of labor (writers and readers) (p. 220). Besides, the study put interactions or learners' social-connectedness to the centre of the writing processes and interestingly demonstrated that learner's autonomy was mediated through several interactional processes. All the mediated behaviours have been driven through learners' goal-oriented and hard work. In other words, motivation for the utilisation of strategies were promoted due to the students' active involvement in attaining their goals. According to Lei (2011), it would be more desirable to explore the etic reformation of the interaction within the mediated strategies through qualitative research design. Assumingly, qualitative research can adduce in-depth stories of a unique context and sample. Building on socio-cognitive framework to writing, this research explores how the Algerian EFL students' writing efficacy can be enhanced through the mediated elements on the blog.

4. Methodology

4.1 Theoretical framework

In accordance to the above-mentioned, it is notable that blogging approach englobes the notions of the 21st-century skills, such as cognition, meta-cognition, collaboration, and interaction. As such the constructivist theory and socio-cultural cognition theory, adopted by Vygotsky (1978), could be relevant to the current study as corroborated by Richardson (2010), weblogs encompass a constructivist approach to learning. The sociocultural approach includes that knowledge acquisition of the learners is achieved on the basis of their cultural values and learning experiences through interaction with the world including people. Through interaction, learners get involved in a problem-solving task which contributes to the development of learners' cognition. Vygotsky formulated the concept of the Zone of Proximal Development which stands to "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). This means that this zone allows the learners to obtain knowledge first through interaction and collaboration with more capable peers and then they will eventually be competent to the previous experience.

4.2 Research participants and setting

The research included 15 EFL Master Students, aged between 19 and 38 at the department of English. This study took place in one of the Algerian universities, which is situated in the North- East of Algeria. All were native speakers of Berber (Kabyle) with a high-intermediate level in French and they were considered as advance learners at English language since this latter was acquired since middle school. Due to the fact that the concept of blogging was new to the participants of this study, at the very beginning of the project, off-line classes and online discussions were introduced to students to familiarize them with it, including how to create and manipulate a blog and the tasks they were required to accomplish during this process. The guidelines provided were perceived as advantageous due to the students' unfamiliarity with e-learning. Before the intervention, the students took part in an interview to get an in-depth understanding regarding their prior background to information and communication technology, EFL writing, and blogging approach. Later, for a period of five weeks, the students engaged in publishing a piece of writing related to their personal experiences weekly. Besides, they were supposed to comment the work of at least three of their peers through the use of a rubric and then revise their productions by taking into account the feedback received. The researcher was engaged in this project by guiding the students throughout the process and provide them constructive feedback. At the end of the study, the students were also interviewed to get their views on blogging in general and their writing efficacy.

4.3 Data collection methods

This qualitative study looked at the Algerian EFL students' perspectives regarding the effectiveness of self-blogging and their self-efficacy development. Therefore, the data were gathered through the adoption of semi-structured interviews, and the blog observation.

Before indulging into collecting data, the ethical standards of this research project were taken into consideration. As a matter of fact, the four moral ethical principles' code which include respect, competence, responsibility, and integrity are taken into account to avoid any harm to my participants (British Psychological Society, 2009).

4.4 Data analysis

All the interviews had been transcribed and examined following a thematic coding analysis. This type of analysis is suitable for this kind of study which is grounded on exploratory-explanatory. The themes and codes emerging in the data can be determined using a deductive method which is extracted from the data analysis or from prior research studies.

5. Results and findings

The findings from the qualitative data collection methods revealed that all of the participants had a positive attitude towards blogging. Weblog-writing was perceived as an authentic, effective and interactive learning setting, it encouraged them to be more engaged in the process of reading and writing. This can be illustrated by participant 11:

> *"it is somehow a means of interaction, when you talk about something, for example I talked about racism, many people commented on it and told their perceptions towards it, it is like an encouragement, it is like they are interacting with you, it is like putting yourself in one place, and pretending to be living this experience, it helps in terms of putting me up."*

Although the students reported that they are 'passive', 'unmotivated', and they are usually dependent on their teachers, they showed that they could be independent and active learners throughout blogging experience. For example, participant 5 expressed:

> *"If the period is for a longer term, I am sure that I will become more independent than I am, on blog, I feel more independent, first I write without being controlled by someone, I can add, omit, revise, I can do whatever I want since I do it wherever I want as well, I feel like I am freer than being in the classroom, surrounded by classmates and the teachers, I feel more comfortable when I write on blog."*

> *"I discovered new methods, my method of writing, I discovered that I am independent that I can write without stopping, I also figured out that I am capable of doing many tasks at the same time, like managing my time and following specific schedule."* *(Participant 3)*

At the very beginning, all the participants mentioned that they are struggling with their writing since their teachers do not engage them in the writing process, apart from delivering theoretical part. This poor writing can be explained due to the teaching strategies adopted by the Algerian EFL teachers in the sense that they do not encourage writing efficacy. Hence, their self-esteem and confidence are very low towards it. Being part in blogging activities enabled them to be aware of their capacity to write in English. In this vein, it might be worth highlighting that the students' writing efficacy was developing and this concern led them to attain a better writing outcome as exemplified by student 11:

> *"The good point is that it really helped me to locate my weaknesses, my issues (the lack of vocabulary, punctuation, and compound tenses, I got an issue), to locate the good points and to unveil my capacities and abilities in terms of writing".*

> *"It is obvious that our writing skill is developing through blog. I have problems in punctuation, sometimes I don't find vocabulary, but through the help of other participants, I became more aware about vocabulary and grammatical mistakes, structure, coherence, cohesion even the writing style in general."* *(Participant 4)*

As a result, the learners with high level of efficacy were able to engage in the problem-solving activities and were intrinsically motivated to accomplish their needs. This means that the students' self-efficacy, which has been developed through their own efforts, has significantly affected their writing development. The efficacy writing development may be related to the commentary-based system in which students collaboratively engaged in exchanging feedback on the productions produced on blog and the opportunity to express themselves freely in English and take responsibility of their own learning. Moreover, the students' motivation was increased due to the social interaction, collaborative learning, and the online build-community that this online platform offered them. This can be exemplified by Student 14:

> *"I think that this is exceptional, it is wonderful because you share with others, especially when they reply to you with their feedback, there is a kind of interaction, when you write it is not only to yourself but to others, to let others know about you. So, if you just write for the sake of writing and no one see it, I think that motivation will minimize, but when you write and share it with others and the others interact with you, this is something wonderful."*

This finding is clearly in line with Bandura's theory stating that learners with high sense of efficacy are more likely to achieve a positive outcome. Another significant result is that the mediated strategies highlighted in Lei's (2008) and Lee's (2011) studies are compatible with those found in this research: artefact-mediated (the blog, internet, the native language 'Kabyle', and the first language 'French'), rule-mediated (self-built rules, effective writing standards, and time mediated), community-mediated (online peer-feedback, classroom interaction, and previous experiences), and role-mediated (Language-mediated and writer-mediated. The present study is different from Lei's and Lee's work in the way that it explored the students' EFL writing efficacy within an online setting.

6. Conclusion

On the whole, weblog-writing assisted EFL students to produce opportunities to practise the language, increase students' cognition and meta-cognition, enhance students' social skills, increase learning interest, and develop writing skills. The aim of this current study is to explore the Algerian EFL students' perspectives towards blogging approach and examine the relationship between self-efficacy and writing development. The study's findings revealed that although technology is still in its infancy within Algerian context in the sense that EFL teachers are still dealing with the old teaching methods, the students demonstrated a considerable autonomy through the use of this online platform, which enabled them to be self-efficient and indeed, their writing was remarkably developing over time. In this respect, it can be observed that weblog-based interactive storytelling offered students a high level of independency which in turn remarkably increased their motivation, and self-efficacy towards writing, enhanced their cognitive processes, and eventually developed their writing to some extent. Notably, the above-mentioned skills are presumably interactional and circular as depicted in the process below:

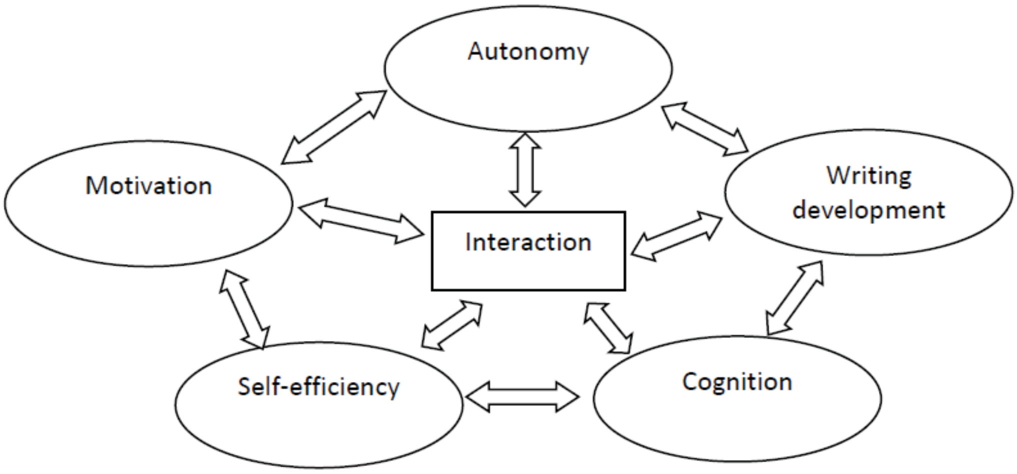

Figure 1: Weblog-based interactive storytelling

The results are necessary for the Algerian EFL teachers, institutions and other international institutions to reflect on their own teaching methods by taking into account the effectiveness of integrating the emerging innovative methods of teaching and learning along with face-to face instruction as an interactive and authentic forum in developing EFL students' writing efficacy, which might be worth investigating for future research studies. Furthermore, the findings of this study recommend from the Algerian policy makers to ease the access of ICT tools and internet connection in all schools and institutions. Besides, it is necessary from them to indulge into a thoughtful and planned change for the sake of being able to analytically contemplate the existing issues and assess the emerging practices, rather than just for the sake of embracing technology.

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Learning Analytics Suggest a Positive Experience: A Descriptive Analysis of a Care and Compassion MOOC (Massive Open Online Course)

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Abstract: Massive Open Online Courses (MOOCs) are a relatively new phenomenon not just in healthcare but also in education as a whole (Sarabia-Cobo et al, 2015; Parkinson, 2015). Their main purpose is to capture the attention of a diverse and global audience in order to increase knowledge through the provision of university level education (Sneddon et al, 2018; Hebdon et al, 2016). The Scottish Improvement Science Collaborating Centre, University of Dundee, developed a care and compassion MOOC hosted by FutureLearn, a digital education platform. This five-week MOOC provided learning resources, activities and information to healthcare professionals and the public in order to help raise awareness and understanding of compassion and improve the provision of compassionate care. A Realistic Evaluation approach was taken which provided an opportunity to utilise mixed methods of data collection thus allowing for the complex nature of the educational intervention to be examined (Pawson and Tilley, 1997). Quantitative data from 957 participants were collected through the MOOCs demographic database and included attrition/retention rates, mechanisms of learning and self-reported impact. In keeping with realistic evaluation, the key components of context, mechanism and outcome were considered throughout analysis. Findings from the quantitative research show potentially promising retention rates with only 8% of enrolees choosing to no longer take part in the course. Of the 957 respondents who completed the pre course survey, 441 (46%) undertook the course to help their career, 311 (32%) to help their academic studies, 349 (36%) for personal reasons and 698 (73%) for social networking (multiple responses were allowed). 94 learners completed the post course survey. Amongst these, 91 respondents rated how the MOOC met their overall needs with 93% providing a positive response and 7% either a negative response or unable to answer. Therefore this paper will discuss a MOOC as a pedagogical approach to teaching the essential and complex healthcare related subject of compassion. It will also consider participants' experiences of learning and the impact this may have on the work practices of healthcare professionals.

Keywords: massive open online course, MOOC, e-learning, pedagogy, care, compassion

1. Introduction

Compassionate care is a vital part of healthcare (Bray *et al* 2014; Mills *et al*, 2015; Dewar and Nolan, 2013; Bridges and Filler, 2014). There are many different definitions of compassion found within the literature. "Understanding or being aware of another person's suffering and acting to end this suffering" (Papadopoulos and Ali, 2016). "Sympathetic pity and concern for the suffering or misfortunes of others" (Oxford Dictionary, 2017). "How care is given based on empathy, respect and dignity, intelligent kindness and central to how people perceive their care" (Department of Health, 2012). However regardless of it's interpretation or understanding it is vital to appreciate that care that is embedded with compassion can produce enhanced results in terms of wellbeing (Steenbergen et al, 2013). Youngson (2012) agree, further affirming that compassionate care provides improved patient satisfaction, enhanced patient safety, savings on time and costs as well as a positive impact on the health and wellbeing of staff and patients. However the quality of patient care within healthcare systems is continuously being called into question (Harrison, 2013; McCrae, 2013). Compassionate care, in particular, has been under scrutiny in the past due to damaging media reports about poor standards of care (Dewar and Nolan, 2013; Harrison, 2013; McCrae, 2013; Price, 2013). And more recently sub standards of care have been brought to the forefront with reports submitted such as The Vale of Leven Hospital Inquiry and The Morecombe Bay Enquiry (MacLean, 2014; Kirkup, 2015). In response The Scottish Improvement Science Collaborating Centre, University of Dundee, developed a Care and Compassion MOOC, using the FutureLearn digital education platform. A team of experts with experience in the field of compassion contributed to the MOOC with either currency of research or educational activity. The five-week course provided learning resources, activities and information to healthcare professionals and the public in order to help raise awareness and understanding of compassion and improve the provision of compassionate care.

Although they have been around since 2008, MOOCs remain a rather novel mode of online education and they are particularly new within healthcare (Sarabia-Cobo et al, 2015; Parkinson, 2015). MOOCs aim to enhance knowledge and understanding using university level teaching. They are directed at a global audience and often include many people from many backgrounds (Sneddon et al, 2018; Hebdon et al, 2016). MOOCS are simply branded as online courses, which often require no formal entry requirements, with no limit to participant numbers and are generally free of charge (Gaebel, 2013). The only real prerequisite is available access to the internet (Turner, 2015; Power and Coulson, 2015). Although many question the authenticity of MOOC learning it is recognised that MOOCs are able to provide genuine learning opportunities (Gaebel, 2013). This form of online learning also promotes discussion and interaction between participants although they do not always have the facility to allow educators to engage with participants (Skiba, 2012). Even though MOOCs were first identified as far back as 2008 they are still very much in their infancy and tentative development stages with a flawless MOOC yet to be developed. There is still much research to be done that could identify elements that may contribute to an exemplary MOOC which with it comes excellent completion rates (Turner, 2015).

2. Method

This study aimed to evaluate a MOOC as a pedagogical approach to teaching the essential and complex healthcare related subject of compassion as well as considering participants experiences of learning and the impact this may have on the work practices of healthcare professionals. Pawson and Tilley's Realistic Evaluation (1997) provided an opportunity for both the measurable aspects of the research as well as the human elements to be considered thus ensuring the complex nature of the MOOC to be examined (Wand *et al*, 2010; Wong *et al*, 2012; Hewitt, 2012). This method also allowed for a deeper understanding of what makes the programme work for whom and in what circumstances to be explored (Pawson and Tilley, 1997; Ryecroft-Malone *et al*, 2010). This process was supported by Wong *et al* (2008) who suggested that when researching within the field of e-learning, attention must be paid to not only measurement of effectiveness but also investigation into environmental, learner and pedagogical contexts that may enhance or limit successful outcome. According to Sarabia-Cobo *et al* (2015) it is essential that an evaluation of any new MOOC, which will enhance the provision of material and enrich the learner experience, is undertaken. Realistic evaluation considers a programme through an understanding of the mechanisms it is comprised of, how these mechanisms influence outcomes and the contexts in which the programme is undertaken (Pawson and Tilley, 1997). This Context, Mechanism, Outcome (CMO) configuration permits a comprehensive evaluation of the MOOC (Wand *et al*, 2010; Dalkin *et al*, 2015). For this project an initial CMO configuration was proposed which allowed for data to be collected in order to evaluate the programme appropriately:

Context

How and where the MOOC undertaken (country, environment at home/work)

Mechanism

Tools within the MOOC such as discussion boards, learner activities and models for practice

Outcome

Impact relating to attitude, behaviour and practice

Another point of consideration is the use of learning analytics for this research. For this purpose learning analytics are understood to be the digital footprints created by learners, which can be used to understand, improve and optimise the learning experience (Almosallam and Chorfi, 2014)

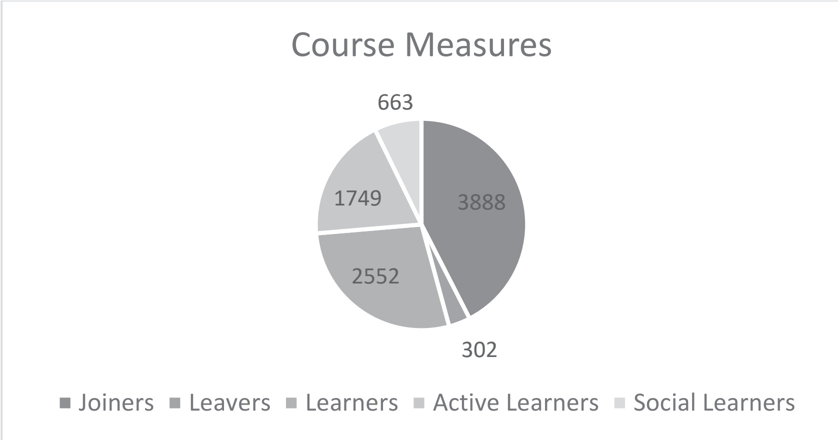
3. Analysis

Quantitative research was undertaken and created two sets of data. Data set 1 - fundamental demographics and attrition/retention rates. Data set 2 – relating to those who had completed the pre and post MOOC survey for this project. Data relating to the realistic evaluation CMO configuration were then considered.

In terms of sample size - there were more than 3000 learners however only 957 completed the pre course survey either fully or partially (analysis of context), 94 learners completed the post course survey either in full or partially (analysis of mechanism) and 42 learners fully completed both the pre and post course survey in full (analysis of context and outcome).

4. Results

Demographics – data set 1



Definitions (as described by FutureLearn)
Joiners – the number of enrolments made for the course including educators, admins and learners
Leavers – users who have chosen to no longer be part of the course.
Learners – users who have **viewed** at least one step at any time in any course week (including those who may have gone onto leave).
Active Learners – those who **completed** at least one step at any time in any course week (including those who may have gone onto leave).

Figure 1: Course measures

Figure 1 shows statistics collected from FutureLearn. This revealed that 3888 individuals had initially registered for the MOOC in week one and by the end of the course 3586 registrants still remained. This shows a potentially promising retention rate, with only 8% of those who enrolled choosing to no longer be part of the course. Of those that remained registered on the course, 1749 (49%) were described as active learners and 663 (18%) as social learners.

Realistic Evaluation Analysis – Data Set 2

5. Context

This analysis was undertaken on respondents who had completed the pre course survey either in full or partially (n=957), this provided varying respondent numbers for each question. This area looked at learners' motivation to participate in the course as well as previous online learning experience. However it is worth noting that respondents were able to select multiple answers for this question therefore showing that many people may have a combination of reasons for undertaking a MOOC.

Table 1: Reason for signing up for the course

To help with job/career	46%	441
To help with academic studies	32%	311
To help for personal reasons	36%	349
To help with social networking	73%	698

Table 1 above shows the numbers of respondents who undertook the MOOC for various reasons and as can be seen from the results that the most popular reason was to help with social networking (73%) which was defined as (share expertise and support with others, socialise with other learners, network with professionals and experts, get feedback and support from others and to learn from others perspectives and experiences).

Table 2: Previously taken a course delivered online?

Yes	61%	553
No	36%	325
Not sure	2%	22

Table 2 shows the majority of respondents (61%) had undertaken some form of online/e-learning prior to the Care and Compassion MOOC.

Table 3: Type of previous online learning taken

Course on FutureLearn	43%	235
Course on a different learning platform	29%	156
Online course for university credit	25%	135
Online continuing professional development or work related course	57%	309
Open learning resource (YouTube, Wikipedia)	31%	170
Other (unspecified)	6%	34

Table 3 shows that just under half (43%) of those who had undertaken previous online learning had done so via the same learning platform, FutureLearn.

The following analysis was undertaken on the respondents who completed the pre and post course questionnaires in full and not partially (n=42).

Gender

The majority of learners on the MOOC (88%) selected their gender as female and 12% selected male as their gender.

Age Range

A wide variety of ages participated in the MOOC from under 18s to over 65s. The highest numbers were concentrated within age ranges 36-65 which totalled 77%, with those 35 and under making up 18% of the total and those over 65 amounting to 5%.

Employment Status

The employment status of learners was represented with the majority (71%) describing themselves as employed, 29% split between the categories of self-employed, unemployed, full-time student or full-time carer.

Where course was undertaken

The highest number of learners (60%) undertook learning within their home environment with the next most popular place being at work (21%). 14% took the course on between a combination of their home and work environments and 2% done it whilst on holiday.

6. Mechanism

The following tables display the analysis which further examines the learning analytics and was undertaken to specifically look at the respondents who completed the post course survey either in full or partially (n=94)

Table 4: Satisfied with the course content

	Yes		No	
Videos and Animations	99%	93	1%	1
Written course content	96%	90	4%	4
Video Subtitles	91%	86	9%	8

Table 4 shows respondents feelings of satisfaction towards 3 key areas of course content. The majority of learners were satisfied with all areas, with only a very small number not satisfied.

Table 5: How engaging were the educators

Very unengaging	2%	2
Fairly unengaging	5%	5
Neither unengaging or engaging	4%	4
Fairly engaging	28%	26
Very engaging	60%	56
Don’t know	1%	1

Table 5 demonstrates how engaging the learners felt that the educators were throughout the MOOC. Just under 90% of respondents reacted with a positive response and described the educators as either fairly or very engaging.

Table 6: How easy or difficult did you find the course

Much harder than I wanted	1%	1
Slightly harder than I wanted	4%	4
About the level I wanted	70%	66
Slightly easier than I wanted	13%	12
Much easier than I wanted	11%	10
Not applicable	1%	1

In table 6 the learners were asked to select how easy or difficult they felt the MOOC was in comparison to what they wanted. Just over 70% were happy that the MOOC learning was at the level that they were looking for. Although interestingly approximately 24% thought the course was in some way easier than they would have liked.

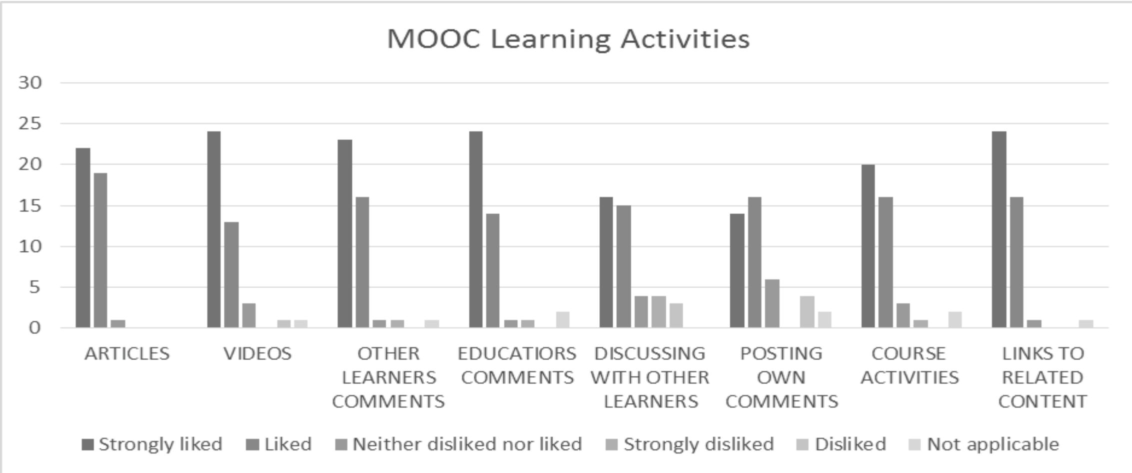


Figure 2: MOOC learning activities

Figure 2 shows the course content/material and the numbers of respondents who like/disliked each form of teaching. As can be seen overall all activities or learning opportunities were either strongly liked or liked by the majority of respondents.

7. Outcome

The outcome analysis was undertaken on the respondents who completed the pre and post course questionnaires in full and not partially (n=42). All of the respondents who completed the post course questionnaire worked within a healthcare setting.

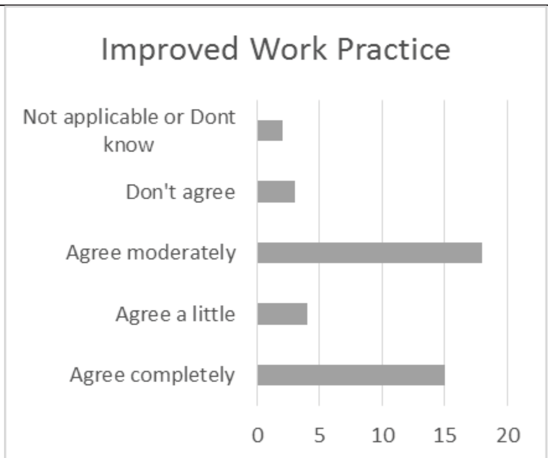


Figure 3: Improved work practice

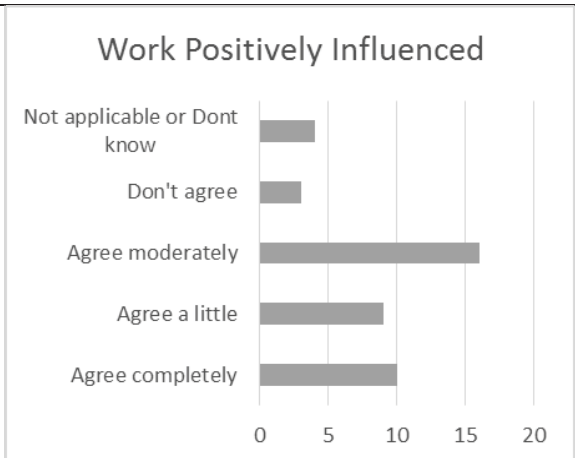


Figure 4: Work positively influences

The nature and subject of the MOOC meant that this questioning examined improvement and influence directly relating to the provision of compassionate care within work practices. Therefore in terms of the intended outcome figures 3 and 4 illustrate that the majority of learners agreed they could see improved compassionate work practices and a positive influence on their compassionate work ethic following completion of the course.

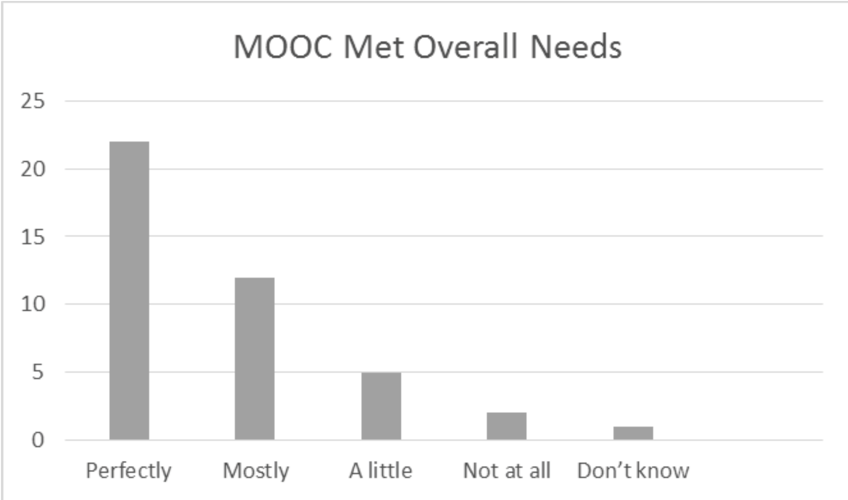


Figure 5: MOOC met overall needs

Figure 5 indicates that 93% of learners described the MOOC as meeting their overall needs either perfectly, mostly or a little and 7% selecting either not at all or don't know as an answer.

8. Discussion

Before discussion begins it is important to gain an understanding of retention, attrition and completion rates as these have been well debated throughout the literature (Jordan, 2015). To add complexity to these debates these terms are frequently defined and interpreted very differently (Gutl et al, 2014). Completion rates, often understood as the number of learners who obtained a certificate of completion (Jordan 2015), can conversely be understood as the number of learners who have met their own personal aims (Huin et al*,* 2016). Hone and Said (2016) implied in their research that retention rates showed the number of learners who have stayed until the end of the course. Put another way it can be the number of learners on the course who simply had the intention to complete (Gutl et al, 2014). In some literature attrition is outlined as the reduction in the number of learners from enrolment to the end (Gutl et al, 2014). However drop out can also be interpreted as the number of learners who have physically unregistered from the course. It is this confusion that creates challenges and complexity with the evaluation of MOOCs. Nonetheless it is important to consider these elements in order to understand learner actions and practices and to evaluate learning experience (Huin et al*,* 2016)

The findings from the Care and Compassion MOOC showed that only 8% of enrolled learners chose to no longer be part of the course. Although unable to examine specifically why those 8% left this MOOC, as they did not complete the post-course survey, some literature suggests that reasons for leaving can be; no real intention to complete, lack of time or skills, course difficulty and bad experiences (Gutl et al, 2014; Jordan, 2015; Onah, Sinclair and Boyatt, 2014). Because only 8% chose to no longer be part of the course, some literature suggests this then leaves what could be interpreted as a retention rate of 92% (Gutl et al, 2014; Hone and Said 2016). This is a very high number for a MOOC of today with much of the literature and concern detailing drop-out rates of between 10% and 20% (Gutl et al, 2014; Onah, Sinclair and Boyatt, 2014). However it could be argued that although only 8% left it does not mean that 92% of learners remained engaged throughout the MOOC. One observation that can be made when considering such a high retention rate is the learners intention to complete or in fact lack thereof. Some literature discusses retention as including those learners that only have the intention to complete when they enrol (Gutl et al, 2014). However other literature conversely suggests that high enrolment numbers can often include those with no real intention to complete which is also possible because MOOCs are free with no commitment and often attract those with an inquisitive nature rather than those wishing to genuinely enhance their knowledge. Nevertheless, as with those that left, it is impossible to measure whether the 92% of retained learners actually had the intention to complete or not but perhaps it should be considered that because learners are able to delve in and out of the course in order to satisfy their own aims and needs they can gain from the content of a MOOC without actually completing it. Drop out, attrition or non-completion rates need not always be looked upon as negative but rather that the learner has the flexibility to stop learning once they have satisfied their own personal goals and achieved their aims (Huin et al*,* 2016). The low number of "leavers" in the Care and Compassion MOOC shows that something within or about the MOOC, be it the course content, subject matter, learner interaction or engagement, caught the attention of the learners and although 92% of learners may not have physically completed it, they may have taken from it what they needed and therefore have been retained (Huin et al*,* 2016).

Looking at individual reasons for enrolling on a MOOC and personal aims for "completion" it can be appreciated that learners enrol on MOOCS for many different reasons (Gaebel, 2013). Some register because they are interested in the main subject matter, some to improve their skills in a particular area and some may even be undertaking the learning in order to gain employment in a specific area and are looking to obtain a certificate of completion (Huin et al, 2016; Jordan 2015; Onah, Sinclair and Boyatt, 2014). When considering completion etc. it is vital that the purpose of enrolling on the MOOC from a learner perspective is considered because they might have gained what they needed before the point of completion whilst finding the MOOC useful and informative as could be interpreted in the Care and Compassion MOOC (Huin et al, 2016). The results of this research showed that the most popular reason for signing up was for social networking purposes which is defined as, sharing expertise and support with others, socialising with other learners, networking with professionals and experts, getting feedback and support from others and learning from others perspectives and experiences.

Now examining the course content as a driving force behind retention, it is evident that in some cases the low number of learners choosing to leave the course may be attributable to the course content which, looking at the results, appears to have been reviewed positively. Of the 94 respondents who fully completed the post course survey, answering questions in relation to how they felt about the course content, most were satisfied with video and animation content, written course content as well as video subtitles. Examining this further and looking in more detail at the activities that were liked/disliked by learners, it is clearly evident that all forms of learning (articles, videos, other learner comments, educator comments, discussions, posting own comments, course activities and related links) were all predominantly either strongly liked or liked. Along with this nearly 80% of post course survey respondents found the educators engaging throughout the MOOC which again may contribute to the retention rates. Some literature does suggest that successful completion rates can be facilitated by ensuring that students are well supported by the educational team (Gutl et al, 2014). Onah, Sinclair and Boyatt (2014) discussed this in their paper which looked at course not only the support offered throughout the course but also its ease or difficulty. The findings from the care and compassion MOOC showed that just over 70% of learners felt that the courses educational level met their expectations. Regardless of these variances it is evident that as a basic framework all MOOCs should have an evident start and finish point as well as containing regular milestones, flagstones or check points that will assess participants learning so far (Turner, 2015).

The findings in terms of changes to work practices appears to be overall positive. Self-reported data showed that the majority agreed that their work practices had improved as a result of the course. As well as this more learners agreed that their work had been positively influenced after completing the MOOC than not. The subject matter of the course meant that this data directly related to the provision of care that is embedded with compassion. Although it is worth noting that this questioning did not allow respondents to specify whether this improvement and positive influence in compassionate care was relevant to them as an individual or if it extended out to their working environment. Nonetheless we know from previous literature that a compassionate care environment can have a positive impact on patient and staff wellbeing (Steenbergen et al, 2013; Youngson, 2012)

In terms of having an overall positive experience with the Care and Compassion MOOC, the initial findings show that not only were 92% of learners retained with hopefully the majority of these taking from it what they wanted or needed but also out of the number of learners asked specifically if the course met their overall needs, the majority had a positive response.

However it must be noted that this research is not without its limitations and has a significantly smaller sample size than that normally offered from quantitative data particularly in the measurement of overall experience. This is because it was taken from the 42 respondents who completed the post course survey in full rather than the 3586 learners who remained registered at the end of the course. This small number was due to the research requesting that only Healthcare Practitioners complete the survey at the end of the course.

9. Conclusion

The learning analytics suggest that this Care and Compassion MOOC has been received positively amongst learners with many elements of the course proving to be popular and successful. However further testing of the hypothesis is required in order to strengthen the empirical element of this research. Further to this, although this research in part was aimed at examining the MOOC in more detail and its learning analytic successes and limitations, it is also for the purpose of examining in more detail the possible impact on healthcare professionals compassionate working practices. In keeping with the sequential nature of this larger research project, the results of the above quantitative analysis will be utilised in order to develop appropriate coding for qualitative data gathered from telephone interviews with MOOC learners at the end of the course. This will allow for a more in depth examination of motivation to complete, successful retention and individual learning experiences. The overall findings from the whole research project will be used to inform educators, healthcare leaders and practitioners of the usefulness of using a MOOC to learn about compassionate care. They will also be utilised to suggest and inform prospective future research in the areas of e-learning and care and compassion.

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The Role of Stakeholders for e-Learning Success in Higher Education

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Abstract: Information and Communications Technology (ICT) plays an important role worldwide because the world is currently in the information age. This has resulted in the transformation and enhancement of teaching and learning in higher education institutions (HEIs). The most of the South African HEIs have also incorporated ICT in teaching and learning practices to remain competitive and relevant globally. One of these learning and teaching methods, which is conducted through ICT, is electronic learning (e-learning) where learners are to study online using web-based technologies. E-learning has a number of benefits for both the students and the instructors. However, it is important to understand that although e-learning has many benefits, HEIs face challenges when it comes to implementing e-learning. These challenges are hindering the success of e-learning and are preventing HEIs from gaining the benefits of e-learning. One of the contributing factors to the challenges of e-learning is that the roles of the HEI stakeholders, who have to ensure that e-learning is a success, are not clearly defined and that there is no clear understanding of the needs and concerns of all the HEI stakeholders. If the needs and concerns are not known or addressed, it becomes a challenge to implement e-learning in an efficient and effective way. There is, therefore, a need to conceptually investigate how these challenges of e-learning can be minimised in order to reap the benefits of e-learning and to ensure that e-learning is a success. The stakeholders play a very important role in the success of e-learning and for this reason, it is necessary to do an analysis of the stakeholders. This conceptual paper will examine who the HEI stakeholders are and what role each stakeholder needs to play to ensure that e-learning is a success at the South African HEIs.

Keywords: ICT, e-learning, higher education institution, stakeholders

1. Introduction

The stakeholders are the most important role players in all the organisations' activities (Al-Sabawy 2013). A higher education institution may have the best e-learning systems and tools, but it does not guarantee their actual use among the stakeholders as these stakeholders can make or break the success of e-learning systems (Maric 2015). Al-Sabawy (2013), furthermore, states that studies on e-learning seem to ignore the fact that there are many stakeholders that play a role in e-learning and these studies usually concentrate on one stakeholder, which is the students. Sudfelt (2016) supports this statement as the author highlights that not much research has been done on the types of benefits and challenges that come with the flipped classroom beyond considering only the experiences of the students. It is, therefore, essential that a thorough stakeholder analysis is conducted because the successful implementation of e-learning also depends on the extent to which the concerns and needs of the stakeholders are being met. Khanyile and Green (2016) raise a concern that research has revealed that due to the anticipation of difficulties in representing the stakeholder's interests, the most organisations do not conduct a formal analysis of the stakeholders.

According to Juha (2014), the stakeholders are the people who have the power to affect or to have an impact on the objectives of an organisation. On the other hand, Khanyile and Green (2016) define a stakeholder as an individual who is interested in the system and the system's performance. It is, therefore, important to note that the success of higher education institutions (HEIs) is highly dependent on the HEIs' capability to ensure that they care for the stakeholders' relationships (Juha 2014). Two types of stakeholders are identified, namely, internal and external stakeholders. Internal stakeholders are the stakeholders who are found in the organisation, for example, the staff and the management; the external stakeholders are found outside the organisation, the suppliers and the society (Slaba, 2015 and Abidin, 2015). Slaba (2015) states, however, that different authors are inconclusive whether customers are internal or external stakeholders. It does not matter whether the stakeholder is internal or external; what matters is that all the stakeholders have their own expectations (Varma, 2016). It is, therefore, of utmost importance to manage the stakeholders because the success of a project depends highly on how the stakeholders are managed and the satisfaction levels of the stakeholders (Abidin, 2015).

2. Stakeholder theory

The main reason for the application of the stakeholder theory is to determine the role of the stakeholders in higher education (Leisyte and Westerheijden, 2014). The stakeholder theory, as mentioned by Khanyile and Green (2016), answers very crucial questions on who the stakeholders are, what stake or claim these stakeholders have and the responsibility of the organisation or institution towards these stakeholders.

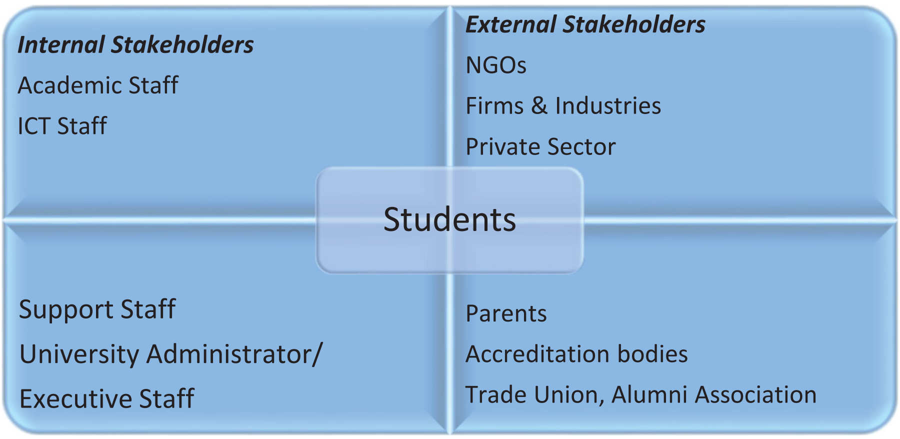
According to Slabbert (2015), the stakeholder theory is more concerned with ensuring that the way the company enriches its stakeholders is in line with the organisation's strategy to benefit both the organisation and the stakeholders. One of the ways to ensure that both the organisations and the stakeholders benefit and also that there is a mutual understanding of interests is through stakeholder management (Bierbooms et al. 2016). Stakeholder management decisions should be based on a stakeholder analysis. The stakeholder analysis, as proposed by Bierbooms et al. (2016), should include four steps, which are as follows:

- Identifying the stakeholders
- Understanding the nature of stakeholder claims
- Identifying the gaps in the organisation or institution's objectives and strategies which are different from the identified expectations of the stakeholders
- Prioritising the stakeholders' demands

This stakeholder analysis is closely related to the findings of Khanyile and Green (2016) who reported how the stakeholder theory answers crucial questions. Three perspectives can be used to analyse the stakeholders, namely, power, legitimacy and urgency (Sudfelt et al. 2016). Power refers to when people do as they wish because they feel they can make such a decision. A stakeholder, who is powerful, has an influence on changing the programme development and on developing programmes (Leisyte and Westerheijden, 2014). Legitimacy is based on an assumption that the people's actions are acceptable because they are in line with the norms, values and beliefs (Sudfelt et al., 2016). Urgency refers to the stakeholder insisting on immediate action and checking the progress constantly (Leisyte and Westerheijden, 2014).

3. Stakeholder analysis

Stakeholder analysis is important when one wants to measure and understand the causes of system success and failure. Through this process, the stakeholders' buy-in is essential (Marziliano et al., 2015). The perspectives of the stakeholders are important to educational organisations if they want to provide a learning process which is successful (Abidin, 2015). Stakeholder analysis is useful in generating the knowledge of the important actors to understand their behaviour, as well as their interests, agendas and intentions and their influence and resources (Maric, 2013). According to Marziliano et al. (2015), the stakeholders are the students, faculty, administrators and staff. Agrawal and Dharma (2014), and Leisyte and Westerheijden (2014) highlight that the stakeholders in higher education are the staff, students, parents, faculty, alumni, administrators, career advisors, media, partners, recruiters, government and society. The authors take it a step further as they identify both internal and external stakeholders. The figure below highlights the stakeholders of higher education institutions.



Source: Adapted from Asiyai (2015) and Leisyte and Westerheijden (2014)

Figure 1: Higher education stakeholders

4. Students

Students were recognised as stakeholders in the literature for the first time in 1975 (Leisyte and Westerheijden 2014). Students are the primary stakeholders as they receive the services directly (Abidin 2015). They are the consumers of e-learning (Wagner et al. 2008). According to Sudfelt (2016), students are dependent stakeholders because their need of e-learning is urgent. Leisyte and Westerheijden (2014) emphasise the need for higher education institutions to treat students as equal partners and for students to be involved in the process of internal quality assurance. The policy theory stresses on including students as stakeholder representatives in order to understand the concept of quality in education (Leisyte and Westerheijden, 2015). E-Learning is beneficial to students because it assists them to gain access to information that was going to be hard for them to access due to time constraints and geographical locations (Wagner et al., 2008).

Students are to exercise their decision-making roles in the education process; especially, when it involves their academics (Asiyai, 2015). They must play their part by attending to their academic work and avoiding problems that might lead to misconduct. In e-learning, an example would be to avoid getting another person to do their work on their behalf just because it is done online.

According to Wagner et al. (2008), students have several concerns about e-learning, which are as follows:

- It is a different learning environment which requires certain skills before the students can use it successfully. Students must have computer literacy as technical sophistication is a necessity.
- E-learning entails much information which the students will come across and access as the information comes from a number of different sources. This process forces students to become critical thinkers with evaluation skills to be able to sort through the information.
- E-learnings forces students to be more independent than needed in traditional learning. This means that students have to be motivated and committed to learning. Therefore, e-learning can be effective.

5. Academic staff

The academic staff are the main producers of education in higher education and they are the ones who set the pace (Asiyai 2015). They are the dominant stakeholders of e-learning because they have the power as the content providers (Sudfelt, 2016). Shonala and Joy (2014) emphasise the importance of the academic staff in implementing teaching and learning in the education system. They are responsible for guiding the educational experiences of students (Wagner et al., 2008). Furthermore, e-learning shifts the academic staff's roles from the main sources of information to the managers of the students' knowledge resources. The academic staff play an important role in ensuring the success of e-learning. The role of the academic staff, as highlighted by Asiyai (2015), is as follows:

- Ensuring effective learning.
- Promoting innovation and creativity among students.
- Communicating effectively with the relevant stakeholders.
- Promoting student-centred lectures.
- Using active learning strategies to enhance the teaching effectively.
- Conducting research continuously to assist with improving instructional practices.
- Monitoring and evaluating the students' learning. Academic staff have to evaluate and monitor the criteria and must be committed (Maric, 2013).

One of the challenges of the academic staff is that they do not have enough confidence to use the ICT devices. The academic staff have to know what their roles are and what their level of competence is when it comes to the use of technology to ensure effective teaching and learning (Maric, 2015). They have to adapt to the ever-changing online learning environments. According to Shonala and Joy (2014), some academic staff members are hesitant to use the new technologies because they need to see the evidence that these new technologies will indeed be beneficial to their learning experience and enhance the learning of students. The academic staff must have an advanced knowledge of the use of the technology since they are the content providers (Wagner et al., 2008). Wagner et al. (2008) state that the academic staff are also concerned if their students are going to accept the e-learning tools.

6. Employers

The employers are the organisations where the graduates will be employed after they have completed their qualifications at the higher education institutions (Wagner et al., 2008). In many countries, the programme accreditation rules include the employers when the higher education institution wants to revise the programme. This inclusion of the employers has become a requirement (Leisyte and Westerheijden, 2014). The reason for this inclusion of the employers is to ensure that there is an increase in the employability of the graduates (Leisyte and Westerheijden, 2014). Employers have a role to play in that they have to provide feedback on how the graduates are performing their duties in the workplace as this will assist with an input in the development and improvement of the curriculum (De Castro et al., 2016).

One of the concerns of the employers about e-learning is that the element of interpersonal skills will be limited or will lack since the students will be studying online and will not have contact with fellow students and academic staff (Wagner et al., 2008). Employers are concerned about the gap between the skills that graduates acquire during their studies at higher education institutions and the skills that they require in the workplace (Maxwell et al., 2010). This gap leads to a need for higher education institutions to ensure that they prepare the graduates by aligning the skills, with which they equip the students, with the skills that are required in the workplace. The education should be competency-based where the main focus should be on the outcomes and this outcome should be linked to the needs of the workplace (Vissers et al., 2014).

7. Administrators and executive management

The administrators, more specifically the executive management, are the most influential stakeholders at the higher education institutions as they are the trendsetters for the students, teaching staff and the rest of the stakeholders through the provision of effective leadership (Asiyai 2015). Furthermore, they must ensure that there is a conducive climate promoting the relationships between the stakeholders, for example, student and academic staff, student and student, academic staff and academic staff, and staff and management. The administrative or executive management structures are definitive stakeholders because they have the power to obtain the resources and to decide if e-learning is to be implemented or not (Sudfelt 2016). The executives' responsibility is to make sure that they pursue excellence when delivering on services. Fitzgerald, Bruns, Sonka, Furco and Swanson (2016) state that the management has a responsibility to inculcate a civic ethos throughout the institution by giving voice to it in public forums and to create the infrastructure as support, as well as to establish sustainable policies. According to Sudfelt (2016), the executive management is of high importance in the higher education institutions because they are responsible for the strategic and long-term planning. Asiyai (2015) lists the following roles of executives to ensure that teaching and learning are successful in higher education institutions:

- Improving the work conditions with the hope of attracting competent academics. Maric (2013) agrees with the improved work conditions for higher education institutions staff.
- Improving the quality of research.
- Establishing an internal quality control system to improve the quality of teaching and learning.
- Assuring that the stakeholders pursue the institution's mission statement and to empower the stakeholders to be responsible and achieve the mission statement.
- Sponsoring the academic and support staff to enable them to attend training programmes, including seminars, conferences and workshops. This will be beneficial in that the training can be shaped in a way that makes it more relevant to the market since the academic and support staff will have the updated knowledge and skills.
- Ensuring that the academic staff provide development training programmes that are professional.

The support staff are concerned with e-learning because e-learning is promoted to deliver courses with the use of less labour, but the time they spend in providing online versions of courses is twice as many hours when comparing the time spent on traditional learning (Wagner et al., 2008). A study that was conducted by Rockwell, Schauer, Fritz and Marx (1999) highlights that, when it comes to distance learning, administrators have several concerns, namely, time, cost, instructional design, policy, instructor-student relationships and training. Fitzgerald et al. (2016) state that administrators have a responsibility to foster conversations in their institutions. They play the role of the middleman between the students and the management as they are the ones who communicate with both. They must bridge the gap between the two by making sure that the two talk to each other and understand each other on the matters related to e-learning platforms. Furthermore, Fitzgerald et al. (2016) recommend that the administrators should evaluate the merits of engagements within the historically prominent outreach units to ensure that there is a potential contribution to an engaged institution.

8. Technical providers

The technical providers provide the technology that is needed to implement e-learning (Wagner et al 2008). It is, therefore, important for technical support to be available because it has a positive effect on the students and academic staff's willingness to use the e-learning systems as well as the level of participation (Alhomod and Shafi, 2013). The technical providers have the role to monitor the service to ensure that it is user-friendly (Kim et al., 2013).

According to Wagner et al. (2008), the technical providers' concerns about e-learning is the technological standards. Moreover, they are concerned about the hardware and the expectations of the consumers as these expectations add pressure to improve the providers' offerings.

9. Accreditation bodies

The quality assessors of the offerings of the education institutions are the accreditation bodies (Wagner et al., 2008). According to Mabizela, Ballim and Mabangizi (2014), the definition of these professional bodies, which was mentioned by the South African Minister of Higher Education and Training, Dr Nzimande, in 2011, reads as follows: They are " firstly, a group of people in a specific regulated occupation who, secondly, are entrusted with maintaining control or oversight of the legitimate practice of the occupation and, thirdly, have a significant influence on education linked to the professions, and ultimately have the final say as to who it will register as one of its own and who it will reject". According to Eaton (2015), accreditation bodies are used by the institutions to provide external quality reviews of the institutions' programmes for quality improvement and assurance. Accreditation bodies should ensure that the higher education institutions' courses meet the minimum requirements to be accredited. Even e-learning accreditation bodies should play a role in ensuring that the courses and information that are posted online do not go against the minimum standards. The accreditation bodies are national systems that register and issue licences to the institutions and the education institutions are also required to undergo quality assurance assessments of the academic programmes (Knight, 2015). Benchmarks are associated with accreditation to ensure that students achieve their specific objectives in the higher education institutions (Chandrasekaran, 2013). South African higher education institutions have several accreditation bodies (DHET 2016), such as Umalusi for the accreditation of national certificates, for example, N1, N2 and N3, the Quality Council for Trades and Occupations (QCTO) for national certificates N4, N5 and N6 and the South African Qualifications Authority (SAQA).

10. Government

Higher education institutions in South Africa are state-owned and for this reason, the government is a stakeholder and has a certain role to ensure that e-learning is a success. The government must see to funding policies because e-learning systems can be very costly (Msomi, 2016). Maric (2013) supports this motion and states that the government is responsible for financial support. Asiyai (2015) states that the government's responsibility is to ensure that the curriculum is reviewed consistently to align with the market demands because the graduates that are produced by the institutions are produced for the market. According to , the government has a responsibility to develop higher education policies which must be implemented by the universities (Spaull, 2013). The government has a huge interest in the HEIs because they invest money into the HEIs. Therefore, they are expecting results through throughput. The money invested by the government should at least correspond with the throughputs in the HEIs.

11. NGOs, local communities and private sector

The private sectors, local communities and non-government organisations (NGOs) contribute to the quality of education in higher education institutions (Asiyai 2015). The private sectors, which contribute to the continuous search for the improvement in university education, are the alumni association, trade unions, other institutions, religious organisations, other employers of labour and industries or firms, as mentioned by Asiyai (2015). The private businesses and industries or firms employ the university graduates; therefore, they need to invest by providing funding to higher education institutions to enhance the efficiency of the e-learning system. The alumni association has to introduce a fixed levy, which must be paid by the members of their institutions, to improve funding. The private sector's main role is to contribute to the funding of education (Asiyai, 2015).

The NGOs play a very important role in the governmental policy and public opinion when it comes to political, economic and cultural matters (Schmidt, 2014). This means that they play a role to ensure that both the government, institutions, students and the community play their roles by ensuring that e-learning is a success. In developing countries, the NGOs assist the higher education institutions with compensation as the funding for education is limited in the most cases (Kieu and Singer, 2017). Moreover, the NGOs play a role by cooperating with the higher education institutions to develop the curricula because the NGO is a possible or potential employer of the universities' graduates (Kieu and Singer, 2017).

12. Parents

The parents of the students have a very important role to play in the success of e-learning in that they must take interest in the studies of their children. Parents need to take the responsibility to ensure that their children develop good study habits to learn effectively (Asiyai, 2015). They should always support their children. Parents should become involved in their children's education that their children can benefit in the educational outcomes leading to future success (Anicama et al., 2017). According to Nurmi and Silinskas (2014), there is an assumption that the children's academic functioning, personal goals and achievements are influenced by their parents through the deployment of beliefs and support as well as involvement. Furthermore, parents' involvement plays a very important evaluation role when it comes to homework assistance (Silinkas et al., 2012). This will assist with e-learning in a way that students are mostly independent and study on their own; therefore, someone must play an evaluator role to make sure that the student has covered the work that they were supposed to cover.

13. Conclusion

It is clear from the literature that the stakeholders play a very important role to ensure that e-learning is a success. Information and communications technology is challenging and, therefore, needs the support of all the stakeholders for it to be successful and to minimise the challenges that come with e-learning. Stakeholders have several similar concerns with e-learning which the institutions and the government need to take seriously and address because these stakeholders have the power to make or break the e-learning initiative. The silo mentality should be avoided at all costs. All the stakeholders should be kept in the loop about the new developments as they affect them either directly or indirectly. The sooner higher education institutions understand the importance of analysing and attending to the stakeholders' needs for e-learning, the more the challenges of e-learning can be minimised.

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Vissers, D., Daele, U.V., De Hertogh, W., De Meulenaere, A. and Denekens, J., 2014. Introducing Competency-Based Education Based on the Roles that Physiotherapists Fulfil. J Nov Physiother Phys Rehabil 1 (2): 053-058. 053 Abstract Introduction: Although there has been a shift towards competency-based medical education in the past decade, littlel iterature is available about the specific use of competency-based education in physiotherapy education. The purpose of this article is firstly to describe the development of a competency-based educational program for physiotherapy and secondly .... *Method: A role-based competency framework was gradually developed and implemented in a*.

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Exploring the Student Teachers' Technological Knowledge for ICTs Integration

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Abstract: Globally, the lackadaisical pace of the adoption of technology for teaching and learning in education has led to numerous evaluations of pre-service training programmes. The technology integration training programmes are observed as the attributes to the inefficacy of the pre-service teachers to integrate technology into learning. It is reported that the integration of technology is still low in the higher education as some institutions, are still using traditional ways of teaching and learning. This is the case at a study University of technology. For pre-service teachers to effectively teach with technology, they must possess three bases of knowledge as portrayed in Technological Pedagogical and Content Knowledge (TPACK) as a theoretical framework for the knowledge base. It is opined that TPACK assists in the technology integration in a specific educational context that is aligned to the content, pedagogy and the potential of technology. This paper will report on Technological knowledge of the TPACK framework. Technology knowledge is a critical knowledge that is required by pre-service teachers because it plays a major role. Technological Knowledge includes being able to choose and use technology in context. The participants were 230 pre-service teachers in the School of Education in the University of Technology (UoT) in South Africa. They were selected randomly from three departments. Quantitative data was collected using adapted TPACK instrument focusing on item for the questions used in: TK1_19; TK2_20; TK3_12; TK4_12; TK5_4 and TK6_25. To determine whether there was a difference between males and females with respect to technology knowledge, an independent samples t-test was computed. Furthermore, to establish whether any differences would be established in terms of Technical Knowledge scores with respect to the departments participants were from, a one-way analysis of variance (ANOVA) was computed. In addition, a Tukey *post-hoc* analysis was carried out to establish which departments' scores were different. The results show that the t-test revealed a statistically significant difference ($t\ (228) = 3.910$, $p < .05$). It may be concluded that in this paper females possess a higher level of technical knowledge than males. A further study is recommended with all the subscale of the TPACK with a similar group of participants.

Keywords: TPACK, technology-enhanced teaching strategies, professional development programmes and technological knowledge

1. Introduction

The slow pace of technology integration in education has subjected the professional development programmes to a lot of scrutiny, globally and locally (Ellis and Anderson, 2018). These are the in-service and pre-service training programmes intended to capacitate the lecturers and the student teachers to integrate technology successfully (Barnes, Zuilkowski, Mekonne & Ramos., 2017). Literature still indicates that the integration of technology is still low in the higher education as some institutions are still using traditional ways of teaching and learning (Asiyai, 2014; Barnes et al., 2017). Mishra and Koehler (2006), identified the missing domain of knowledge that is crucial for the integration of technology. They posited that the technological knowledge should be incorporated in the training programmes. The incorporation of technological knowledge in Shulman's (1986) work resulted to the Technological, Pedagogical and Content Knowledge framework (TPACK) (Mishra & Koehler, 2009) These authors emphasize that implementing technology cannot be accomplished without technological equipment (Herring, Mishra & Koehler, 2016). It also argued that teachers are inclined to teach in the same manner they were taught (Fore et al., 2015)

Currently, at a study UoT, student teachers in the school of Education are trained and empowered using the traditional teaching methods. Yet, when these student teachers are deployed to schools for teaching practice, they are expected to deliver the learning content using the 21st Century technologies. In 2015, when these students were deployed in various schools for teaching practice in the Gauteng and Mpumalanga Provinces, it was discovered that the Departments of Education (DoE) had installed and integrated various electronic devices for teaching and learning in the classrooms. In some of the schools, learners were issued with tablets and iPads.

The classroom chalkboards were replaced with smart boards and interactive whiteboards. This was done to replace the traditional methods of teaching to meet the demands and skills required in the 21st century. This innovation posed a challenge to the student teachers as they were not able to utilize these technologies for teaching and learning. It is in that regard that this study sought to establish whether the student teachers possess the required technological knowledge, as part of the crucial domain for successful integration. TPACK was adopted as a framework for this study.

Ever since TPACK was introduced as a framework, it has been actively utilized in a variety of studies in different contents. It is also reported that from 2005 to 2011, about 200 studies were already conducted using the TPACK (Voogt et al., 2013). Numerous studies have been conducted to validate TPACK as the framework for assessment tool and development (Durdu & Dag, 2017; Ndongfack, 2015). TPACK has also been used to establish the technology knowledge possessed by the teachers and the results showed that it is only the minority of teachers that know about the technology and are integrating in their teaching. The results indicated that the teachers need to be taken through phases of professional development for them to acquire all the necessary domains of knowledge to integrate successfully (Reyes et al., 2017). TPACK has been utilized to analyze how teachers construct knowledge by engaging in communities of practice in integrating technology. TPACK in that case was employed to establish their knowledge before the teachers were provided with the relevant resources and environment that enabled them to interact. The results were positive. Teachers were exposed to more resources and gained knowledge on how technologies are used for teaching and learning, and they also realized the possibilities of incorporating them in their own practices (Olofson, Swallow & Neumann, 2016). For establishing the perceptions of teachers towards the use of technology, the TPACK was used before and after the engagement with technology enhanced strategies. The results showed that their perceptions were positive after the course (It is also stated that many researchers, after the introduction of TPACK as the framework, developed their own assessment survey tools as research instruments to evaluate their knowledge of technology using information from the TPACK. These tools were used to assess both the in service and preservice teachers. Angeli and Valanides (2009) have used the TPACK to develop tools for self-assessment, peer assessment and expect assessment on the TPACK for formative and summative assessment. Framework.

2. Literature review

2.1 Professional development programmes

Professional development programmes are utilized as the intervention or ploy for the integration of technology to take place in the higher institution of Learning (Dengerink, Lunenberg & Kools, 2015) Example of development programmes are the in-service (INSET), pre-service training programmes as well as technology-enhanced empowerment programmes (Koh & Chai, 2016). For the technology-enhanced professional development and empowerment programmes to be implemented successfully, technology-enhanced teaching strategies must be incorporated for lecturers to apply in their teaching practices. These programmes are perceived as eminent (Barnes et al., 2017). Hence universities globally, have already introduced the compulsory in-service and pre-service programmes for the lecturers and student teachers on the integration of technology to achieve the desired learning outcomes (Tsotetsi, 2013; Mofokeng, 2005; Coffey and Gibbs, 2000). Sustained and frequent in-service training programmes gradually change the teachers' beliefs and their practices (Barnes et.al., 2017). However, the challenges brought about by the new technologies in education demand the new standards for both in-service and pre-service of educators (Jos & Esteve, 2000). Both the in-service and the pre-service on the integration of technology should be supported (Fore et al., 2015). These authors further state that the lecturers must integrate technology for student teachers to mimic their behaviour on their future work places.

2.2 Pre-service programmes

Pre-service programmes are designed to capacitate student teachers before they engage in the actual services (Naylor, Campbell-Evans & Maloney, 2015). If student teachers do not engage with the current technologies through their experiences in class, it becomes a challenge for them to apply the technological skills in their work environment (Imenda & Muyangwa, 2000). The pre-service programmes for the integration of technology are therefore, programmes that are developed to capacitate student teachers to be able to integrate technology in the future classrooms (Anderson & Maninger, 2007). Technology-enhanced training programmes are to be in place since the integration of technology training cannot be conducted without using the educational technologies themselves (Delfino and Persico, 2007). The student mobility through technology deepens exploration, connecting pre-service teachers to the larger communities and provides them with larger personalized experience (Martin and Ertzberger, 2013).

2.3 Technology-enhanced teaching strategies

Technology-enhanced teaching strategies are models and methods for teaching with technology (Simelane & Ngcapu, 2013; Mnisi, 2015). These authors argued that the advancement of technology in education has left teachers with no option but to consider the approaches they follow in teaching with an aim to create conducive learning environments. In this regard it is important for lecturers to select appropriate teaching strategies with relevant technologies (Simelane, 2008a; 2008b). To incorporate technology successfully and competently in teaching and learning, lecturers will require assistance (Mnisi, 2015). The correct incorporation of technology in education will bridge the gap between knowledge of good pedagogy, technology and content (Mishra & Koehler, 2006). Various technology-enhanced teaching strategies exist. For an example the Technology Acceptance Model (TAM) (Davis, 1989), the Technology-Organization-Environment (TOE) framework (Tornatzky & Fleischer, 1990), Rogers' Innovation Diffusion Theory (IDT) (Rogers, 2003), the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, & Zang, 2010), Technological, Pedagogical and Content Knowledge (TPACK) (Mishra & Koehler, 2006) as well as networked-based pedagogies (Saadatmand & Kumpulainen, 2012). These technology-enhanced teaching strategies have been explored in higher education (Simelane & Ngcapu 2013). The Modern Learning Environments MLE, allow students to access digital tools and use them to acquire skills that they can use beyond the classroom (Miftachul et al. 2018).

2.4 Technology-enhanced learning approaches for student teachers

The technology-enhanced learning approaches are the different ways in which students use various technologies to actively engage to acquire knowledge and skills (Miftachul, Andino, Kamarul, Abdul, Busrah, Kamarul, Mohd, Badlihisham and Roslee, 2018)). In this case, lecturers are assigned with developing lifelong learners who can survive and prosper in a global knowledge economy (Mnisi, 2015). In fact, these student teachers should have the potential to apply 21st century skills as well as competencies to engage effectively and creatively to new situations in an ever-changing, complex world (Valtonen, et al, 2017; Simelane-Mnisi and Mji, 2016; Blaschke, 2012). The technology training in authentic environments are courses that are integrated into the real context where student teachers are taught how to use ICTs in class by demonstrating and then given a chance to experiment. Examples of the authentic environment are workshops, creating electronic portfolios and podcasting (Ertmer & Ottenbreit-Leftwich, 2010). The modelling of technology by lecturers is vital**,** as the student teachers will then mimic what the saw and apply it in similar situations (Tondeur, et al., 2012).

2.5 Theoretical Framework -Technological, Pedagogical and Content Knowledge (TPACK)

Pedagogical Content Knowledge (PCK) framework was coined by Gudmundsdottir & Shulman in 1987.It was further developed into Technological, Pedagogical and Content Framework (TPACK) (Mishra & Koehler, 2006). This framework is opined that, for the teachers to be able to integrate successfully, they need to acquire all the three bases of knowledge, namely content knowledge(CK), pedagogical knowledge (PK) and technological knowledge (TK). (Graham, 2011). However, Burgoyne, Graham & Sudweeks (2010), in Simelane & Skhosana (2012) See also (Herring, Koehler and Mishra, 2016), posits that, technology must be used in context to enhance teaching and learning. The amalgamation of these three core bases of knowledge resulted into four more bases of knowledge, namely, pedagogical content knowledge (TPK), technological content knowledge (TCK) and technological pedagogical content knowledge (TPACK) (The seven knowledge bases are represented in figure 1.

2.6 Technological knowledge

The focus of technological knowledge is not only on what technology is, but it is on how technology is used for teaching and learning (Ndongfack, 2015). Studies demonstrate that, teachers in their first year, use technology in a narrow way because of their limited technological knowledge (Gudmundsdottir & Hatlevik 2018). Graham (2011), argues that a distinction between technologies was not made earlier when TPACK was introduced as the framework. He therefore states that technological knowledge may include the knowledge of the old technologies and the emerging ones. Technologies vary from chalkboards, pens, computers, to Management systems, tablets, cellphones and smart boards. It is posited that according to TPACK perspective, every teaching and learning scenario requires a tool hence technologies are distinguished between the hard technologies, such as tools, devices, hardware, etc. and the soft technologies such as software, methods, processes, etc. (Jonassen, 2004). Angeli and Valanides (2009), use the TPACK as aligned to the Information Communication Technology which is in alignment with this study. Durdu and Dag (2017) stipulate the International Society for Technology Education (ISTE) standards for the teacher's competencies to integrate technology successfully.

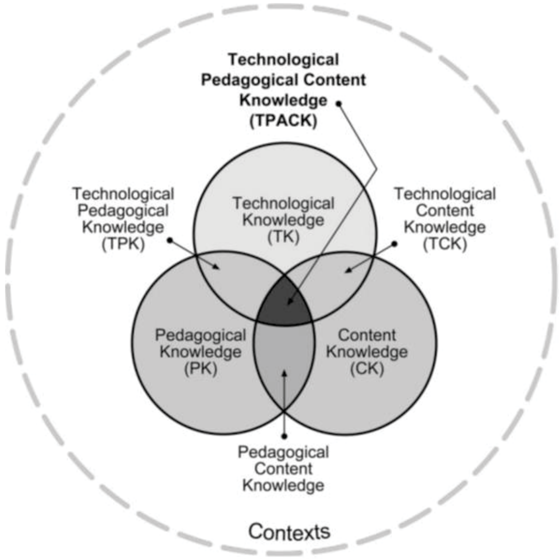

Figure 1: TPACK Framework (adapted from Koehler & Mishra, 2009)

3. Methodology

The quantitative method was used in study to answer the research questions:

RQ1: Is there a statistically significant difference between males and females regarding technology knowledge?
RQ2: Is there a statistically significant difference between the scores from the different departments?

The adapted TPACK measuring instrument was used to better understand participants technological knowledge which consisted of 6 items. An independent sample t-test was computed to determine whether there was a difference between males and females with respect to TK. Furthermore, to establish whether there would be significant difference between the technical knowledge scores in terms of the participants from various departments, a one-way analysis of variance (Anova) was computed. In addition, a Tukey post-hoc analysis was carried out to establish which departments' scores were different. Data was analysed using the SPSS.

4. Participants

The participants in this study were 230 second year pre-service teachers in the School of Education in the study University of Technology in South Africa. These participants were selected using stratified random sampling from the Department of Technology Vocational Education 60 (26.1%), Mathematics Science and Business 133 (57.8%) and Education Foundation 37 (16.1%). There were 133 (57.8%) females and 97 (42.2%) males. Their ages ranged from 17-24 years 189 (82.2%), 25-30 years 38 (16.5%) and 31years and above 3 (1.3%). These participants were deployed for their teaching practice in the following provinces in South Africa, Gauteng 76 (33.0%, Mpumalanga 67 (29.1%), Limpopo 23 (10%), KwaZulu-Natal 62 (27%) and Free State 2(9%).

5. Instrument and procedure

The TPACK measuring instrument consisted of seven subscales that measure technological knowledge, content knowledge, pedagogical knowledge, pedagogical content knowledge, technological pedagogical knowledge, technological pedagogical content knowledge (Koehler & Mishra, 2009). The permission to use TPACK questionnaire was granted by the authors. The focus of this study was on the technological knowledge (TK), which consists of 6 items that measure:

- TK1: I can find my own solutions to most technical problems when working with digital technology;
- TK2: I learn new digital technologies easily;
- TK3: I frequently experiment with different software;

- TK4: I know a lot about different digital technologies;
- TK 5: I have the technical skills to use digital technology in my teaching; and
- TK6: I have had sufficient opportunities to work with different technologies.

Participants were requested to indicate their choice on 5-point Likert-type rating scale anchored by 1: Strongly Agree and 5: Strongly disagree. The reliability of the TK was computed by Cronbach's alpha (Cronbach, 1951), α value was .82.

6. Results

RQ1: Is there a statistically significant difference between males and females regarding technology knowledge?

To determine whether there was a difference between males and females with respect to technology knowledge, an independent samples t-test was computed. The t-test revealed a statistically significant difference ($t(228) = 3.910$, $p < .05$). It may be seen from Table1 that females possessed higher technical knowledge than males.

Table 1: Means and standard deviations of the Technology Knowledge scale by gender

Gender	N	M	SD
Male	97	14.48	5.923
Female	133	17.18	4.532*

*. p < .05

RQ2: Is there a statistically significant difference of technology knowledge between the scores from the different departments?

To find out whether there would be a statistical significant difference between the scores from the various departments, a one-way analysis of variance (ANOVA) was computed. Table 2 shows that there was a statistically significant difference.

Table 2: Results of one-way analysis of variance in terms of the participants' departments

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	483.856	2	241.928	9.147	.000
Within Groups	6003.709	227	26.448		
Total	6487.565	229			

It may be seen from Table 3 that the highest mean was for students from the Mathematics Science and Business Education department (MSBE)

Table 3: Means and standard deviations of technical knowledge scores according to department students were from

	N	Mean	SD
Technical and Vocational Education			
Education Foundation	37	13.73	5.905
MSB Education	133	17.25	4.992
Total	230	16.04	5.323

Since the ANOVA indicated a statistical difference, a Tukey *post-hoc* analysis was carried out to establish which departments' scores were different. Table 4 shows that the statistically significant differences were between MSB Education and both technical and Vocational Education as well as Education Foundation.

Table 4: Tukey *post-hoc* analysis of the differences according to department

(I) Department	(J) Department	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Technical and Vocational Education	Education Foundation	1.070	1.075	.580	-1.47	3.61
	MSB Education	-2.448*	.800	.007	-4.33	-.56
Education Foundation	Technical and Vocational Education	-1.070	1.075	.580	-3.61	1.47

(I) Department	(J) Department	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
	MSB Education	-3.518*	.956	.001	-5.77	-1.26
MSB Education	Technical and Vocational Education	2.448*	.800	.007	.56	4.33
	Education Foundation	3.518*	.956	.001	1.26	5.77

*. The mean difference is significant at the 0.05 level.

7. Discussion

The results present that the majority of the participants were females and from the Department of Mathematics Science and Business. It may be argued that this might be influenced by various intervention programmes of increasing the enrollment of African girls in Science, Mathematics and Technology (Leder, 2015). These programmes included Special Project on Scientific, Technical and Vocational Education of Girls in Africa in the framework of the UNESCO's Medium-Term Strategy" (1996–2001), Africa's Science and Technology in 2007 and Africa and Gender Equity" UNESCO Medium-Term 2008–2013 (Leder, 2015). Most of the participants attended their teaching practice in Gauteng and Mpumalanga provinces. In these provinces most of the schools are equipped with technology such smart boards and tablets (Mokoena, Simelane-Mnisi, Coezter & Mji, n.d.). It may be argued in this study that the TK internal consistency was acceptable because it was comparable to that reported in Literature (Moroney & Haigh; 2011; Sahin, 2011). It may be seen from the results that females possess higher technical knowledge than males. These results are supported in literature that higher skills of technological knowledge are possessed by females compared to males (Mason, at el., 2015). In the study conducted in Singapore in 2010, the results showed that male pre-service teachers rated their TK higher than females (Koh, Chai & Tsai, 2010). These authors argued that gender gaps may close as computers become more prevalent in schools and this as advocated in this study that females have higher in TK than males. Other studies also yielded similar results such as in a study where the students were using electronic devices to respond to the question in a presentation. The male students were at ease compared to female students (Kay, 2009).

8. Conclusion

The purpose of this study was to establish the technology knowledge of the student teachers for the integration of technology in teaching and learning. The results indicate that the student teachers do possess this crucial base technological knowledge for integration of technology in Education. The comparative results contradict several studies that show a greater percentage of males in the technological knowledge than females. It may be concluded that in this paper females possess higher technical knowledge than males. The results from one-way ANOVA showed that there was a statistically significant difference in the TK scores with respect to the different departments. Furthermore, a Tukey post-hoc revealed that the statistically significant differences were between MSB Education and both technical and Vocational Education as well as Education Foundation. MSBE students were more competent in integrating technology in their learning experience.

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Does Flipped Learning Satisfy the Technological Learning Needs of Mature Students?

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Abstract: This paper presents the findings from a mixed methods study looking at the differences in attitudes towards technology-enhanced learning (TEL) between university students of different ages. The findings are then considered in terms of a flipped classroom. Students at a university in Northern England were surveyed in order to compare the difference in attitudes to TEL between mature students, defined as those who enter higher education at age 26 or above, and younger "non-mature" students. Students were also invited to attend an interview to explore which factors affect their attitudes and confidence with TEL. It was found that the main differences between mature and non-mature students lie in how they use technology for learning, and not in their attitudes. Mature students use fewer technologies for learning on their courses, and use it less often than their younger counterparts. Students of all ages feel that familiarity, flexibility, and clear reasons for use is important, and there should be a support infrastructure in place for the technologies used. Even with flipped classrooms, face-to-face contact is still important. Providing a range of available technologies encourages both mature and non-mature students to engage with TEL in whichever way they prefer for their own self-directed learning, and therefore is one of the most important aspects of the flipped classroom. Flipped learning in principle satisfies the technological learning needs of mature students, and offers an age-inclusive learning experience. These findings will be useful to educators who teach groups that may include mature students, and are concerned with the technological demands this may place upon them.

Keywords: technology enhanced learning, flipped learning, mature students, learning needs, second chance education, technology attitude questionnaire

1. Introduction

1.1 Mature students

Mature students entering second chance education have been a fast-growing sector of university admissions for the past few decades (Evans and Nation, 1996; Schuetze, 2014; Pearce, 2017). Mature students are defined here as those who enter higher education at an age of 26 or over (Baxter and Britton, 2001). In 2017, UCAS (2017) found that 10.4% of UK-domiciled university acceptances were aged 26 and over, and generally there have been large increases in acceptance rates for older age groups over the last few years. It is therefore important to ensure that classes are age inclusive.

Mature students are often anecdotally thought to have different attitudes and competencies with technology than younger students (Broady, Chan and Caputi, 2010). In particular, they are stereotypically viewed as struggling with technology. If this is true, it is a problem, as higher education institutions are widely adopting a variety of technologies in the form of technology enhanced learning (TEL).

1.2 Technology enhanced learning

Technology enhanced learning has no single agreed definition, with many definitions being specific to online technologies (Loughlin, 2017), or other foci (Gregory and Lodge, 2015). The definition used here is by Law et al. (2016), who define TEL as "integrating the use of digital technology into the learning and teaching process to improve the quality of learning". TEL has been shown to promote students' higher-level thinking (Lee and Choi, 2017), as well as improving the student experience, pedagogically and otherwise (Loughlin, 2017), so it is not surprising that it is a growing focus of the higher education industry. Every student is expected to engage with technology, and this is why it is important to consider the learning needs of all students when designing learning activities involving technology.

This paper presents the findings from a mixed methods study by the author exploring the differences in attitudes towards TEL between university students of different ages. Studies examining mature students' attitudes to technology are often outdated (Czaja and Sharit, 1998) or about very specific technologies (Al-Emran, Elsherif and Shaalan, 2016). As technology evolves, so do attitudes (Broady, Chan and Caputi, 2010), so one of the goals of this study was to do an up-to-date survey of attitudes. The following research questions were posed: (1) What are the attitudes of mature students to technology enhanced learning compared to younger HE students? and (2) What factors affect their attitudes and confidence with TEL?

1.3 Flipped learning

The "flipped classroom", or flipped learning, is a relatively recent technology learning model, requiring students to engage with online materials before attending face-to-face classes that focus on knowledge application, clarification, and consolidation (Jensen, Kummer and Godoy, 2015; O'Flaherty and Phillips, 2015; Marshall et al., 2017). This is the reverse (the "flip") of a traditional learning model where students receive information within the classroom, and are expected to apply the concepts in the form of homework (Jensen, Kummer and Godoy, 2015). It allows students and educators to use contact time in a more useful way.

Blended learning approaches, including flipped learning, are facilitated using a range of technologies (O'Flaherty and Phillips, 2015). One of the main concerns of educators teaching classes including mature students is that they will have negative attitudes and anxiety towards technology (Broady, Chan and Caputi, 2010). It is therefore vital to ensure that flipped learning is appropriate for mature students.

It is thought that flipped learning is particularly useful for engaging students in active learning (Jensen, Kummer and Godoy, 2015), since it shifts the focus to an interactive, deep-learning classroom experience, rather than the traditional 'listen and take notes' lecture. Since mature students are more likely than younger students to adopt a deep-learning approach (Jelfs and Richardson, 2013), flipped learning can support them to do this.

This study aims to bridge the gap between research and practice for designing TEL resources that are inclusive of mature students. The discussion will examine the implications of these findings in regards to a flipped classroom, and ask to what extent flipped learning satisfies the technological learning needs of mature students. Flipped learning research itself is in its infancy (O'Flaherty and Phillips, 2015), and there is very little research regarding mature students in relation to flipped learning. These findings will therefore be useful to educators who teach groups that may include mature students, and are concerned with the technological demands this may place upon them.

2. Students' attitudes to technology enhanced learning

2.1 Methods

The mixed methods study was based at a Russell Group university in Northern England. An invitation to participate in an online questionnaire was circulated to the student volunteers mailing list within the university. Since the aim was to compare younger students (25 and under) and mature students (26 and older), all students were invited to participate. A total of 161 participants completed the questionnaire. Mature students comprised 30% (n = 49) of the sample, while the remaining 70% (n = 112) were younger adults (henceforth "non-mature"). The participants were enrolled on a variety of courses ranging across all disciplines, and included both part time and full time students. The questionnaire also invited participants to volunteer for follow-up interviews. Eleven participants were interviewed, six of whom were mature.

The online questionnaire was a new instrument designed by the author, as no suitable questionnaires were found to be appropriate in their entirety. The new instrument was called the Technology Attitude Questionnaire (TAQ), and adapted items from Jay and Willis (1992), Knezek, Christensen and Miyashita (1998), Garland and Noyes (2005), Nguyen, Hseih and Allen (2006), Liaw, Huang and Chen (2007), Pierce, Stacey and Barkatsas (2007), Saadé and Kira (2007), Bonanno and Kommers (2008), Sagin Simsek (2008), Teo, Lee and Chai (2008), Teo (2008), Edmunds, Thorpe and Conole (2012), Lee and Clarke (2015) and Al-Emran, Elsherif and Shaalan (2016).

The TAQ consisted of three sections. In the first section, participants were asked whether they had ever used various technologies for course activities, non-course activities, or both. In the second section, they were asked how often they currently use each of the technologies (daily, weekly, monthly, less often than monthly, never), and how long they have been using these forms of technology (less than a year, 1-2 years, 3-5 years, 6-10 years, more than 10 years, never). The third section presented 31 items designed to assess attitudes to technology and find underlying factors. A 7-point Likert scale was used for possible responses: ("Entirely disagree", "Mostly disagree", "Somewhat disagree", "Neither agree nor disagree", "Somewhat agree", "Mostly agree", and

"Entirely agree". A "pass" option was also included). A 7-point scale was chosen since they are more reliable than 5-point scales, and offer more opportunity to discriminate between values (Schwarz et al., 1991). The internal consistency of this section was assessed using Cronbach's alpha coefficient and found to be 0.935.

For the quantitative TAQ data, a combination of Shapiro-Wilk tests for normality and visual inspection of distributions and Q-Q plots were used to determine whether the distributions for the mature and non-mature groups were normal or not. Where the distributions were found to be normal, t-tests were used to assess for differences between the two groups. Where normality was not found, Mann-Whitney U tests were used.

An exploratory factor analysis (EFA) using principal components analysis (PCA) was carried out to determine the factor structure of the TAQ. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.888, and Bartlett's test of sphericity was significant ($\chi^2(136) = 1712.280$, $p < 0.001$). Horn's parallel analysis was used to determine how many factors to extract (Horn, 1965). The parallel analysis showed that three factors should be retained; however, factor 3 was found to be a method factor, containing all the negative items related to factor 1 (Zhang, Noor and Savalei, 2016). The items loading onto factor 3 were removed, and therefore two final factors were assumed. In addition, items with factor loadings lower than 0.4 and items with cross-loadings over 0.4 were removed. In total, 14 items were removed, and a two-factor structure with 17 items was confirmed through EFA.

The qualitative interview was divided into three main topics: enjoyment of technology, confidence with technology, and knowledge of technology. The interviews were transcribed, and a basic theoretical thematic analysis (Braun and Clarke, 2006) was used in order to identify themes arising from the data. Pseudonyms are used for all participants.

2.2 Results and discussion

2.2.1 Number of different technologies used

In total, the minimum number of technologies used across all students was 9, and the maximum was 24 (out of a total of 24 different technologies presented), with the mature students using a median of 21 types of technology and the non-mature students using a median of 22.

The difference in the overall number of different technologies used by mature (mean rank = 68.59) and non-mature (mean rank = 86.43) students was statistically significant ($U = 2136$, $z = -2.259$, $p = 0.024$), with mature students using fewer different technologies than non-mature students. The effect size for this Mann-Whitney test is small ($r = -0.178$). A t-test showed that mature students used fewer technologies for their course activities ($M = 12.76$, $SD = 3.55$) than their non-mature counterparts ($M = 13.88$, $SD = 3.11$), which was a statistically-significant difference, $M = 1.12$, 95% CI [0.23, 2.22], $t(159) = 2.015$, $p = 0.046$. The effect size is medium to small ($g = -0.348$). Meanwhile, a Mann-Whitney U test showed there was no evidence of a significant difference in the number of technologies used for non-course activities by mature (mean rank = 68.59) compared to non-mature (mean rank = 86.43) students ($U = 2136$, $z = -2.259$, $p = 0.024$). The effect size here is also small ($r = -0.112$).

The main difference lies in how mature students use fewer technologies for learning on their course. The fact that they show no difference for non-course activities is interesting since it essentially debunks the conception that mature students are afraid of technology. This is a positive point for inclusive flipped classrooms.

2.2.2 Frequency of use of technology

The difference in frequency of use of technology for mature (mean rank = 91.86) and non-mature (mean rank = 76.25) students was found to be statistically significant ($U = 2212$, $z = -2.176$, $p = 0.030$). Due to the direction of the question, lower codes mean that technology is used more often, therefore mature students having a higher rank means that they use technology less often. However, the effect size is small ($r = -0.171$).

2.2.3 Length of time of use of technology

The difference in the length of time of use of technology for mature (mean rank = 121.33) and non-mature (mean rank = 63.36) students was found to be statistically significant ($U = 768$, $z = -7.726$, $p < 0.001$). Mature students have a higher rank, meaning that they have used each technology for a longer period of time over their lives. The effect size for this is large ($r = -0.609$).

This difference could simply be due to the fact that mature students are older, and therefore adopted these technologies earlier than their younger counterparts.

2.2.4 Attitudes

For the Likert data, a two-factor structure with 17 items was found through exploratory factor analysis. This is shown in Table 1. Factor 1 contains eight items about comfort, confidence, and perceived competence, so this factor was labelled "confidence". The second factor, containing 9 items, includes aspects of when students use technology and how interested they are in it, and was labelled "how students use technology".

Table 1: Rotated pattern matrix by principal axis factoring, with promax rotation and Kaiser normalisation; rotation converged in 3 iterations

Item content	Factor	
	1	2
I am easily able to learn new technology skills	.952	
I am good at using technology	.926	
I generally feel confident working with technology	.925	
I feel comfortable using technology	.865	
I find it easy to get technology to do what I want it to do	.840	
I am comfortable using technology I have chosen in my home	.720	
When I use computers, I feel in control	.672	
I feel I need more training to use technology properly	.590	
I learn more rapidly when I use technology		.749
The use of technology increases my motivation to study		.729
The use of technology makes a course more interesting		.696
Technology can help me organise my studies		.663
Technology allows students to learn at their own pace		.646
Technology allows me to learn wherever I need to		.614
Technology stops me from being bored		.497
Technology makes my study activities more personal and my own		.468
I would like to know more about technology generally		.414

A comparison of the factor 1 attitude dimension, confidence, between mature (mean rank = 74.61) and non-mature (mean rank = 83.79) students was found to be non-significant (U = 2431, z = -1.152, p = 0.249). The effect size for the Mann-Whitney test is very small (r = -0.091).

A comparison of the factor 2 attitude dimension surrounding technology use between mature (M = 5.40, SD = 0.917) and non-mature (M = 5.55, SD = 0.757), students was found to be non-significant, M = 0.14, 95% CI [-0.13, 0.42], $t(159)$ = 1.037, p = 0.302. The effect size is (g = -0.185) and is small. There is therefore no indication of difference in attitudes to how the students use technology.

The overall attitude was compared, consisting of both the confidence and technology use factors. The difference between mature (mean rank = 74.66) and non-mature (mean rank = 83.77) students was found to be non-significant (U = 2433, z = -1.141, p = 0.254). The effect size for the Mann-Whitney test used is very small (r = -0.090).

There is no indicated difference in any attitudes or dimensions towards technology between mature and non-mature students. In combination with the lack of difference in how many technologies are used for non-course activities (i.e., activities done for pleasure), the conception that mature students are afraid of technology can be disregarded.

2.2.5 Enjoyment of technology

During the interview, ten of the participants said that they enjoy using technology for learning, and only nine said that they enjoy using technology generally, for non-learning activities. Those who did not enjoy using technology generally were in the two eldest age groups interviewed. When asked why they enjoyed using technology for learning, usefulness was the prevailing reason by most participants. Sometimes technology saves the student time or creates a channel of communication with others:

> *It's just… convenient. […] It's the instant access at any time on multiple devices in multiple places. I don't have to wait for a Monday, or I don't have to get up early for a piece of information or a submission, I can do that any time I like. (Daniel)*

Generally, participants felt that younger students enjoyed technology for learning more because they were used to it. Interestingly, the participant who did not enjoy technology for learning was non-mature; their reason is that although they do use technology for their course, they prefer paper-based learning, and as that was what they used as they were growing up. This is consistent with the idea that you enjoy technology that you are used to, so flexibility in types of technology is required for flipped classrooms.

Students did not enjoy technology when they found it inaccessible, unreliable, or when it simply did not work. It is therefore important to provide well-planned learning activities and an appropriate support infrastructure in order to avoid alienating students. Many of the older students commented that they grew into enjoying technology for learning:

> *I do enjoy it, I would say I do. As I've learned - I think being very ignorant at the start made it very slow, quite scary at times, but as I've learned more and more, I would say yes, I do enjoy it. (Gwen)*

One mature student, Sophia, who grew up with a more traditional, paper-based education, had strong feelings that while technology can be useful, having interaction with human beings was absolutely vital, "at least 50% [of the time]". Flipped learning has built-in face-to-face contact time in order for students to consolidate their knowledge, so students who feel this way are able to use it.

2.2.6 Confidence with technology

Participants were asked to rate themselves on a scale of one to ten on how confident they were with technology generally, and learning about technology. Apart from one mature student who is also an engineering lecturer, the trend of increasing general confidence with technology with increasing youth was clear. However, when asked to rate their confidence about learning about technology, there was a difference. Younger students were more likely to rate themselves as less confident learning about technology than their general technology confidence, whereas the older students tended to be more confident in their technology learning skills than their general confidence. This suggests that although younger students are confident using a range of different technologies, as shown by the earlier result of them using a greater number of technologies, they are less comfortable when faced with new technologies, as the following excerpts illustrate:

> *Interviewer: Which forms of technology are you the least confident using?*
>
> *Bill: Yeah, unfamiliar things.*
>
> *If someone were to put a Mac in front of me, I wouldn't know what to do. […] That would make me a bit uncomfortable. (Emma)*

The reasons given by the participants for being confident with technology generally centre on familiarity. Most students made comments to the effect of being more confident with the technologies they use most. Bill stated:

> *I think just the fact that I've used technology so much, I've adapted to it, like, a lot better than say, my parents, who have hardly been on technology. (Bill)*

There was no relationship between age and whether students felt they needed support using technology. This seemed an individual matter of how confident they felt finding their own answers through, for example, YouTube videos. Support was usually only sought with unfamiliar technologies.

More of the mature students (67%) said they were sometimes anxious about technology compared to the younger students (20%). However, this was rarely to do with the technology itself, and more to do with the tasks being attempted. For example, Anne was anxious when submitting work for her course, due to the worry of it not being done correctly. Support should therefore be offered as standard in flipped classrooms. Several students of all ages commented that they weren't anxious about technology per se, but were sometimes uncomfortable with the issue of cyber security.

2.2.7 Knowledge of technology

Very few students had technology qualifications of any kind. Generally, the students felt they had comparable technology knowledge to others of their age, especially when referring to their friends. 80% of students felt they were more knowledgeable than people older than them. However, Bill suggests that older people are as knowledgeable, but that knowledge acquisition is slower:

> *Bill: I think [older people] also had to adapt to the change in technology in the workforce. But then at the same time, I think they're also a lot slower at kind of understanding in comparison to youth and people my age.*
>
> *Interviewer: So they have the same knowledge, they're just slower getting there?*
>
> *Bill: I think so, yeah. I think they kind of need more patience to understand it because they're not wholly used to the idea.*

When asked to compare themselves to people who were younger, 55% said they had less knowledge than younger people, whilst 36% said they had more. Those who thought they were less knowledgeable gave reasons such as younger people being more surrounded by technology, growing up with it from a young age, and therefore having more of an instinctive way of using it. The 36% who said they were more knowledgeable felt that they had had more experience of technology than younger people, and therefore were more familiar with it.

3. Implications for flipped learning

The mixed methods study explored the differences between mature and non-mature students on a range of attitudinal and usage criteria for technology. The results indicated that mature students use fewer technologies overall than their non-mature counterparts, and they use them less often; however, the technologies that they do use have been used for longer over their lifetime. There was no indicated difference in their confidence and attitude towards the use of technology compared to the younger students. The main differences between mature and non-mature students lie in how they use technology for learning, and not in their attitudes.

The range of technologies used in flipped learning would be problematic for mature students if there was a difference in attitude towards technology (Broady, Chan and Caputi, 2010). Flipped learning puts students in control of their own learning before attending class, with a range of learning activities such as videos, notes, automated tutoring, and quizzes (O'Flaherty and Phillips, 2015; Marshall et al., 2017). Therefore, an important outcome of the current study is the evidence that mature students' attitudes are no different to those of non-mature students. However, each piece of technology must have a point, in order to be useful and therefore enjoyable.

The prevailing theme that arises from the interview data is one of familiarity. Students of all ages are most comfortable with the technologies they are most familiar with. The range of technologies encourages flexibility and learning at one's preferred pace, and therefore is one of the most important aspects of the flipped classroom. This was recognised by interviewees:

> *I think that flexibility is really important. Especially for a lot of students today who are working because they are worried about their debt, then you know, they can't always get there at 2 o'clock, or they've got parents to look after, or they've got, you know, they're ill. (Aylen)*
>
> *One of the main […] benefits of technology and the internet when it comes to kind of like, you know, exploring learning to a more suitable level to yourself. (Bill)*

The fact that so many different types of resources using different types of technologies are available for students before face-to-face sessions means that students can pick and use which resources suit them. Since mature students tend to use fewer technologies, the broad range allows them to choose which technologies they are the most familiar and confident with. Lecturers should be careful not to assume high levels of casual and broad technology use if they are to be inclusive of mature students.

4. Conclusion

It was found that mature students do not have different attitudes to technology, but simply use it differently, in ways that are compatible with the structure of flipped learning. This allows both mature and non-mature students to engage with a variety of technologies in whichever way they prefer for their own self-directed learning, while still providing important face-to-face contact where students can get help with questions about the work. It seems that flipped learning in principle does satisfy the technological learning needs of mature students, and also matches their preference for deep-learning. It may also encourage younger students to develop deeper learning approaches.

Further factors to explore may include the impact of lecturers' attitudes to technology, especially when it comes to choosing or designing resources, or delivering technology-based activities in class. O'Flaherty and Phillips (2015) identify that an appropriate infrastructure for staff should be in place. Jensen, Kummer and Godoy's study (2015) suggests that the mere act of switching to 'active learning' is a major part of flipped learning's success, so this is also something to consider.

Overall, flipped learning offers an age-inclusive learning experience. It is hoped that the emergence of flipped learning in higher education will improve the experience of mature students, and that these findings will be useful to educators who teach groups that may include mature students, and are concerned with the technological demands this may place upon them.

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Masters Research Paper

Users΄ Experience in a Gamified Online Educational Environment

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Abstract: With digital systems being a stable technology and e-gaming being the norm of playing in the new generation, digital learning environments emerge to frame the synthesis of an educational model that supports both Game-Based Learning (GBL) and e-Learning. Among the most promising gaming environments, with high engagement but also ambiguous learning outcomes, are Massive Multiplayer Online Role-Playing Games (MMORPGs). On the other hand, most learning environments with high learning frameworks seem to have low engagement marked with high dropout rates. The main objective of this research is to create a gamified learning strategy that would implement MMORPGs in a learning environment, developing a gamified e-course that is both engaging and educative. The instructional design framework was employed to construct an experiential MMORPG e-course model answering to this problem. This framework was used to design and implement the synchronous MMORPG apt2Valoria to the online learning environment of Moodle. The evaluation results of apt2Valoria e-course indicated that the experiential Live Action Role-Playing Game (LARPG) framework was useful as a design framework, with respective contribution to game experience. There are seven sub-factors measuring game experience: immersive, flow, competence, tension, challenge, positive affect and negative affect. The results showed the sub-factors that lead to positive values had higher mean value than the sub-factors that led to negative value.

Keywords: live action role playing game (LARPG) framework, experiential MMORPG e-course, role playing, gamification, game experience

1. Introduction

The need for continuing education, along with the need for a competitive cost that maintain reliability and high educational values, results in an increased demand for distance learning programs. According to the survey of Allen and Seaman (2013), it is estimated that participation in distance learning programs increased between 2002 and 2011 from 10% to 32% of total enrolment in tertiary education programs in the U.S. However, one of the basic weaknesses of distance learning programs is the high dropout rates compared to the traditional face-to-face (F2F) training programs (Jun, 2005; Rochester & Pradel, 2008). Although the studies conducted to investigate the causes of the dropout effect are limited in number, most of them link the phenomenon of abandonment due to lack of incentives and the low level of satisfaction of the trainees (Croxton, 2014; Jun, 2005; Lorenzo, 2012). Which means that further research is needed in order to develop a motivational strategy that would result in an increased satisfaction of the trainee in a distance learning program.

Game-based learning provides an extended bibliography on motivation theories, engagement and performance, which can be utilized in learning environments to support motivational framework (Norman, 1993). Combining e-games with e-learning forms a learning culture that derives values from the interests and habits of the Digital Natives, as described by Prensky (2001). Educational games in particular, are already used in training in supportive activities, to the workshops but the potential of the Massive Multiplayer Role-Playing Games (MMORPGs) is not fully exploited. This is due to the research gap observed in the scientific field of educational technology, in exploring the design of virtual online learning environments that combine the enhancement of knowledge building with the facilitation of acquiring higher skills (eg. solving a problem), while satisfying the engaging and entertainment criteria.

The main objective of this research is the experiential exploration of the framework of, a substructure of MMORPGs limited from a massive scale to a subscribed group of participants and from virtual to an enhanced reality, digital live role-playing games, intergraded into an e-learning environment, particularly exploring the impact of Live Action Role-Playing Games (LARPGs) on the learner's game experience, so that the "final" e-course is both engaging and educative.

2. Game experience

In recent years, although the gaming experience is a subject of academic research, attempts to conceptually define the term are limited due to the complexity, the subjective dimension and the broad dynamic of the term. Ermi and Mäyrä (2007) define as gaming experience, the players experience obtained by interacting with the gameplay functions and includes the impressions, thoughts, feelings and actions. The aforementioned definition underlines the importance of the elements of the game, the players and the content in the conceptual definition of the term. However, the fact that the gaming experience is associated with subjective factors and takes a variety of forms, makes the process of compiling a list of data for the exact description of the term impossible (Salen & Zimmerman, 2004).

According to Wiemeyer et al. (2016), a player's gaming experience can be considered in three distinct levels:

- The socio-psychological level, in which the psychological factors that determine the individual -personal experience are integrated.
- The level of behaviour, which includes the "external" observable behaviours.
- The level of physiology, which includes the reactions of the human body.

In the present research we approach the concept of gaming experience at a socio-psychological level. In order to experientially investigate the game experience and quantify it, we use the Fun of Gaming (FUGA) model, as developed by Poels et al. (2007) through focus group surveys, expert interviews and questionnaires and based on a seven-stage model determining the experience of the game. The seven components of the game experience (Table 1) are the following: competence, sensory & imaginative immersion, flow, tension/annoyance, challenge, negative affect and positive affect.

Table 1: Game experience questionnaire (GEQ) subfactors with definition (Poels et al., 2007).

Game Experience	
Subfactors	Definition
1. Competence:	The degree to which the player feels strong and capable of participating in the game.
2. Sensory and imaginary immersion:	The degree to which the player uses their imagination.
3. Flow:	The degree to which a player experiences the ideal state of enjoyment, feeling fully absorbed by the game.
4. Tension/annoyance:	The degree to which the player feels intensity.
5. Challenge:	The degree to which the player feels stimulated by making a strong effort.
6. Positive affect:	The degree to which the player feels happy.
7. Negative affect:	The degree to which the player feels fretful.

Note that the attendance dimension is integrated into the immersion component. Additionally, the negative and the positive affect imply negative and positive feelings, respectively.

3. Theoretical background

Based on the GBL theories, the socio-cultural environment along with motivation and positive emotions are of equal importance to the student's cognitive skills. The integration of LARPGs into digital learning environments requires the developing of a conceptual framework, combining elements from both the educational theories and game development (see Figure 1). The conceptual framework expands in three fields, combining theories and strategies. From the social learning theories, the Project Based Learning (ProjBL) model is utilized in order for a task oriented framework to be developed, as it is essential for a game to have specific tasks (Orey, 2012). The educational strategy adopts elements from the social learning theories of Role-Playing and Group Investigation and the cognitive learning theory of Problem Solving, developing a combined complex educational strategy, in order to meet the requirement of an Educational Role-Playing Game. The integration of the three LARPGs structural components, actors, rules and resources (Klabbers, 1999) are implemented under the Project-Based Learning framework (ProjBL). The motivational aspect of the conceptual framework is supported by the ARCS motivation development model (Keller, 1987) in order to enhance learner motivation. Also, elements from the psychological flow model (Csikszentmihalyi, 2009) are used to achieve the ideal psychological flow through the balance between competences and challenges that will lead to engaging.

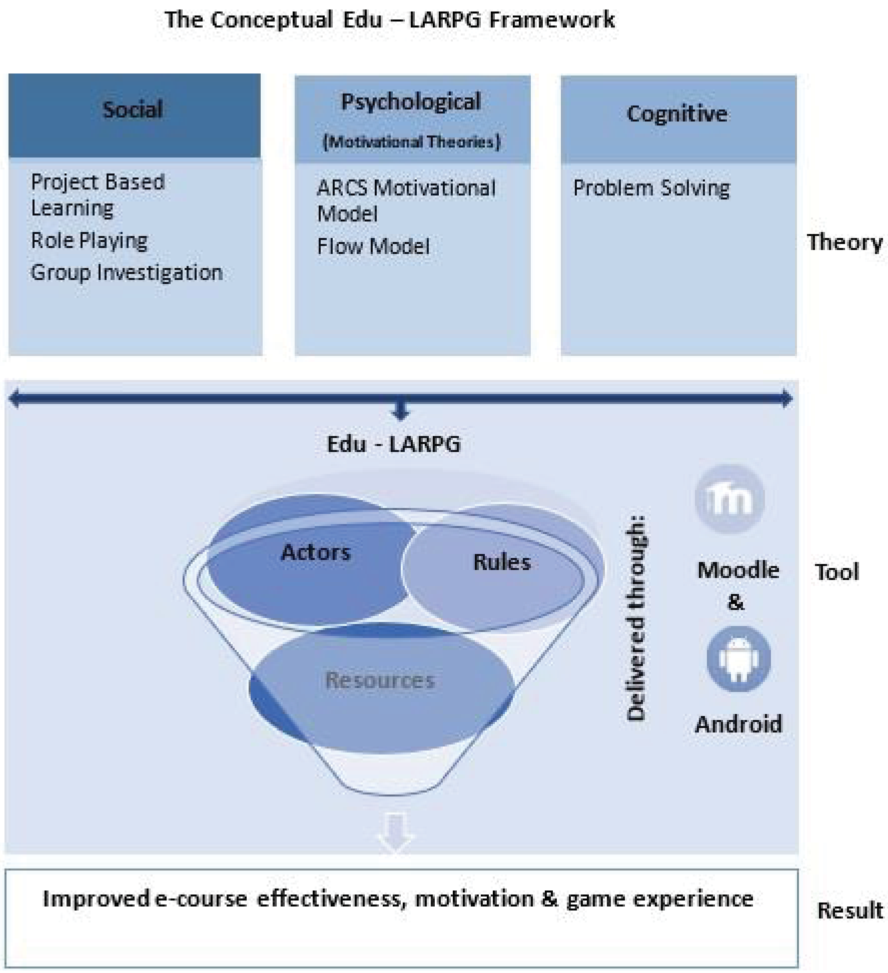

Figure 1: The conceptual framework

The technologies of Information and Communication Technology (ICT) can support the organization of LARPGs by facilitating the flow of information from Game Masters (GMs) and Non-Player Characters (NPCs) to players, and at the same time, improving the quality of information (Tychsen, 2006). The proposed framework for integrating LARPGs into eLearning environments is delivered through LMS Moodle (Cole & Foster, 2007) and the QQuest Android application (Melissourgos & Paraskeva, 2017).

3.1 Complex educational strategy

Due to the lack of an educational strategy that would frame a gamified distance educational process in every step, a complex educational strategy has been developed, combining the strategies of Role-playing (Joyce, Weil & Calhoun, 2014), Group Investigation (Eggen & Kauchak, 2012) and Problem Solving (Eggen & Kauchak, 2012). The synthesis results in an educational strategy that is similar to the structure of an MMORPG, in our case a LARPG, and thus suitable for an educational scenario to embedded within. In the following table, the development of the complex educational strategy is presented containing six phases (Table 2).

Table 2: The six phases of the complex educational strategy created for the utilization of LARPGs

ProjBL Phases	Role Playing	Group Investigation	Problem Solving	Complex Strategy (6) Phases
Planning	Define objectives	Define objectives	Problem understanding	1. Understanding objectives
	Context & roles	Group preparation	Representation	2. Group & roles assignment
Creating	Student preparation	Research	Identify solutions	3. Research solutions

ProjBL Phases	Role Playing	Group Investigation	Problem Solving	Complex Strategy (6) Phases
	Role play	Implementation	Try out a solution	4. Try out a solution (Battle/debate quiz implementation)
Processing	Assessment	Result analysis	Evaluate results	5. Assessment (Battle/debate quiz implementation)
	Concluding, discussion	Feedback	-	6. Review

The composition of the complex educational strategy supports the three dimensions of learning, cognitive, social and emotional (motivational), and includes elements from the field of MMORPGs, most notably role playing (Schell, 2008).

4. Methodology

The assessment of the gaming experience is part of the larger study conducted for the purpose of developing competitive-cost e-learning courses that will be educative and engaging for the trainees. In the educational scenario developed, the macro and micro script were deployed based on the aforementioned complex educational strategy. In this article only the macro-script of the educational scenario is included, as it is essential to the instructional design, that concluded to the game experience results.

The collection of the research data was carried out using the Game Experience Questionnaire (GEQ) (IJsselsteijn, de Kort & Poels, 2013), and the Statistical Package for Social Sciences, version v.22.0, was used for the statistical analysis of the data. The sample of the survey consisted of 80 undergraduate students of the Department of Digital Systems at the University of Piraeus, 60 male and 20 female aged from 20 to 28.

4.1 Macro-script

The macro-script of the educational scenario was developed based on the phases of the complex educational strategy and defines the educational activities, the level of interaction, the Moodle tools required and the duration of each activity (Table 3).

Table 3: Activities developed for each phase of the teaching model

Complex Strategy (6) Phases	Interaction	Activities	Moodle Tools	Duration
1. Understanding objectives	F2F individual	Problem introduction	Label, File	1h
2. Group & roles assignment	Online groups	Work allocation	Book, Group Choice	15′
	Online individual	Context understanding	Quiz, Chat	15′
3. Research solution	Online groups	Search educational theories (e-library research)	Journal, Forum	2h
	Online groups	Link educational theories with ICT activities (mind-map)	Book, File, Assignment	4h
	Online groups	Cross validation of the mind-map (crossword)	Puzzle, Glossary	15′
4. Try out a solution (Battle/debate quiz implementation)	Online groups	Create lesson plan (presentation)	Assignment	4h
	F2F groups	Advocate the lesson plan	Android app. QQuest	1h
	Online groups	Promote the lesson plan (poster)	File	4h
5. Assessment (Battle/debate quiz implementation)	F2F groups	Evaluation	Android app. QQuest	1h
6. Review	Online individual	Self – assessment	Certificate, Feedback	30′

As described in the macro-script, participants are introduced to a fantasy world where the problematic situation is embedded and are assigned to a fantasy role that reflects the roles of conductor, researcher and reporter (Melissourgos & Paraskeva, 2017). After the role assignment, groups are formed, and each group has to investigate the stimulated problem and proceed with a solution. During this process the participants interact with both Non-Playable Characters and Tutors to receive guidelines and other scaffolding material.

4.2 Implementation

The integration of the apt2Valoria LARPG into an online course is implemented on the Moodle version 3.3.2 e-learning platform (see Figure 2). The platform selection was made because Moodle supports features such as, learning management system, learning content management system, authoring tool, evaluation tool, and learning process learning (e-course monitoring system).

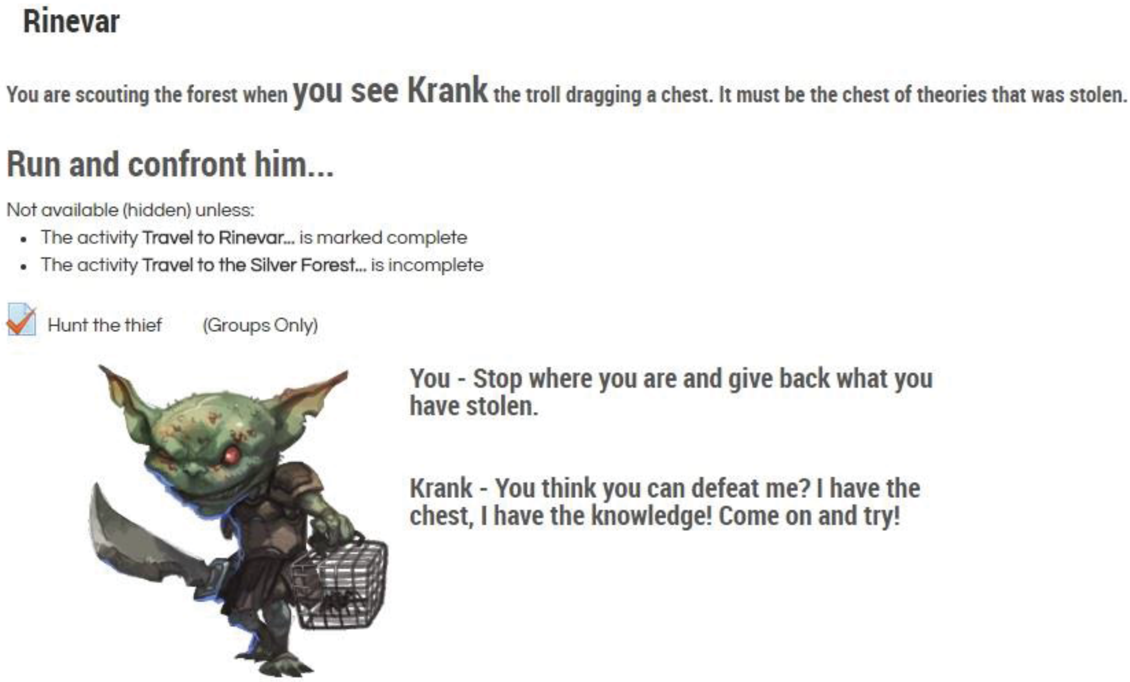

Figure 2: Apt2Valoria e-course user interface (warm-up activity "Confront Krank")

The scaffolding material of the e-course included notes and interactive texts, in the form of hints and tips, conceptual maps and images, in order to promote the problem-solving process and support different learning styles.

5. Results

In order to have a complete picture of the game experience, we categorized the factors of the FUGA model based on the classification of Poels et al. (2007), into two basic categories. Table 4 includes the factors that positively influence the game experience and in the second subclass (Table 5) the factors that negatively affect the gaming experience.

Table 4: Descriptive statistics for each Game Experience Questionnaire (GEQ) positive subfactor with exemplary statements, mean, standard deviation and Cronbach's a

Positive Factors*	Example Statement	N	M (SD)	a
Competence	I felt skilful.	80	2.70 (0.61)	0.74
Immersion	I was interested in the game's story.	80	2.94 (0.70)	0.90
Flow	I was fully occupied with the game.	80	1.68 (0.73)	0.81
Positive affect	I felt happy.	80	3.01 (0.75)	0.91
*Likert 5-point scale ranging from one ("not at all") to five ("extremely").				

From the Alpha Cronbach it is observed that both positive and negative factors show high reliability with a significant correlation between the group. More specifically, significance of the positive affect with competence, immersion and flow is p<0.01 with values r(80)c=0.802, r(80)i=0.861 and r(80)f=0.651 respectively. Negative affect has a significance of p<0.01, r(80)t=0.750 with tension and p<0.02, r(80)ch=0.339 with challenge.

Table 5: Descriptive statistics for each Game Experience Questionnaire (GEQ) negative subfactor with exemplary statements, mean, standard deviation and Cronbach's a

Negative Factors**	Example Statement	N	M (SD)	a
Tension	I felt annoyed.	80	0.61 (0.74)	0.79
Challenge	I thought it was hard.	80	1.43 (0.53)	0.62
Negative affect	It gave me a bad mood.	80	0.94 (0.67)	0.80
**Likert 5-point scale ranging from one (“not at all”) to five (“extremely”).				

According to the research data, factors that positively shape the gaming experience, with the exception of the flow factor, show a high average from 2.70 to 3.01. The positive affect factor shows the highest average value and is evaluated by the questions: I felt content, I thought it was fun, I felt happy, I felt good and I enjoyed it. While players, who reacted negatively on the gaming experience, show a low average of 0.61 to 1.43. The pressure/ irritation factor shows the smallest average and is rated by the questions: I felt annoyed, I felt irritated and I felt frustrated.

6. Conclusion and future work

In this work, a gamified learning strategy implementing MMORPGs in a learning environment was proposed. Moreover, the experiential complex edu-LARPG strategy was used to design and implement an educational and gamified e-course called apt2Valoria. The evaluation results indicate an overall positive game experience, leaving the participants satisfied during the whole process. Taking under consideration the negative effect that some game bugs had on the participants, due to the lack of an Alpha and Beta testing of the game, we may conclude that a gamified learning environment has a positive effect on engagement. In terms of performance, all the educational goals were meet successfully, with grades quite above the average of previous years with a mean of 9 out of 10. In short, we believe that it is possible for a gamified distance educational environment to be engaging and educative at a competitive cost. Limiting factors of this research were the relatively small sample and the duration of the educational program (one academic semester). Those limitations also limited the game elements that were able to be tested in an educational scenario. A broader sample, more courses and a more flexible duration could facilitate the research in more game elements, as well as the effect they could have on the engagement of the student. It is, of course, the duty of the academic community to study the extended framework of all the factors surrounding such an environment, taking into consideration issues of moral, social and emotional integration, suitability in different contexts and the ability of people with disabilities to participate effectively.

Acknowledgments

This research is made in conjunction with several research projects in apt2 research group of the University of Piraeus. We wish to thank all partners in these projects. We also thank all those postgraduate students who took part in the “apt2Valoria” e-course and completed the questionnaires. Last but not least, special thanks to Aspa Pavlidaki for linguistic editing.

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Work in Progress Papers

The Effects of Augmented Reality Representations on Student's' Understanding on Learning Fraction

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Abstract: Representations have been widely used in STEM education due to their effectiveness to transform abstract concepts into concrete ideas. However, the use of representations does not necessarily mean that students could fully comprehend the teaching materials given. Furthermore, according to TIMSS 2015, students in this country showed low level of motivation in leaning math. What they have learned in class tends to be not relevant to their daily lives. Some math teachers reported that majority of students are suffered from learning fraction due to a lack of contextual linkages. We proposed a study that assumes the functionality of augmented reality (AR) may better make such links. With the use of AR that augments graphical representations on concepts of fractions into the real objects, the learning effects could be significantly improved. The proposed AR-represented instructions may help students be able to overlay carefully designed representations of abstract concepts onto real-life images. We planned to create an App that allows students to go through a three-step process to experience a mixed-reality environment on learning fractions. In order to verify our assumption, a quasi-experiment will be conducted with 80 3th-grade students. AR-represented instruction will be embedded in experimental group, while the pictorial instruction will be performed in control group. In summary, this AR-represented instruction aims at tackling with the misconceptions that students are often suffered in learning fractions, by displaying augmented virtual overlays on real objects. Both student's representational fluency as well as their conceptual/procedural understanding of learning contents will be examined.

Keywords: augmented reality, representation, fractions, representational fluency, conceptual and procedural understanding

1. Representations in education

STEM are core subjects in education domain. Researchers have made lots of efforts on these subjects by investigating how to deliver these subjects more efficiently; also, how to cultivate students with better understanding on them. Among various teaching methods, there has been an enormous wave of interest on the relationship between STEM and representations. Representations have been widely used in STEM due to its effectiveness to transform those abstract concepts into more concrete ideas (Arcavi, 2003).

Among STEM, mathematics is the fundamental subject. However, according to TIMSS 2015, students showed low level of motivation in leaning math, for what they have learned in class were not relevant to their daily lives. Nonetheless, within the math fields, the majority of students are suffered from learning fraction due to the difference from whole number concepts and invisible essence in daily lives. Thus, the relationship between mathematical abstract concepts and daily lives is worth more attention.

Representations have been influential in mathematics education, especially fraction. Teachers use these kinds of representations in hopes to represent the intangible abstract concepts with students' experience-related ideas and, with the means of these real-life-like representations, look forward to enhance students' learning motivation and develop their deeper understanding of abstract concepts.

However, it's not spontaneously when students connect representations. Lesh (1981) proposed a model that illustrated the translation among various representations (as Figure 1). He noted that if students were suffered from translating one particular representation to another, then the reverse order instructions could solve the difficulty. In other words, to solve the problems that mathematics symbols are lack of real life relevance, it may be helpful for students to learn in the reverse order, i.e. from real world situation onto symbols.

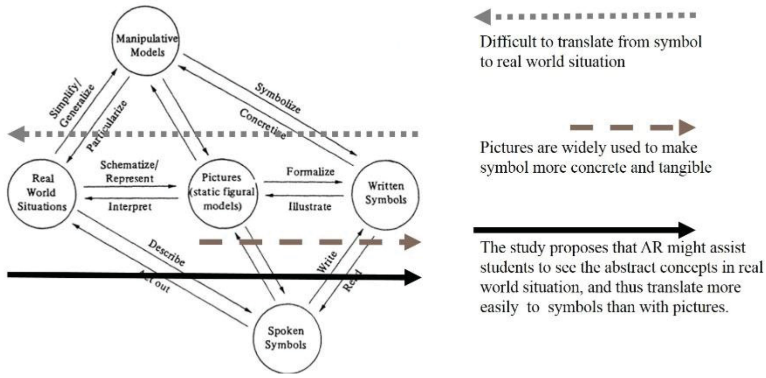


Figure 1: Translation process

Note. Adapted from "Applied mathematical problem solving" by R. Lesh, 1981, Educational Studies in Mathematics, 12(2), 246. Copyright 1981 by Springer.

A number of studies have embedded real-life experiences in instructions, in hopes to stimulating students' real and tangible experiences. Davis (2007) encouraged students to learn with self-invented terminology; however, the research indicated that using students' own representations led to fragile mathematics understanding. Moreover, MacDonald (2013) transformed what students knew into modes of representations by asking them to create their own representations. However, intensive encouragement for students to depict more completely about the target concepts were always required.

In addition to the factors of learners themselves, the environment also contributes to learners' learning effectiveness under the circumstances of learning with representations. Martin and Schwartz (2005) highlighted the benefits of adaptive environment, which brought about advanced learning. As Martin (2009) noted, the external environment and students' internal states "coevolve" with each other. The embodied-interaction design framework, which promoted the alignment of spatial-temporal simulated action, was proposed to enhance mathematics learning efficiently (Abrahamson & Trninic, 2011).

The means of pictures have been used for a long time in mathematics classroom. However, pictures can hardly convey any further information except the static and meaningless appearances. Thus, this study hypothesizes that it may be beneficial for students to perceive the abstract concepts in real-life situation directly, and then be able to translate from real-life situation to symbol more easily than from pictures, with the aid of advanced technology, Augmented Reality (AR).

2. The effectiveness of AR in mathematics education

With the advance of emerging technology, representations are more likely to break through the constraints of traditional devices, presenting in novel forms and ways. Billinghurst (2002) indicated benefits that AR brings along, one of which is that AR support seamless interaction between real and virtual environments. With the aid of AR, students are able to perceive even more and various kinds of representations which are not possible to realize before (Sarama & Clements, 2009). The effectiveness of AR in developing mathematics abilities was also proved from psychological perspectives, i.e. physical, cognitive, and contextual aspects (Bujak, Radu, Catrambone, Macintyre, Zheng, & Golubski, 2013)

Several applications in math are discussed below. For instance, Kaufmann and Schmalstieg (2003) improved students' spatial abilities in geometry with AR. Conics goes well with AR in promoting the opportunity to interact with abstract concepts that was unlikely to take place with traditional paper-and-pencil instructions (Salinas & Pulido, 2017). AR are also proved to complement learning in quadratic equations (Barraza Castillo, Cruz Sánchez., & Vergara Villegas, 2015).

As for the elementary education, Radu, McCarthy and Kao (2016) collaborated with elementary school teachers and AR designers to explore the educational potential of AR technology. In their study, the suitability of several math topics with AR was examined. The criteria of matching are (1) visualizing the mathematical content in three dimensions; (2) visualizing the content through multiple representations at the same time; (3) physically interacting with mathematical topics, and (4) having in-context access to additional information. Results showed that Fractions and Number Lines was only match with AR in medium degree, while the teaching difficulty was high. According to the authors, it seems the pedagogical design flaws leads to ineffectiveness.

The study aims to examine students' conceptual and procedural understanding difference between AR representation and picture representation, and verify the influence of students' prior knowledge and representational fluency when learning with different instructions.

3. AR-Represented instructions design

The pedagogical sequences of concrete-picture-abstract are proved to enhance students' mathematics learning outcomes effectively (Leong, Ho, & Cheng, 2015). Among the transition of these three kinds of representations, McNeil & Fyfe (2015) indicated that fading mechanism is beneficial for learning. In general, decreasing students' attention to the external representation is favourable for students to connect the external representations with the internal ones (Uttal et al. 2009). The linking mechanism is shown in Figure 2.

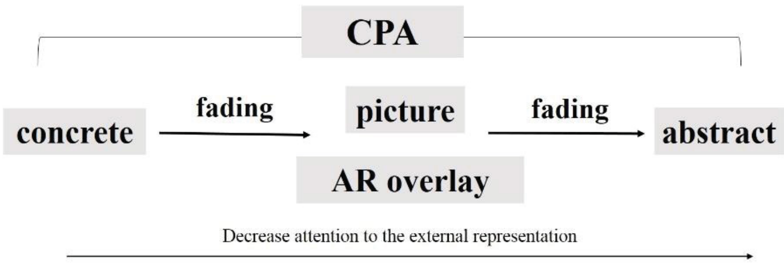


Figure 2: The linking mechanism of AR-Represented instructions

To validate the assumption that real-life AR-representations are more beneficial than pictures, the study will design an instrument called "AR-Represented Instructions". Following are the stepwise concepts of AR-Represented Instructions, shown in Figure 3. 1) with a camera-equipped mobile device, students will be asked to capture designate target object, virtual lines will be augmented onto the boundary of real target once it is scanned; 2) animated lines will be dubbed onto the scanned target to demonstrate the process of sharing equally; 3) boundary lines and equally-sharing lines in 1st and 2nd steps will be both displayed, and enclosed proportion will be coloured.

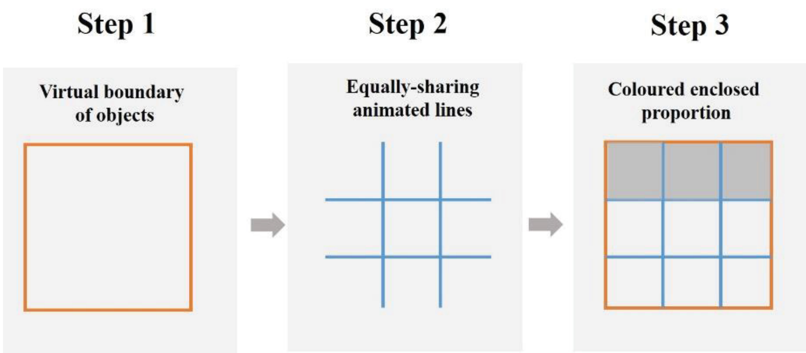


Figure 3: The stepwise concepts of AR-Represented instructions

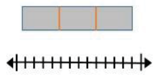
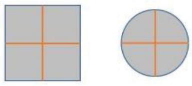
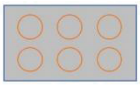
4. Methodology

In order to align the AR-Represented Instructions with the existing curriculum guidelines, the participants in this study will be 80 third-grade students. These students, aged between 8 and 9 year-old, are new to fraction concept, as elementary educational guidelines proposed by Ministry of Educations. The study will develop AR-Represented Instructions with Unity, and four instruments are to measure students' achievements, including conceptual knowledge test, procedural knowledge test, representational fluency, and Interview questions.

The conceptual knowledge test and the procedural knowledge test are adapted from Rau, Aleven, & Rummel (2017a). These tests will be conducted in paper-and-pencil format. The former test includes eight items that assessed students' principled understanding of fractions. On the other hand, the procedural knowledge test includes nine items that assessed students' ability to solve questions by applying algorithms. The tests have good reliability with Cronbach's α of .70. and .77. Furthermore, the representational fluency test is adapted from Rau, et al. (2017b). A 4-item test form for the equivalence unit, and a 4-item test forms for the comparison unit. The test will conduct on tablets, with software developed by the research. Students' log files will be analysed, including completion time and error rate.

Through the instructions, by learning fraction concepts with the corresponding objects (as shown in table 1), students are expected to understanding three core concepts of fractions (part-whole, equalization, unit); understand fractions in three different categories (1D continuous quantity, 2D continuous quantity, discreteness); and utilize proper fractions to solve real-life problems.

Table 1: Fraction concepts and corresponding objects

Category	Unit	Objects
1D continuous		
2D continuous		
Discreteness		

The experimental process last 80 minutes, including a pre-test, learning activities, and a post-test, as shown in table 2. In pre-test, students take three tests: conceptual knowledge test, procedural knowledge test, and representational fluency test. During the main activities, experimental groups are instructed to accomplish 9 tasks with AR-Represented Instruction, while the control groups are taught with pictures. After the instructions, students will take the conceptual and procedural knowledge tests, which are parallel to their pre-tests. Interviews will be conducted after experiments with 5 random-chosen students from experimental and control group, respectively.

Table 2: Experimental process

		Control Group	Experimental Group
Pre-test 20 min		1. Conceptual knowledge test 2. Procedural knowledge test 3. Representational fluency	
Activity 50 min	Warm up 5 min	Activity Introduction	
	Activity 40 min	**9 tasks with pictures**	**9 tasks with AR-Represented Instruction**
	Wrap up 5 min	Reflection	
Post-test 10 min		1. Conceptual knowledge test 2. Procedural knowledge test	
Interview 25 min		5 random-chosen students from each group	

The AR-Represented Instructions will be conducted under the scenario of "Make your own pizza" activity. Three worksheets will be distributed to each group. Learners are required to use camera-equipped mobile device to scan the target objects. For instance, the manipulation procedurals on cheese are shown in figure 4. Moreover, as Rau et al. (2012) suggested that the interleaving order would be much more beneficial than blocking multiple representations, the tasks are arranged in interleaving order of different fraction models within single section, as shown in figure 5.

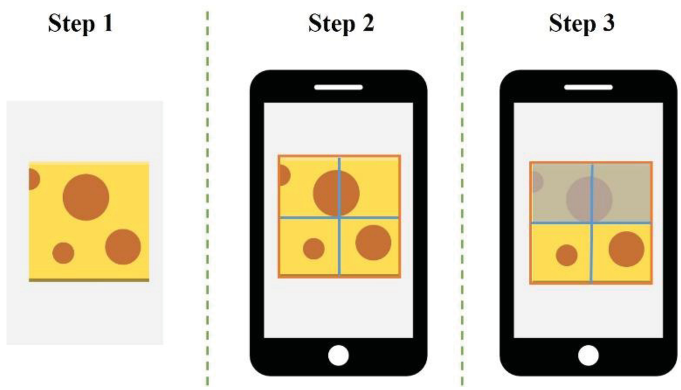


Figure 4: The arrangement of the fraction concepts

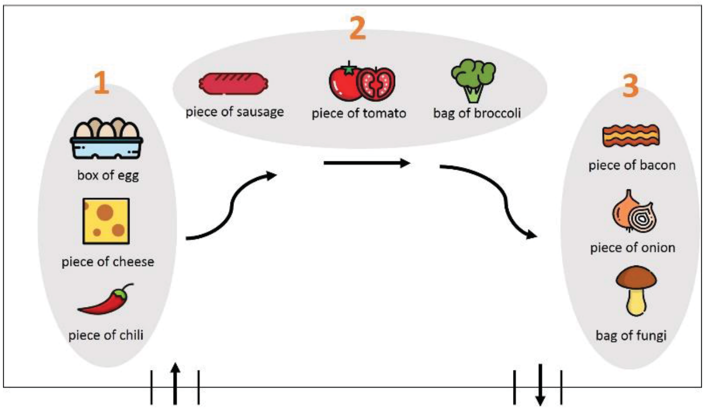


Figure 5: The arrangement of the fraction concepts

5. Potential contributions of the work

The study aims at strengthening representations by equipping them with further information than pictures, and complementing the faint connection between abstract concepts and its' usefulness in fractions. The potential contributions of the study are proposed from two perspectives. From the instructional design perspective, the majority of AR instructional design literature focus on the concepts of 3-Dimension of geometry. The study will provide suggestions of designing representations, and the emphasis will place on the complementary effectiveness of the virtual information when students are interacting with manipulative in reality. From the psychological viewpoints, the study is intended to enhance the perceived usefulness of abstract concepts, with the attempt to design those intangible concepts truly involved and perceived in real world situations. By developing students' sense of numeracy not only from textbook, but real life situations, the study looks forward to encouraging students make use of mathematics concepts in daily lives more often once they realize how commonly of the mathematics concepts intertwined with their lives.

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Gamifying the University Library: Using RPG Maker to Re-Design Library Induction and Online Services

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Abstract: Changing paradigms of what is expected of a modern University library, has adapted to reflect the needs and current working practices of its students and lecturers. Significant thought, time and money has been invested into redesigning and rebuilding University library architecture and its inner working spaces to compliment a progressive step towards more social and group learning opportunities (Cunningham & Tabur, 2012). Whilst our understanding of space in a library setting is rapidly shifting, there must also be an equal effort to ensure that learning activities, resources, content and services that are on offer, also reflects this change. Particular emphasis should be placed in ensuring that those who cannot attend or have little opportunity to visit the library space, such as distance and/or online learners, have access to relevant & interesting methods in which they can also access and feel part of the learning community the University library provides. This paper presents a work in progress report of the theoretical approach and design process of a Library Induction game created with RPG Maker. RPG maker, a games engine for creating simple pixel art, top down 2D games, was chosen for its ability to rapidly prototype a game and to create art in engine that could accurately represent the chosen physical spaces.

Keywords: gamification, library induction, online learning, higher education, RPG maker

1. Background

Librarians across Higher Education share many of the same concerns regarding library inductions, and often encounter low levels of participation. One of the biggest challenges is finding ways to make fairly dry subject matter more interesting. Suggestions to better engage students include the use of pop culture themes (Langman & Dennis, 2012), challenges based throughout the library rather than in a classroom (Boss, Angell & Tewell, 2015) and student-driven models such as the 'Cephalonian Method' (Morgan & Davies, 2004). Another consideration is the appropriate timing of delivery, as traditional inductions typically take place very soon after students have arrived at university. This is generally before students have been set their first assignment and have understood the relevance of information literacy to their studies, and during a 'period of transition' to university where they may have greater social or physiological priorities (Barton, 2017). The tone of library inductions is also a concern. Walker (2017) argues that they should be 'inspirational rather than a list of rules and regulations,' and that key messages should include the welcome and support offered by staff. A further challenge is the pressure on staff time to deliver inductions to all new students, typically during a very concentrated period in the first few weeks of term (Martin, 2012; Towlson 2012).

Game-based learning refers to the borrowing of gaming principles and applying them to non-entertainment purposes to engage users in fields such as, but not limited to education, business and health. (Trybus 2015). Game-based learning has been adapted to immerse and motivate users (Garris, Ahlers and Driskell, 2002; Rooney, 2012; Arnab et al, 2013) and evidence has shown that this approach to learning and behaviour change yields positive outcomes in the intended users (Connolly et al, 2012; Graafland et al, 2012). Due to the success of game-based learning in other areas of education, it is not unsurprising that it has been adopted in a number of areas of higher education, including that of library-based education and services. A number of University libraries have adopted a range of playful and gameful learning activities including scavenger hunts (Pagowsky, 2013), Literacy games (Markey et al, 2010) and escape room activities (Walsh, 2016; Clarke et al., 2017) to creatively engage and promote a range of services to University staff and student members.

Coventry University Library, UK, is unique in that it has an innovative policy to ensuring students and staff experience creative and interactive experiences when it comes to library services and workshops. In September 2017, Coventry University Library introduced a new approach to induction and hosted a series of events including animal visits, a silent disco, afternoon tea, and a Mario Kart tournament. The intention was to encourage students to engage with the Library and its staff. Students were engaged with this approach, but it was evident that there was still a need to provide essential introductory information, ideally at point of need. In addition to these events, the Business Academic Liaison Librarians deliver a Continuing Professional Development module which contains embedded learning content. This module is taken by all undergraduates within the School of Strategy and Leadership and requires students to earn a number of 'CPD points'. They may choose to attend a wide variety of workshops, including a range of six delivered by the Library. The one-hour 'Library Basics' session, essentially a library induction, is repeated thirty times per year, representing a significant investment of time.

Based on this body of supporting evidence, and in line with current innovative practice that is currently being adopted at Coventry University Library, the authors decided to investigate the development of an educational game system using the game development platform: RPG Maker. RPG Maker was chosen for its simplicity of use, visual style, and its nod to older games Role-Playing Games (RPG's) that had strong narratives which are used to drive player engagement. Other practical considerations of developing a game-based learning approach to induction, courses and its online materials was that it could provide an engaging alternative to the 'traditional' chalk and talk induction, it could be made available anytime and anywhere to support online users and that it could reduce the time spent on face to face teaching on basic support and information concerning services. The authors propose to trial the Library Induction game in September 2018 with the new cohort of Undergraduate students starting at the university. The next section outlines the ongoing design and development of the game.

2. Design

The overall design approach taken to developing the game has been guided by the Trans-Disciplinary Model for Serious Games Design (Arnab & Clarke, 2015), chosen for its methodology in developing a multi-disciplinary working approach to the design process.

RPG Maker was selected as the game development tool to create a game-based learning approach, for its simplicity and access to pre-generated art assets. This was an essential component for saving time and being able to construct quickly, a game environment as seen in Figure 1. that visually represented the Coventry University Library space.

Figure 1: Lanchester library game environment: A reading floor within the library

As orientation was a core consideration in the development of the games learning objectives, particularly for developing student awareness of the subject librarian office and where to go to access different support and resources, the environment was developed carefully to replicate as accurately as possible, the space around and within the Library. Figure 2. Shows the Librarians office laid out in a game environment that replicates real-life.

Figure 2: Lanchester library game environment: Subject librarian office

Once the game environment was built, the learning objectives of the game were constructed based on the needs and requirements of the subject librarians. Tasks relating to induction, workshops and online services were drawn up into a table and set out against the task category, learning outcome and game-based objective (See Table 1.).

Table 1: Learning objectives and game objectives planning.

Category	Learning Outcome	Game Objective
Orientation	IT Services	Mini task - finding it
Orientation	Sigma	Mini task - finding it
Orientation	CAW	Mini task - finding it
Orientation	Group Study Rooms (that they exist)	Mini task - finding it
Orientation	Rovers Podium	Mini task - finding it & source of help
Orientation	2nd Floor Enquiry Desk	Mini task - finding it & source of help
Orientation	Subject Librarian Office	Locating it, then more additional tasks
Orientation	Mobile Shelving	Include it if we can make it some sort of puzzle (move the shelving to get to another location/NPC)
Online Orientation	Library Basics Libguide	Code on Libguide
Online Orientation	Libguides	Code somewhere on a guide
Online Orientation	Twitter page	Codes hidden on pages
Online Orientation	Facebook page	Codes hidden on pages
Online Orientation	YouTube Channel	Codes hidden on pages
Online Orientation	Document Supply	
Online Orientation	YouChose	Place request for specific dummy book, reply with code.
Online Orientation	Referencing Guide	Code on Libguide
Library Skills	Construct a reference in CU Harvard	Making the reference provides a code (e.g. first letter of each part)
Library Skills	Find a book in the library	Finding a book in the game's bookcases
Library Skills	Find an eBook	Dummy eBook on Locate - code within book - also covers navigating an eBook
Library Skills	Find an article on Locate	Dummy article record on Locate
Library Skills	Reserve a book	Reserve a dummy book within the game, collect it later.
Knowledge	Loan limit is 20 items	Character giving quiz

Category	Learning Outcome	Game Objective
Knowledge	Books can be borrowed for one or three weeks	Character giving quiz
Knowledge	Fines	Character giving quiz
Orientation	Self-issue machines	Game/puzzle using the machines
Online Orientation	Accessing databases	Dummy dragon -slaying Libguide
Knowledge	Support offered by subject librarians	Interaction with in-game characters
Knowledge	Support offered at service desk and enquiry desk	Interaction with in-game characters (If you get stuck in the game you can always go to the enquiry desk)
Knowledge	Support offered by Rovers	Interaction with in-game characters (If you get stuck in the game you can always find a Rover)

This follows on the recommendation of Arnab & Clarke's (2015) model and the development approach to game-based learning design using the LO-GO (Learning Objective to Game Objective) mapping approach by Clarke et al., (2016) to ensure that players achieve learning outcomes through accomplishing in game tasks otherwise known as game objectives. In game completion of the set-out tasks found in Table 1, followed by additional checks utilising repetition of information, will be used to help build up knowledge retention on the individual tasks as set by the subject librarians.

Another core drive to ensure that students would remain engaged with the game, has been the development of a strong narrative in which to deliver the learning objectives. Based around the narrative-led game elements traditionally found in RPG games, it was important for the developers to bring this to life in the Library game. It was proposed early on in the pre-production phase, that the game shouldn't come across too seriously and instead, should deliver a humorous experience in an effort to make it as accessible as possible, especially to those students who may not be gamers. Based on a familiar storyline of 'rogue technology' (Portal, Space Odyssey 2001), the developers sought to use this narrative structure to familiarise students with Coventry Universities Online Database service; Locate. Structuring Locate as the game 'enemy', has allowed the developers to develop learning objective tasks that send the player out into services such as Locate, outside of the game. This allows for a multi-media style approach in which, players can explore many different aspects of the library (online services, real-world locations).

3. Conclusions

The authors have used this paper to present an overview of the learning and game design methodology adopted utilising the Trans-Disciplinary Model (Arnab & Clarke, 2015) and the LO-GO approach (Clarke et al., 2016) for serious games design. The concept design, learning objective design and the development process have been briefly described, to present an early-stage account of game development to other interested facilitators, practical developers, librarians and academics who are interested in developing a library-based game in RPG Maker. The authors are continuing to develop the game and plan to iteratively work with student feedback and data gathered in the upcoming trials in September 2018, to ensure the game reflects the needs of the target end users.

4. Future works

Work is ongoing to develop the game ready to go live with the first intake of undergraduate students in September 2018. The authors plan a mixed methods research study alongside the trial of the game to determine efficacy of this game-based learning approach to developing knowledge and familiarity around library services.

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Impact of Analyzing Open Online Educational Video on University Students' Academic Performance

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Abstract. The Purpose of this paper is twofold: First, it provides an analysis of the constructivist philosophy and pedagogical insight of inquiry-based learning that stand behind the integration of open online educational video lectures into a general core curriculum course. The targeted course measures the extent to which university students have developed the institutional learning outcomes and competencies that enable them to be employable in a competitive labor market; second, the paper reports on a quantitative case study conducted at Prince Mohammad Bin Fahd University (PMU) to measure the extent to which engaging students in analyzing online educational video lectures impact their development of employability competencies among which are communication, critical thinking and problem solving . The study used a 15 - item-questionnaire administered to 45 students enrolled in a Learning Outcomes Assessment Capstone Core Curriculum Course at the case institution. The Statistical Package of Social Sciences (SPSS) has been used to analyze the collected data from the survey. The findings of the study indicate that well selected online educational video lectures advance students' communication on the discourse level, critical thinking, deep learning, and future employability.

Keywords: online educational video, core curriculum, employability competencies

1. Introduction

1.1 Background

This study was implemented at PMU, a private higher education institution in the Eastern Province of the Kingdom of Saudi Arabia. Participants were junior male and female students enrolled in the Learning Outcomes Assessment II core course which all students, regardless of their majors, have to take. The study outlined the instructional problem and how open online video lectures addressed the instructional needs of the Assessment course. As the instructor of this course, I find it very hard to get students read textbooks and those who are willing to do so, they struggle to understand theoretical concepts on their own. I addressed this instructional problem by embedding open online video lectures into the curriculum of the course under inquiry. The teaching – learning environment of the case institution is grounded on a learner-centered constructivist paradigm which centralizes learning-by doing, inquiry based learning, and performance based learning and assessment. Towards this goal, I embedded open online video lectures into the syllabus of the course under inquiry based on the findings of the following literature review.

2. Review of the literature

The integration of open-online video lectures into the curriculum of higher education across world countries has been evolving as a discourse and initiative in the literature over the last ten to fifteen years or so due to the availability of free online videos from well reputed websites such as EdX, Youtube, TED, Video-lectures, and Coursera. A large body of research has emerged to address and assess this area. The purpose of the following review is two-fold: First, it critically analyzes research on the usefulness of using open online video lectures on student academic success. Second, it identifies factors that impact the effective integration of open online video lectures.

2.1 Research on the usefulness of open online video lectures

The research has largely been in agreement about the learning benefits of online video lectures (Brecht, D. and Suzanne M., 2008; Brecht, D. and Ogilby, S., 2008; Arguel, A. and Jamet, E., 2009; Brecht, D., 2012; Blomberg, et al., 2013). In 2008, Brecht and Suzanne empirically examined the instructional impact of online video lectures on student learning using a statistical analysis of the perspectives of 130 students. They found that online video lectures assist students in solving complex problems related to course content. 68.5% of the participants indicated that online video lectures assisted them in understanding course materials. Also, 72.2% of the sample (132 college students) pointed out that online video lectures helped them with their homework.

2.2 Problem statement

There has been a growing interest in integrating open-online video lectures in higher education curriculum. Yet the available literature lacks empirical evidence of the impact of online video lectures on students' development of employability competencies, especially in developing countries. Over and above, rarely is there any mention with respect to the usage of such technological initiatives in the context of Saudi Arabia. The aim of this research is to address this gap in the literature.

3. Purpose and assumptions of the study

The purpose of this study is to provide empirical evidence through measuring participants' perceptions of the impact of analyzing open online video lectures on university students' academic performance and development of the employability competencies. Based on the reviewed literature, three assumptions are developed to lead the research process: (1) engaging students in analyzing open online video lectures related to course objectives improves student learning, (2) easing the analysis of open online video lectures impacts students' acceptance of this type of technology integration, and (3) engaging university students in analyzing open online video lectures improves their development of employability competencies. Given the identified gap in the literature, the following questions have been developed to guide the inquiry process, mainly:

- To what extent does analyzing open online video lectures increase students' development of employability competencies?
- To what extent does the usage of open online video lectures advance students' academic performance compared to traditional face-to-face teaching?
- How often do university students use open online video lectures for doing course assignments and exam preparation?

4. Context of the study

The course under study is part of the core curriculum program at the PMU. The core curriculum program is a set of courses in humanities, social sciences, economics, geography, world civilizations, natural sciences, mathematics and learning outcomes assessment. Students, regardless of their majors, have to take between 46 and 50 credit hours of these courses according to their major. The course under study is Learning Outcomes Assessment II which measures students' development of six employability competencies: communication, critical thinking and problem solving, technology, teamwork and leadership, and professional development. One of the assignments of the course measures students' ability to critically analyze three open online video lectures on the concepts of self-assessment.

5. Theoretical underpinning

This study is premised on a constructivist view of learning where students socio-culturally construct funds of knowledge through active, engaging, reflective, and collaborative process of meaning making. The design of the learning outcomes course centralizes the integration of well-selected open online instructional videos. This design is based on the principles of a constructivist-oriented flipped classroom model where there is no traditional lecture. Students are guided to manage the class through goal-based discussion, presentations and group works.

6. Research design

6.1 Participants

With the theoretical assumptions of the research in mind, a case study survey was distributed to 45 junior male and female students enrolled in the Learning Outcomes Assessment II course. The choice of the sample was purposeful because analyzing open online video lectures that address the course concepts was a major assignment.

6.2 Research methods

Based on the literature review, a case study perception survey consisting of 15, 5-point Likert Scale items has been developed. The main purpose of the survey was to provide an understanding of the extent to which open online video lectures increases student development of employability competencies and academic performance as measured by students' perceptions.

6.3 Data collection

The first five perception survey items measure participants' perceptions of the impact of analyzing open online video lectures on student developing of employability competencies. The second section of the survey includes another five items that measure the extent to which the usage of open online video lectures advances students' academic performance. The last five survey items measure students' attitudes towards their acceptance of using open online video lectures.

6.4 Data analysis

The survey was administered in class to all the 45 male and female students enrolled in three sections of the Learning Outcomes Assessment II course. All the students took the survey. The reliability of the survey has been established through Cronbach's alpha (α). According to Sweet. S. and Grace-Marin, K. (2012), the Alpha score of .70 or higher on a survey of four or more items is deemed to be good. In this research, Cronbach yielded Alpha at .826, indicating a strong scale reliability. The responses of the survey were subjected to the Statistical Package of Social Sciences (SPSS) to calculate the mean of participants' perspectives of using open online video lectures in a flipped learning environment.

7. Results and discussion

Data analysis is performed in relation to the main research variables. Research question one, "To what extent does analyzing open online video lectures increase students' development of employability competencies?", measured students' perception of the extent to which the usage of open online video lectures increases students' development of employability competencies. Analysis of the five items related to this variable indicated that the 87. 26% of the respondents consider the usage of open online video lectures to have a positive impact on their development of employability competencies, especially the communication skill (M = 4.4667). Table 1 shows that the majority of the responses were directed towards level 4 and 5 (To a high extent and to a very high extent) with an overall mean at 4. 4667 and an overall standard deviation (SD) 0.5205.

Table 1: RQ1

RQ1 - To what extent does analyzing Open Online Video Lectures increase students' development of employability competencies?													
Variables	Students number	Not at all		To a very little extent		To a little extent		To a high extent		To a very high extent		Mean	Std. Dev.
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%		
1-To what extent does analyzing Open On line video lectures improve your communication skills?	45							24	53	21	47	4.467	0.504
2-To what extent does analyzing Open On line video lectures improve your critical thinking skills?	45					2	4	24	53	19	42	4.37	0.57
3-To what extent does analyzing Open On line video lectures improve your technological skills?	45							26	58	19	42	4.4	0.49
4-To what extent does analyzing Open On line video lectures improve your teamwork skills?	45							28	62	17	38	4.38	0.5
5-To what extent does analyzing Open On line video lectures improve your leadership skills?	45					2	4	28	62	15	33	4.2	0.54
				Grand mean & std. Dev.								4.363	0.521

Research question two, "To what extent does the usage of open online video lectures advance students' academic performance compared to traditional face-to-face teaching?", measured students' attitudes toward the usage of open online video lectures as learning tools compared to traditional face–to-face instructional model. Table two shows that the descriptive statistics of the five items of this variable indicate that analyzing open online video lectures improves students' academic performance signaling an overall mean at 4.28 and a SD at 0.49.

Table 2: RQ2

RQ2 - To what extent does the useage of Open On line Educational videoes as a means of learning advance students academic performance compared to traditional face to face teaching?

Variables	Students number	Not at all		To a very little		To a little		To a high extent		To a very high		Mean	Std. Dev.
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%		
6-To what extent does analyzing Open Online video lectures enhance your understanding of the learning materials?	45							35	78	10	22	4.2	0.42
7-To what extent does analyzing Open Online video lectures enhance your individualized larning?	45					1	2	34	76	10	22	4.2	0.45
8-To what extent does analyzing Open Online video lectures improve your reflective learning?	45					1	2	30	67	14	31	4.3	0.5
9-To what extent does analyzing Open Online video lectures facilitate your revision of course content?	45					1	2	30	67	14	31	4.3	0.51
10-To what extent does analyzing Open Online video lectures assist you in completing course assignments?	45					2	4	25	56	18	40	4.4	0.57
								e of mean & std. Dev.				4.28	0.49

Research question three, "How often do university students use open online video lectures for doing course assignments and exams preparation?" measured students frequent usage of open online video lectures for learning purposes. Table three points out the descriptive statistics of the five items of this variable showing that 87.6 % of respondents frequently use on line video lectures for various purposes. The overall average mean is at 4.38 with a SD at 0.534. Students' frequent usage of the open online video lectures is an indication of their acceptance of this online learning method.

Overall, the analysis of the three main variables indicates that there is a statistically significant positive impact of using open online video lectures on students' development of employability competencies and skills. It is also evident that students' acceptance of this method of learning impacts their behavioral attitude towards its frequent usage.

8. Concluding remarks

In this flipped course, students' analysis of relevant open online video lectures allowed them to be more engaged in class discussion. Flipping the Assessment course allowed students to do their homework at the university while the traditional lecture-oriented classroom work is done at home. Class time, as such, is devoted for deep reflective problem-based leaning. This study proved that a scaffolded flipped learning environment stimulates students to come to class ready for discussion and solving problems.

Table 3: RQ3

RQ3 -How often do university students use open online video lectures for doing course assignments and exam preparation?													
Variables	Participant	Never		Rarely		Sometim		Often		Always		Mean	Std. Dev.
	Students number	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%		
11-How often do you use On line Education videoes for understanding course concepts?	45					3	7	22	49	20	44	4.4	0.61
12-How often do you use On line Education videoes for doing course assignments?	45					1	2	20	44	24	53	4.5	0.54
13-How often do you use On line Education videoes for mid and final exams presentations?	45					1	2	30	67	14	31	4.2	0.5
14-How often do you use On line Education videoes before classroom lectuures?	45					1	2	32	71	12	27	4.3	0.48
15-How often do you use On line Education videoes after classroom lectuures?	45					1	2	21	47	23	51	4.5	0.54
								and mean & std. Dev.				4.38	0.534

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Promotion of Healthy Lifestyle in Social Media: Potential Effects and Reality

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Abstract: Using of social media for e-learning in the area healthy lifestyle looks like a very attractive and fresh idea. Social media is widely used by professional trainers and teachers, who are ready to explain and to show basic practices of healthy lifestyle. Besides, social media is very popular among youth. The Internet is not so popular in Russia as it is in the US and Europe. But the recent researches show, that even in our country 90-95% of young people use social media every day. So, it looks like potentially social media can be described as a ready-made tool for e-learning in healthy lifestyle. There is no doubt, that it can be used by teachers and trainers for spreading of information about practices of healthy lifestyle among young people. And there is also no doubt, that such information can be seen by many young users of social media. But do these facts make social media an effective instrument of popularization of healthy lifestyle among users? This question concerns complicated nature of social media. Using the combination of theory of self-referential systems of N. Luman and the dramaturgical analysis of E. Goffman, we can describe social media as an autonomous and self-sufficient system of social interaction, which allows any person to create his own strategy of communication to respond to the requirements of the social system. So, on the one hand, spreading of information about practices of healthy way of life creates special requirements for promotion of a healthy lifestyle, which cannot be simply ignored by ordinary users. However, on the other hand, there is no guarantee, that such requirements stimulate real popularization of healthy lifestyle among users. Users create their own way of communication and they always can respond for these requirements only by fabrication of a healthy lifestyle, not by implementation of real activities. In this paper we present a sociological project, aimed for evaluation of potential effectiveness of using of social media as a tool of e-learning in the area of healthy way of life. The main purpose of our project is to identify possible patterns of popularization of healthy lifestyle in the context of youth interaction in such social media as Facebook; Instagram; YouTube. Our hypothesis is that potentially social media can be used for popularization of healthy lifestyle among young people, but the effect of this popularization is compensated by the presence of a large number of users who only fabricate their healthy lifestyle in social media and do not implement any relevant activities in reality.

Keywords: social media, internet, healthy lifestyle, youth

1. Introduction

Sociological researches in the area of modern social transformations still need the formulation of accurate and acknowledged principles of understanding possibilities of using of social media for e-learning in the area of healthy lifestyle. It is obvious, that potentially social media can be used for such purpose. Social media can be used by professional trainers and teachers for distribution of information about healthcare, sport-activities and many other relevant topics. Besides, recent researches demonstrate, that contemporary social science has already noticed the possibility of using of social media for solution of different tasks of healthcare policy. For exampmple, we can mention here the projects implemented by the team of Don S. Dizon (Dizon et al, 2012), team of Francisco Jose Grajales III (Grajales et al, 2014) and many other scientists, who tried to explain the effects of using of social media for solution of different tasks in the area of healthcare. But nevertheless, the effectiveness of using social media as an instrument of popularization of healthy lifestyle still needs clarification. Of course, social media help to spread information about healthy way of life. But is it enough to say, that social media can be described as an effective instrument of popularization of such way of life among users?

2. Social media

Social theory provides an ambiguous explanation of this question. Social media has a very complicated nature. That is why understanding of effects of social media needs combination of different approaches. We suppose, that the analysis of influence of social media on popularization of healthy lifestyle among young people can be built on the interparadigmatic conceptual basis, combining the theory of self-referential systems of N. Luhman (Luhman, 1995) and the dramaturgical analysis of E. Goffman (Goffman, 1956)

Using the theory of N. Luhman, we can describe social media as an integrated communicative system - self-sufficient and self-reproducing environment of communication of individuals, determining both the purpose and the nature of their social interaction. According to the approach of N. Luhman, we can also conclude, that such system tends to be isolated, non-hierarchical and decentralized. Within the boundaries of isolated social media, the primary role is assigned to communication flows, because the frequency and dynamics of the messaging between users determine the structure, the internal logic and the specific of activity of the system. The lack of centralization and a single code contributes to the consolidation of horizontal links in virtual area of social media. The lack of a strong hierarchy in social media allows users to implement various model of communication ("many-to-many", "one-to-one" or "one-to-many") and allows each user to create and distribute personalized content, interact with other users directly and in real time. Using the E. Goffman's ideas, we can also conclude, that particular users of social media always can act as an independent subject and can build their own communication strategy depending on the circumstances and focusing on the expectations of significant people for them. So, the combination of these theoretical traditions allows to analyze social media as an autonomous and self-sufficient social interaction environment, which allows any individual to build his own communication strategy in such a way as to respond to the "scenario" requirements of the social system. In fact, this conclusion helps us to formulate a basic conceptual assumption about the influence of social media on popularization of healthy lifestyle among young people.

So, we assume, that the specific of communication in social media makes possible two kinds of effects, concerning popularization of healthy way of life among users. On the one hand, when trainers, teachers or someone else spread information about practices of healthy way of life, they create socially approved requirements for adherence to healthy way of life. However, on the other hand, users can respond to these requirements not only by real implementation of healthy practices, but also by demonstrating of a fabricated healthy practice in social media. There is no doubt, that evaluation of balance between these two effects needs an empirical analysis. And we would like to describe the idea of parcticular empirical research, which was started in Ural Federal University in this area.

We have started our research in May 2018. An empirical study of the project is based on the analysis of 3 social media: Facebook; Instagram; YouTube. These social media resources were selected for the research because they allow to analyze different aspects of demonstration of healthy lifestyle: both text and visual. Besides, these social media are popular both in Russia and in EU, which makes possible obtaining correct data for comparative analysis.

The first step of the research is aimed for preliminary analysis of the textual and visual healthy lifestyle of youth in social media which will help to find basic key concepts and categories used by young people in communicative activities (for example, "sport", "healthy lifestyle", "fitness" and others.). This stage of the research also presumes the procedure of content analysis aimed to the disclosing of the patterns of the using of certain concepts and identification of the frequency of using of different concepts in social media. For now we have launched only this stage of the research.

The next step of the research is supposed to be based on the data of online-survey. At least 250 respondents are expected to be involved in the online survey. During the analysis of gathered data, the completed questionnaires of respondents will be correlated to their pages in social media. The data analysis will be focused on the identification of the coincidence or disparity between the real behavior of youth in everyday life and the behavior they show in social media through text and visual information elements.

Gathered data will be used as a basis for building a model, which will be applicable for identification and evaluation of the main ways and mechanisms of youth demonstration of healthy lifestyle in social media. The construction of the model bases on the hypothesis that demonstartion healthy lifestyle of young people in social media is influenced by a number of factors: age; number of pages in different social medias; number of friends in social media; number of years since the moment of registration in social media; average number of publications in social media per day; average number of publications about fitness and healthy lifestyle; social and economical development of region of residence; city type; education; other factors.

3. Conclusion

Now we suppose, that potentially social media can be used as an instrument of e-learning, appropriate for popularization of healthy way of life. But potential effectiveness of it's using is compensated by the presence of a large number of users who only fabricate their healthy lifestyle and do not implement any relevant activities in reality. In the end of 2018 we are going to finish the project to check, if this hypotehsis correct or wrong.

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