Proceedings of the

18th European Conference on e-Learning
ECEL 2019

Hosted By
Aalborg University
Copenhagen, Denmark

7-8 November 2019

Edited by

Rikke Ørngreen, Mie Buhl and Bente Meyer

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.

Ethics and Publication Malpractice Policy

ACPIL adheres to a strict ethics and publication malpractice policy for all publications – details of which can be found here: http://www.academic-conferences.org/policies/ethics-policy-for-publishing-in-the-conference-proceedings-of-academic-conferences-and-publishing-international-limited/

Conference Proceedings

The Conference Proceedings is a book published with an ISBN and ISSN. The proceedings have been submitted to a number of accreditation, citation and indexing bodies including Thomson ISI Web of Science and Elsevier Scopus.

Author affiliation details in these proceedings have been reproduced as supplied by the authors themselves.

The Electronic version of the Conference Proceedings is available to download from DROPBOX http://tinyurl.com/ecel19 Select Download and then Direct Download to access the Pdf file. Free download is available for conference participants for a period of 2 weeks after the conference.

The Conference Proceedings for this year and previous years can be purchased from http://academic-bookshop.com

E-Book ISBN: 978-1-912764-41-9
E-Book ISSN: 2048-8645
Book version ISBN: 978-1-912764-42-6
Book Version ISSN: 2048-8637

Published by Academic Conferences and Publishing International Limited
Reading
UK
44-118-972-4148
www.academic-conferences.org

Contents

Paper Title	Author(s)	Page no.
Preface		vi
Committee		vii
Biographies		x
Research papers		
EFL Blended Learning Course: Implementing a Discussion Forum to Enhance Students' Self-Direction	Dina Adinda, Pascal Marquet and Thaddee Ntihinyuzwa	1
The Impact of m-Learning on Business Students' Performance	Amani Albinali and Allam Hamdan	11
Online Environments for Supporting Learning Analytics in the Flipped Classroom: A Scoping Review	Muriel Algayres and Evangelia Triantafyllou	16
Visual Representations Supporting Implementation of A K12 Programming Curriculum in Open and Democratic Educational Institutions	Benjamin Brink Allsopp and Morten Misfeldt	24
The Impact of Cultural Familiarity on Students' Social Media Usage in Higher Education	Dhuha Al-Shaikhli, Li Jin, Alan Porter, Andrzej Tarczynski, Dilshod Ibragimov, Deneze Bektasheva and Mikhail Shpirko	32
Digital Literacy in Social Media: A Case Study	Rafaela Andreou and Iolie Nicolaidou	40
A Hybrid Fuzzy DEMATEL-AHP/VIKOR Method for LMS Selection	Sarra Ayouni, Leila Jamel Menzli, Fahima Hajjej and Mohamed Maddeh	47
Developing Creative Online Learning Communities: A Case Study of Student Perceptions	Wendy Barber	59
Situating Resilience, Grit and Growth Mindset as Constructs of Social Presence in the Fully Online Learning Community Model (FOLC)	Wendy Barber, Roland van Oostveen and Elizabeth Childs	65
Soft-Digital Skills in Higher Education Curricula	Susana Bastos, Helena De Oliveira, Moreira Manuel Silva and Liliana Azevedo	70
Traineeships in Jordan: Mutual Engagement, Joint Enterprise and Shared Repertoire Between Companies and Students	Naoual Benamar and Rikke Magnussen	78
Student Engagement, Mobile Technologies, and Changing Curriculum Delivery	Jeffrey Boehm and Neil Glen	86
Supporting Blended Learning in ESP Courses: Switching Between "Online", "Offline" and "Onstage"	Pavel Brebera and Zuzana Bezdíčková	93
Computational Thinking Utilizing Visual Arts, or Maybe the Other way Around	Mie Buhl	102
Plagiarism Tendencies and Contributing Factors in e-Learning Environments: Rwandan Higher Education Context	Jean Claude Byungura, Henrik Hansson, Kamuzinzi Masengesho and Thashmee Karunaratne	109

Paper Title	Author(s)	Page no.
Current Challenges in Gamification Identified in Empirical Studies	Daniel Cermak-Sassenrath	119
'Breaking bad': Overcoming Barriers Preventing Higher Education Faculty From Offering Quality Blended Learning Programs	Paula Charbonneau-Gowdy and Manuel Herrera	128
Using VLEs to Offer Higher Education Students Choice and Differentiation in Learning Activities: Micro-Pathway Learning Design Implementation and Opportunities	Simon Cross	137
Experience of Using Project-Based Learning in the URFU Hypermethod e-Learning System	Lyudmila Daineko, Yury Davy, Viola Larionova and Inna Yurasova Ural Federal University, Ekaterinburg, Russia	145
Effects of Blending Digital Games into Traditional Lecture-Based Learning on University Students' Programming Learning Achievement	Kannika Daungcharone	151
Students' Learning Experience Within a Blended Learning Environment in a Higher Education Institution in Ghana	Emmanuel Freeman, Ahmed Antwi-Boampong and Odeneho Baffoe-Kodom Agyemang	160
Serious Digital Games to Further Human Rights Education	Sonja Gabriel	169
Flipped Classroom: A Renewal Opportunity or a Pedagogical Cul-De-Sac?	Dorina Gnaur	176
Using Augmented Reality for Teaching Pupils With Special Educational Needs	Vojtěch Gybas, Kateřina Kostolányová and Libor Klubal	185
The use of Visualisations and Video Productions in Online Game-Based Learning	Heidi Hautopp and Stine Ejsing-Duun	192
Methodology for Developing Algorithmic Thinking in Pre-school Education	Tatiana Havlásková, Zuzana Homanová, Kateřina Kostolányová and Zdeněk Barteček	200
Online Learning of Reflective Journal Writing in Tertiary Education	Karl Holm, Jovita Yeung, Mimi Yu, Rodney Ho, Yvonne Loong and Felix Chao	207
Using H5P Interactive Teaching Aids to Solve Problems	Zuzana Homanova, Tatiana Prextova, Daniel Tran and Katerina Kostolanyova	214
On the Role of Unplugged Programming in K-12 Education	Niklas Humble, Peter Mozelius and Lisa Sällvin	224
A Comparative Study on Language Teachers' Perceptions of ICT Self-Efficacy	Ilknur Istifci	231
e-Learning and Classroom Learning Activities	Antonín Jančařík	239
Good Questions in e-Learning Environments	Kateřina Jančaříková and Jarmila Novotná	247
Practical Application of MicroLearning in Education of Future Teachers	Tomas Javorcik and Radim Polasek	254

Paper Title	Author(s)	Page no.
Problem Based Learning: A Facilitator of Computational Thinking	Tanja Svarre Jonasen and Sandra Burri Gram-Hansen	260
Finding an Effective Data Mining Algorithm for Automatic Detection of Learning Styles	Ioannis Karagiannis and Maya Satratzemi	268
Formal Education as Lifelong Learning for Working Professionals: A Case Study	Thashmee Karunaratne and Pooyeh Mobini	276
Towards an Agile-Based Process Model for Effective Teacher Training on LMS	Thashmee Karunaratne, Helena Zhemchugova, Jean Claude Byungura and Ulf Olsson	284
Assessing Programming Concepts in the Visual Block-Based Programming Course for Primary School Students	Siu-Cheung Kong and Yi-Qing Wang	294
Investigating Participants' Collaborative Patterns in a MOOC for Teacher Professional Development	Nikolaos Koukis and Athanassios Jimoyiannis	303
Students Behavioural Patterns on the National Open Education Platform	Viola Larionova, Andrey Sheka and Stanislaus Vasilyev	313
A Critique of Blended Learning: Examples From an Undergraduate Psychology Program	Maria Limniou and Caroline Hands	320
The Contribution of Social Media on Heritage Experience: A Case Study of Samchuk Community and Old Market District, Suphanburi	Thanya Lunchaprasith and Sarakard Pasupa	329
Strategic use of Social Media in e-Learning	Iwona Lupa-Wójcik	340
The Role of Accessibility and Usability in e-Learning Websites for Students With Disabilities: Can Policies Help?	Motlhabane Jacobus Maboe, Mariki Eloff and Marthie Schoeman	349
Adding Narrative to Gamification and Educational Games With Generic Templates	Sebastian Mader, Niels Heller and François Bry	360
Digital Literacy and Course Design	Gunver Majgaard and Regina Lamscheck-Nielsen	369
Application of Digital Tools for the Development of Entrepreneurship Competencies	Josef Malach and Nataliia Kysil	378
Gamification for Promoting Acceptance of an Online Learning Environment Among Teachers	Flavio Manganello and Francesca Pozzi	387
Towards an ICT Enabler for Enhancing Non-Cognitive Skills in a Lifelong Learning Setting	Pooyeh Mobini and Thashmee Karunaratne	396
Technology-Based Education and Students' Performance: Literature Review	Maryam Murad, Anjum Razzaque and Allam Hamdan	406
e-Design Education Using a 3D Printer Based on Design Thinking at Primary School	Kazuhiro Muramatsu, Sonam Wangmo and Yeshi Wangchuk	412
Interaction and Group Work in Blended Synchronous Higher Education: Exploring Effects on Learning Outcomes, Satisfaction and Retention	Lena-Maria Öberg, Christina Amcoff Nyström, Stefan Hrastinski , Peter Mozelius and Jörgen Söderback	420
Using YouTube Analytics to Investigate Instructional Video Viewing Patterns	Michael O'Brien, Darina Slattery and John Walsh	428
Dissemination of Distance Teaching Practice	Anders Øgaard	437

Paper Title	Author(s)	Page no.
Investigating the use of Moodle at a PBL University: Design Factors and Experiences	Rikke Ørngreen, Sara Paash Knudsen, Ditte Kolbæk and Rune Hagel Skaarup Jensen	444
Meeting Online to Reduce Carbon Emissions and to Emphasise Values in Life and at Work	Rikke Ørngreen, Dorina Gnaur and Birgitte Henningsen	453
Understanding the Urgency and Complexities of the Energy Transition Through Serious Gaming	Tania Ouariachi and Wim Elving	461
Using OneNote as an ePortfolio: Promoting Experiential Learning and Self-Regulation	Maria Luisa Perez Cavana	467
Feasible Ways to Personal Meaning Mapping in Out-Of-School Contexts?	Morten Raahauge Philipps, Bjørn Friis Johannsen, Thomas Dyreborg Andersen, Henrik Levinsen and Kristian Kildemoes Foss	476
Investigating the Voice of Customers for M-Learning Application Quality	Arunotai Pongwat	486
Learning Gains of Process Oriented Guided Inquiry Learning in an Online Course Setting	Saptarshi Purkayastha, Mounika Guntu, Radhika Ravindran and Asha Kiranmayee Surapaneni	495
E-Learning and Learner Knowledge Sharing Quality: Ahlia University as a Case Study	Sameh Reyad, Sherine Badawi, Layla Faisal Alhalwachi, Allam Hamdan Anjum Razzaque and Abdalmuttaleb Al-Sartawi	505
Examining the Compatibility of Students in Distributed Pair Programming	Maya Satratzemi, Despina Tsompanoudi, Stelios Xinogalos and Leonidas Karamitopoulos	510
Towards Integration of Deep Gamification Into Formal Educational Settings	Heinrich Söbke and Jörg Londong	519
Policies to Implement Smart Learning in Higher Education	Maria José Sousa and Miguel Sousa	526
A Teaching-Learning Blended-Course Model Support Tracking Student Bahaviour	Gridaphat Sriharee	533
Automated Scaffolding and Feedback for Proof Construction: A Case Study	Korbinian Staudacher, Sebastian Mader and François Bry	542
A Study of Investigating Pre-Service Teachers' Attitudes Towards Using e-Learning Resources	Ming-Jiun Sung and Liza Lee	551
Structures for Mapping Learning Content	Andreas Lindenskov Tamborg, Jonas Dreyøe, Lisbeth Liv Nøhr, Mia Onsvig Gregersen and Benjamin Brink Allsopp	559
Effects of Personalized Learning With Preferred Digital Media Types on Learning Motivation	Jirapipat Thanyaphongphat	567
Effects of Digital Learning on Students' Learning Achievement in Learning Computer Programming	Krittawaya Thongkoo	574
Collaborative Online International Learning: A Pedagogical Intervention to Enrich Students' Learning	Anisa Vahed and Steven Levine	579

Paper Title	Author(s)	Page no.
Threshold Concepts in Online Music Education: Transforming Conservatoire Training	Dario van Gammeren and Aleksander Szram	588
Assessments Used in an Open Distance e-Learning Environment to Promote Self-Directed Learning	Dalize van Heerden and Leila Goosen	593
How can Flipped Classroom Activities Support Teacher Motivation?	Tone Vold and Ole Jørgen Ranglund	603
Cross-Location and Cross-Disciplinary Collaborative Prototyping Using Virtual Reality in Higher Education	Fei Yu and Md. Saifuddin Khalid	609
Phd Research Papers		619
A Thematic and Grounded Theory Understanding of Faculty Adoption of Blended Learning in Higher Education	Ahmed Antwi-Boampong, Emmanuel Freeman and Hannah Muat	621
Estimating Student Workload During the Learning Design of Online Courses: Creating a Student Workload Calculator	Nicola Beer	629
Experts' Insights About Blended Learning Implementation: What Teacher Attributes are Relevant?	Bram Bruggeman, Jo Tondeur, Bram Pynoo and Katrien Struyven	639
Work In Progress Papers		649
Incarcerated Students' Support Services in Open Distance e-Learning: A Mixed Methods Protocol	Caroline Agboola	651
Challenges in Designing e-Learning for Educators With Limited Time and Access	Lillian Buus and Michal Pilgaard	655
Digital Literacy in a Sociomaterial Perspective	Michael Jensen	659
Meaningful Communication and Active Learning in Online Courses	Amy Sheng Chieh Leh and Amanda Burk	662
The Climb to the Blended Learning Peak	Nuria Lopez	665
Developing an Implementation Framework for Adaptive Learning: A Case Study Approach	Victoria Mirata and Per Bergamin	668
Breaking Sequentiality: An Interactive MOOC	Maria Cecilia Reyes and Guglielmo Trentin	674
Choose Your own Adventure: Self-Directed Adult Learning and Assessment	Holly Rick and Karla Phlypo	680
YouTube as an Instrument of Learning in Higher Education: Opportunities and Challenges	Dmitry Rudenkin and Veronika Grushevskaya	684
Students From Central Asia in Russian Universities: The Social Media as a Tool of Adjustment	Galina Savchuk, Olga Iakimova and Anastasia Yufereva	687
Utilisation of Open and Distance eLearning Students Support Services by Postgraduate Students in an Open and Distance eLearning Institution	Omari Shabani and Kefiloe Maboe	691
Future Challenges for Academic-Industry Value Co-Creation Through Lifelong Learning	Carina Sjödin, Leo Hatvani and Anders Olsson	695
Blended Learning Sessions to Improve job Interview Skills	Michiko Toyama and Yoshitaka Yamazaki	698

Preface

ECEL Preface

These proceedings represent the work of contributors to 18th European Conference on e-Learning (ECEL 2019), hosted by Aalborg University, Copenhagen, Denmark on 7-8 November 2019. The Conference Co-Chairs are Rikke Ørngreen, Mie Buhl and Bente Meyer, and, all from Aalborg University, Copenhagen, Denmark.

ECEL is now a well-established event on the academic research calendar and now in its 18th 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.

The opening keynote presentation is given by *Anthony "Skip" Baisel*, from the Queen Mary University of London on the topic of *Higher Education Pedagogy using Game Design*. The second day of the conference will open with interactive collaborative keynote by *Mie Buhl, Bente Meyer, Rikke Ørngreen,* on the topic of *Does IT work? Investigating factors at play in e-learning research*.

With an initial submission of 181 abstracts, after the double blind, peer review process there are 76 Academic research papers, 3 PhD research papers, and 26 work-in-progress papers published in these Conference Proceedings. These papers represent research from Austria, Belgium, Bhutan, Canada, Chile, China, Cyprus, Czech Republic, Denmark, France, Germany, Ghana, Greece, Greenland, Hong Kong, Ireland, Italy, Japan, Norway, Poland, Portugal, Russia, South Africa, Sweden, Taiwan, Thailand, The Netherlands, Turkey, UAE, UK and USA.

We hope you enjoy the conference.

Rikke Ørngreen, Mie Buhl and Bente Meyer

Aalborg University
Denmark
November 2019

ECEL 2019 Committee

Dr Adrian Adascalitei, Technical University Gh. Asachi Iasi, Romania; Dr. Wilfried Admiraal, Leiden University, Leiden, The Netherlands; Dr Elham Akbari, Tarbiat Modares University, Iran; Dr Kinaz Al Aytouni, Arab International University, Syria; Dr. Ali Alawneh, Philadelphia University, Jordan; Prof. Stephen Alstrup, Department of Computer Science, University of Copenhagen, Denmark; Prof. Antonios Andreatos, Hellenic Air Force Academy, Greece; Dr. Anca-Olga Andronic, Faculty of Psychology and Educational Sciences, Spiru Haret University, Romania; Dr. Razvan-Lucian Andronic, Faculty of Psychology and Educational Sciences, Spiru Haret University, Romania; Sara Archard, University of Waikato, Hamilton, New Zealand; Dr. Ezendu Ariwa, London Metropolitan University, UK; Prof. Mohamed Arteimi, Libyan Academy of Graduate Studies, Libya; Dr. Bunyamin Atici, Firat University, Turkey; Marc Augier, SKEMA Business School , France; Dr. Anders Avdic, Dalarna University, Sweden; Prof. Liz Bacon, University of Abertay, Dundee , UK; Prof. Alina Badulescu, University of Oradea, Romania; Dr. Nimalathasan Balasundaram, University of Jaffna, Sri Lanka; Dr. Joan Ballantine, University of Ulster, UK; Dr. Wendy Barber, University of Ontario Institute of Technology, Canada; Dr. Trevor Barker, University of Hertfordshire, UK; Karen Barnstable, UBC Okanagan, Canada; Karen Barton, University of Hertfordshire, UK; Dr. Patricia Beckenholdt, University of Maryland University College (UMUC), USA; Andrea Benn, University of Brighton, UK; Dr. Igor Bernik, University of Maribor, Slovenia; Daniel Biella, University of Duisburg-Essen, Germany; Prof. Dr. Mirela Blaga, Technical University "Gheorghe Asachi", Romania; David Bond, University of Technology, Sydney, Australia; Dr. Tharrenos Bratitsis, University of Western Macedonia, Greece; Ian Brown, Hong Kong Polytechnic University, Hong Kong; Dr James Brunton, Dublin City University, Ireland; Prof. Sheryl Buckley, Unisa, South Africa; Mie Buhl, Aalborg University Copenhagen, Netherlands; Prof Kiymet Caliyurt, Trakya University, Türkiye; Maggie Carson, Edinburgh University, UK; Dr. Antonio Cartelli, University of Cassino,, Italy; Dr. Ivana Cechova, University of Defence, Czech Republic; Maria Celentano, University of Lecce, Italy; Dr. Valentina Chappell, Friends University, USA; Dr. Paula Charbonneau-Gowdy, Universidad Andres Bello, Chile; Athina Chatzigavriil, LSE, UK; Dr. Phaik Kin Cheah, University Tunku Abdul Rahman, Malaysia; Dr. Esyin Chew, Cardiff Metropolitan University, UK; Satyadhyan Chickerur, B V Bhoomaraddi College of Engineering and Technology, Hubli, India; Prof. Jyotie Choudrie, University of Hertfordshire, UK; Dr. Lucian Ciolan, University of Bucharest, Romania; Dr. Melanie Ciussi, SKEMA Business School, Sophia Antipolis, France; Dr. Barbara Class, University of Geneva, Switzerland; Prof. Dr. Jürgen Cleve, Wismar University, Germany; Prof. Delaine Cochran, Indiana University, USA; David Comiskey, University of Ulster, Northern Ireland; Dr. Eduardo Correia, Christchurch Polytechnic Institute of Technology, New Zealand; Dr. Caroline Crawford, University of Houston-Clear Lake, USA; Dr. Marija Cubric, University of Hertfordshire, UK; Ken Currie, CAPDM Ltd, UK; Prof. Laura Czerniewicz, University of Cape Town, South Africa; Dr. Valentina Dagiene, Vilnius University, Lithuania; Mark De Groot, Leeds Metropolitian University, UK; Antonio De Nicola, ENEA, Italy; Prof. Dr. Carmen De Pablos Heredero, Rey Juan Carlos University, Spain; Dr. Souad Demigha, UNIV Paris 1 and Paris11, France; Dr. Faiza Derbel, University of Manouba, Tunisia; Dr. Prof. Dorien DeTombe, International Research Society Methodology of Societal Complexity , The Netherlands; Dr. Rajiv Dharaskar, GH Raisoni College of Engineering, Nagpur, India; Prof. Vicenzo Di Lecce, Politecnico di Bari, Italy; Dr Natalia Dneprovskaya, Financial University under the Government of the Russian Federation, Россия; Dr. Martina Doolan, University of Hertfordshire, UK; Dr. Yanqing Duan, University of Luton, UK; Dr Palitha Edirisingha, University of Leicester, UK; Dr. Colin Egan, University of Hertfordshire, Hatfield, UK; Dr Ramadan Elaiess, University of Benghazi, Libya; Dr Akbari Elham, university of Tehran, Iran; Prof. Dr. Alptekin Erkollar, ETCOP, Austria; Dr. Marius Costel ESI, Stefan cel Mare University, Romania; Dr. Prof. Iancu Eugenia, Stefan cel Mare University, Romania; Ms Khristin Fabian, Perth College UHI, UK; Prof. Liz Falconer, University of the West of England Bristol, UK; Prof. Gert Faustmann, Berlin School of Economics and Law, Germany; Rachel Fitzgerald, Brisbane University , Australia; Duncan Folley, Leeds Metropolitian University, UK; Dr Panagiotis Fotaris, Brighton University, UK; Dr. Gabriele Frankl, Alpen-Adria-Universität Klagenfurt, Kärnten; Dr. Michelle French, University of Toronto, Canada; Dr Václav Friedrich, VSB - Technical University of Ostrava, Czech Republic; Dan-Adrian German, Indiana University School of Informatics and Computing, USA; Apostolos (Paul) Giannakopoulos, Unisa, South Africa, South Africa; Dr. Mark Glynn, Dublin City University (DCU), Ireland, Ireland; Dr. Katie Goeman, University of Leuven, Belgium (KU Leuven), Belgium; Prof Maria de Fátima Goulão, Universidade Aberta, Portugal; Dr. Susan Greener, University of Brighton, UK; Dr. David Guralnick, Columbia University and Kaleidoscope Learning, New York , USA; Dr. Richard Hall, De Monfort University, Leicester, UK; Prof . Patricia Harvey, Greenwich University, London, UK; Muhammad Said Hasibuan, Institute Business and Informatics Darmajaya, Indonesia; Thanos Hatziapostolou, International faculty of the university of sheffield, Greece; Dr. Stylianos Hatzipanagos, King’s College London, UK; Dr. Tali Heiman, The Open University, Israel; Alan Hilliard, University of Hertfordshire, Hatfield, UK; Anita Hiralaal, Durban University of Technology, South

Africa; Dr. Md. Fokhray Hossain, Daffodil International University (DIU), Bangladesh; Dr. Margaret-Anne Houston, Glasgow Caledonian Universtiy, UK; Rob Howe, The University of Northampton, UK; Dr. Maggie Hutchings, Bournemouth University, UK; Dr Maria Impedovo, Aix-Marseille Universite, France; Dr Ilknur Istifci, Anadolu University, Turkey; Dr. Eunice Ndeto Ivala, Cape Peninsula University of Technology, South Africa; Dr Sheila Jagannathan, World Bank, USA; Prof. Dinesh Chandra Jain, Computer Science & Engineering, S.G.I., India; Dr. Antonin Jancarik, Faculty of education, Charles University, Czech Republic; Dr Nicolae Jascanu, University Dunarea de Jos Galati, Romania; Prof. Aman Jatain, Amity University, India; Kanthi Jayasundera, Simon Fraser University, Canada; Mr Amor Jebali, King Abdulaziz University, Saudi Arabia; Dr. Amanda Jefferies, University of Hertfordshire, Hatfield, UK; Runa Jesmin, Global Heart Forum, UK; Dr. John Jessel, Goldsmiths, University of London, UK; Aidan Johnston, Glasgow Caledonian University, UK; Geraldine Jones, University of Bath, UK; Prof Paul Jones, Coventry University, UK; Phillip Jones, Hong Kong Institute of Education, Hong Kong; Dr. Jowati Juhary, National Defence University of Malaysia, Malaysia; Prof. Leila Kajee, University of Johannesburg, South Africa; Dr. Michail Kalogiannakis, University of Crete, Faculty of Education, Crete; Jana Kapounova, University of Ostrava, Czech Republic; Dr. Elisabeth Katzlinger, Johannes Kepler University, Austria; Dr. Andrea Kelz, University of Applied Sciences Burgenland,Campus Pinkafeld, Austria; John Knight, Bucks New University, UK; Dr. Renata Korsakiene, Vilnius Gediminas Technical University, Lithuania; Dr Utku Kose, Suleyman Demirel University - Dept. of Computer Engineering, Turkey; Dr. Jasna Kuljis, Brunel University, UK; Dr Bolatzhan Kumalakov, Almaty Management University, Kazakhstan; Dr. Swapna Kumar, University of Florida, USA; Blair Kuntz, University of Toronto, Canada; Dr. Yacine Lafifi, Guelma University, Algeria; Dr. Jean Lai, Hong Kong Baptist University, Hong Kong; Prof. David Lamas, Tallinn University, Estonia; Mr Iain Lambie, Glasgow Caledonian University, United Kingdom; Dr. Maria Lambrou, University of the Aegean Business School, Greece; Dr. Mona Laroussi, Institut National des Sciences Appliquées et de la Technologie, Tnis and Lille, Tunisia; Dr Jose Alberto Lencastre, University of Minho, Portugal; Dr Sook Ling Lew, Multimedia University, Malaysia; Mr Eddy K. W. Li, Faculty of Education, University of Cambridge, United Kingdom; Dr. Gi-Zen Liu, National Cheng Kung University, Taiwan; Dr. Ying Liu, Cambridge University, UK; Dr. Kim Long, Wiley College, USA; Prof Ana Paula Lopes, Polytechnic of Porto (P.Porto)/ISCAP , Portugal; Jenny Lorimer, University of Hertfortshire, UK; Ana Loureiro, Politechnic Institute of Santarem - School of Education, Portugal; Prof. Sam Lubbe, NWU, South Africa; Dr. Robert Lucas, Keylink Computers Ltd, Kenilworth, UK; Prof. Zdena Lustigova, Charles University in Prague, Czech Republic; Dr Teodoro Macaraeg, University of Caloocan City, Philippines; Dr Łukasz Mach, Opole University of Technoilogy, Poland; Dr. Martin Magdin, Constantine the Philosopher University in Nitra, Faculty of Natural Sciences, Slovakia; Prof Abdelhak Mahmoudi, Ecole Normale supérieure, Morocco; Dr Katerina Makri, National and Kapodistrian University of Athens, Greece; Annalisa Manca, University of Dundee, Dundee; Dr. Chittaranjan Mandal, Dept of Computer Sc & Engg, IIT Kharagpur, India; Dr. Lindsay Marshall, Newcastle University, UK; Dr JOSE MARTI-PARREÑO, Universidad Europea de Valencia, Spain; Dr. Maria J Martinez-Arguelles, Universitat Oberta de Catalunya, Spain; Dr Andrei Maxim, Faculty of Economics and Business Administration, "Alexandru Ioan Cuza" University of Iasi, Romania; Miss Orlagh McCabe, Manchester Metropolitan University, UK; Linda Joy Mesh, Universita degli Studi di Siena, Italy; Ms Bente Meyer, Aalborg University Copenhagen, Denmark; Julia Mingullon, Universitat oberta de catalunya, Spain; Prof Luisa Miranda, Polytechnic Institute of Braganca, Portugal; Dr. Ali Moeini, Prague, Czech Republic, Iran; David Moffat, Glasgow Caledonian University, UK; Dr. Jonathan Moizer, Plymouth University , UK; Dr. Begoña Montero-Fleta, Universitat Politecnica de Valencia, Spain; Prof Lina Morgado, Universidade Aberta, Portugal; Jolanda Morkel, Cape Peninsula University of Technology, South Africa; Molefe Motshegwe, University of Botswana, Gaborone, Botswana; Kate Mottram, Coventry University, UK; Peter Mozelius, Stockholm University, Department of Computer and Systems Sciences, Sweden; Ms Ayanda Msomi, Nelson Mandela University, South Africa; Dr. Antoinette Muntjewerff, University of Amsterdam Faculty of Law, The Netherlands; Dr. Minoru Nakayama, Tokoyo Institute of Technology, Japan; Dr. Michaela Nettekoven, WU Vienna University of Economics and Business, Austria; Dr Annie W.Y. Ng, Department of Systems Engineering and Engineering Management, City University of Hong Kong, Hong Kong; Dr. Dick Ng'ambi , Uiversity of Cape Town, South Africa; Prof. Emanuela-Alisa Nica, Center for Ethics and Health Policy and Petre Andrei University from Lasi, Romania; Dr Susanna Nocchi, Dublin Institute of Technology, Ireland; Dr. Chetsada Noknoi, Thaksin University, Songkhla, Thailand; Prof Jarmila Novotná, Charles University, Czech Republic; Ms. Mary O'Rawe, Dublin Institute of Technology, Ireland; Prof Birgit Oberer, ETH Zurich, Switzerland; Dr. Maruff Akinwale Oladejo, Department of Educational Administration, University of Lagos, Akoka, Nigeria; Dr. Kamila Olsevicova, Univeristy of Hradec Kralove, Czech Republic; Laurence Olver, Brighton Business School, University of Brighton, UK; Prof. Abdelnaser Omran, School of Economics, Finance and Banking, Universiti Utara Malaysia, Malaysia; Dr. Rikke Orngreen, Aalborg University, Denmark; Maria Osuna Alarcón, Salamanca University, Spain; Dr. Abdul Jalil Othman, Faculty of Education, University of Malaya, Malaysia; Dr. Kutluk Ozguven, Zirve University, Turkey; Dr. Ecaterina Pacurar Giacomini, Louis Pasteur University, France; Lecturer Veerabhadram Paduri, Namibia University of Science and Technology, Namibia; Dr. Alessandro Pagano, University of Bari, Italy; Vasileios Paliktzoglou, University of eastern Finland, Finland; Masouras Panicos, Cyprus University of Technology, Cyprus; Prof. Kyparisia Papanikolaou, School of Pedagogical and Technological Education, Greece; Dr. Iraklis Paraskakis, South East European Research Centre (SEERC), Thessaloniki, Greece; Dr Ayyub Patel, king khalid university college of medicine biochemistry dept, saudi arabia; Paul Peachey, University of Glamorgan, Treforest, UK; Dr. Arna Peretz, Ben Gurion Univeristy of the Negev, Israel; Dr. Carmen Pérez-Sabater, Universitat Politècnica de València, Spain; Dr. Beth Perry, Athabasca University, Canada; Dr. Donatella Persico, Istituto Tecnologie Didattiochje-Consiglio Nazionale Ricerche, Genova, Italy; Dr. Christopher Perumalla, University of Toronto, Canada; Dr Parichat Phumkhachorn, Ubon Ratchathani University, Thailand; Prof. Mário Pinto, Polytechnic Institute of Porto, Portugal; Prof. Selwyn Piramuthu, University of Florida, Gainesville, USA; Dr. Toomas Plank, University of Tartu, Institute of Physics, Estonia; Dr. Maria Magdalena Popescu, Carol I National Defence University, Romania; Dr. Francesca Pozzi, ITD-CNR, Italy; Dr. Muhammad Abdul Qadir, Mohammad Ali Jinnah University, Islamabad, Pakistan; Prof. Ricardo Queirós, ESEIG/KMILT & CRACS/INESC, Portugal; Susannah Quinsee, City University, London, UK; Dr. Bilba Radu, George Bacovia University, Romania; Abdul Rafay, Asia Pacific University College of Technology & Innovation, Malaysia; Prof Pongsak Rattanachaikunsopon, Ubon Ratchathani University, Thailand; Dr. Brenda Ravenscroft, Schulich School of Music, McGill University, Canada; Dr. Liana Razmerita, Copenhagen Business School, Denmark; Prof Asmaa Retbi, Mohammadia School of Enginners, Mohammed V University in Rabat, Morocco; Hugo Ribeiro, University of Porto, Portugal; Prof Sandra Ribeiro, ISCAP-IPP, Portugal; Mr. Sumowalt Roosevelt, Liberia Initiatives For Fostering Empowerment, Inc., Liberia; Prof Helle Rootzen, Technical University of Denmark, Denmark; Dr Marco Valerio Rossi, Sapienza University of Rome, Italy; Dr. Eleni Rossiou, Univerisity of Macedonia, Greece; Dr. Danguole Rutkauskiene, Kaunas University of Technology, Lithuania; Dr. Florin Salajan, North Dakota State University , USA; Prof Abdel-Badeeh Salem, Faculty of Computer and Information Sciences, Ain Shams University, Cairo, Egypt; David Sammon, Univesity College Cork, Ireland; Prof. Vitor Santos, New University of Lisbon, Portugal; Dr. Daniyar Sapargaliyev, Almaty Management University, Kazakhstan; Dr. Venkat Sastry, Defence College of Management and Technology, Cranfield University, UK; Prof Maya Satratzemi, University of Macedonia, dept of Applied Informatics, Greece; Dr. Guy Saward, University of Hertfordshire, UK; Dr Sofie Schratt-Bitter, Department of elearning, Austria; Prof. Jeanne Schreurs, Hasselt University, Diepenbeek, belgium; Dr. Jane Secker, London School of Economics, UK; Dr. fabio serenelli, Università degli Studi Milano Bicocca, Italy; Dr. Olga Shabalina, Volgograd state technical university, Russia; Dr. Zaffar Ahmed Shaikh, Benazir Bhutto Shaheed University, Karachi, Pakistan; Aileen Sibbald, The Business School, at Edinburgh Napier University, UK; Dr. Petia Sice, University of Northumbria, Newcastle-upon-Tyne, UK; Dr Armando Silva, ESE School of Education of Polytechnic of Porto, Portugal; Dr Paulino Silva, ISCAP / IPP, Portugal; Prof. Ali Simsek, Anadolu University, Turkey; Dr. Gurmeet Singh, The University of The South Pacific, Suva, Fiji, Fiji; Dr. Deena Slockett, ADU (Adventist University of Health Sciences), USA; Imelda Smit, North-West University, Vanderbijlpark, South Africa; Prof. Cees Th. Smit Sibinga, IQM Consulting for International Development of Quality Management in Transfusion Medicine, The Netherlands; Dr. Keith Smyth, University of the Highlands and Islands, UK; Bent Soelberg, South Danish Educationscenter (SDE), Denmark; Dr. Yeong-Tae Song, Towson University, Maryland, USA; Dr. Michael Sonntag, FIM, Johannes Kepler University, Linz, Austria; Dr Lew Sook Ling, Multimedia University , Malaysia; Dr. Sonia Sousa, Tallinn University, Estonia; Dr. Rumen Stainov, University of Applied Sciences, Fulda, Germany; Dr. Mark Stansfield, University of West of Scotland, UK; Dr. John Stav, Sor-Trondelag University College, Norway; Caroline Stockman, University of Winchester, UK; Thomas Strasser, Vienna University of Education, Austria; Dr. Amanda Sykes, University of Glasgow, UK; Dr. John Thompson, Buffalo State College, USA; Dr. Socaciu Tiberiu, University of Suceava, Romania; Dr. Claudine Toffolon, Université du Mans - IUT de Laval, France; Dr Łukasz Tomczyk, Pedagogical University of Cracow, Poland; Florica Tomos, South Wales University, UK; Dr. Eulalia Torras-Virgili, Open University of catalonia, Spain; Dr. Melih Turgut, Eskisehir Osmangazi University, Turkey; Christopher Turner, University of Winchester, UK; Karin Tweddell Levinsen, Aalborg University, Copenhagen, Denmark; Prof Tuna Uslu, Istanbul Gedik University, Occupational Health and Safety Program, Türkiye; Mrs Patris van Boxel, Leiden University, Netherlands; Ms Annelien Van Rooyen, University of South Africa, South Africa; Prof. Andreas Veglis, Aristotle University of Thessaloniki, Greece; Dr. Steven Verjans, Open Universiteit of The Netherlands, The Netherlands; Prof Isabel VIeira, Polytechnic of Porto, Portugal; Dr. Porawat Visutsak, Faculty of Applied Science, King Mongkut's University of Technology North Bangkok, Thailand; Dr Stephen White, University of Huddersfield, UK; Dr Philip Wilkinson-Blake, Loughborough University, UK; Dr Sheryl Williams, Loughborough University, UK; Dr. Katherine Wimpenny, Coventry University, UK; Prof. Stanislaw Wrycza, University of Gdansk, Poland; Prof Mohammad H Yarmohammadian, Health Management and Economics Research Center, Iran; Dr. Panagiotis Zaharias, Open University of Cyprus, Greece;

Biographies

Conference and Programme Chairs

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.

Bente Meyer is an Associate Professor at the Department of Learning and Philosophy, Aalborg University. Her research interests include practice and sociomaterial perspectives on ICT in education, global perspectives on ICT in learning as well as computer assisted language learning (CALL). She has edited several books on media, ICT and Learning.

Rikke Ørngreen, Professor Head of the Research Center for Video, and of the Research Group ILD (IT and Learning Design), at the Department of Learning and Philosophy. Aalborg University. Research theories, methods and tools in the design, implementation and evaluation of digital learning processes, in particular video-based activities that support creativity and reflexivity.

Keynote Speaker

Dr Anthony 'Skip' Basiel is an eLearning research and development thought-leader with over twenty years of experience in UK Higher Education and over 55 international publications. His Doctorate in Learning Technology Design explored ePedagogy for virtual learning environments while providing a methodology and toolkit to support the eLearning profile for blended curriculum. This visualisation provides evidence to inform a change management strategy for the organisation moving to blended learning solutions.
See: http://tinyurl.com/y59jhkvc & VLE Profile Toolkit at: http://tinyurl.com/VLEprofile

Biographies of Contributing Authors

Dina Adinda is a Ph.D. candidate in educational sciences. Her research interest includes higher education, students' self-direction and the use of technology for teaching and learning. Worked as a teacher at Institut Français Indonesia and teaching assistant at Rectorat de l'Académie de Strasbourg, she graduated from Master Designing Training and Technology at the University of Strasbourg.

Caroline Agboola is an ODL Postdoctoral Research Fellow in the Department of Sociology at the University of South Africa (UNISA). She obtained her PhD in 2015 from UNISA. Her research interests include Open Distance Learning, student support and Sociology of crime.

Muriel Algayres is a PhD fellow in the Department of Architecture Design and Media Technology at Aalborg University Copenhagen, Denmark. She holds a M.A in Educational science, and her research interest resides in technology-enhanced learning, active learning and game-based learning.

Layla Alhalwachi: PhD holders from Brunel University – London. Assistant Professor of Management.

Benjamin Allsopp is an associate professor at Aalborg University in Copenhagen. He is broadly interested in the intersection of technology and transformation with a focus on epistemic technologies and especially semantic networks.

Ahmed Antwi-Boampong holds a Bsc Agriculture Technology, Bachelor of Law , 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.

Wendy Barber Dr is an Associate Professor and former Director of the B.Ed. Program in the Faculty of Education at Ontario Tech University in Oshawa, Canada. She was the recipient of the UOIT Teaching Award of Excellence and her work focuses on Health and Physical Education, Teacher Development, Resilience, and Online Pedagogy. She is an Associate Researcher with the Education Informatics Lab at Ontario Tech University, where her research is focused on problem-based learning and fully online learning communities.

Susana Bastos: PhD in Education and Didactics (2011) Professor in management and accounting. Gave lectures on subject Management Simulation (2003)– an innovative approach to learning environment at University. Researcher/publisher in educational European Journals about need to bring soft skills into curricula of courses. Project manager: Coski21 – Core Skills for 21rst Century Professionals, http://www.skills-4u.eu/; Project "Living Lab" at city of Matosinhos.

Nicola Beer is a PhD student in Technology Enhanced Learning at Lancaster University and has worked as learning designer in higher education.

Jeffrey D. Boehm, Ph.D. serves as Learning Technologist and as a lecturer in Writing and Performance (Music) at Bath Spa University in the UK. He is interested in the use of mobile technologies for deepening student engagement in performance-based classrooms. Boehm also works with technologies in music performance.

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.

Bram Bruggeman is a PhD candidate at the Vrije Universiteit Brussel (VUB). His research interests are in professional development in higher education in the context of online and blended learning.

Jean Claude Byungura is a Lecturer at University of Rwanda and a PhD Candidate at Stockholm University, DSV, in Sweden. He received his MSc Degree in Informatics, from Jönköping University. He is PhD research focuses on IT alignment with higher education institutions. He has been involved in several ICT in Education Projects in Africa.

Daniel Cermak-Sassenrath is Associate Professor at the ITU, Copenhagen, and member of the Center for Computer Games Research (game.itu.dk) and the Pervasive Interaction Technology Lab (PitLab, pitlab.itu.dk). Daniel is interested in artistic, analytic, explorative, critical and subversive approaches to and practices of play. More info is available at dace.de.

Paula Charbonneau-Gowdy is Associate Professor and researcher in English as a Foreign Language Teacher Education at the Universidad Andres Bello in Santiago, Chile. 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. She was a 2017 recipient of two Laureate Publication Awards for her writing in this area.

Simon Cross Dr is a Lecturer in Educational Technology at The Open University, UK. His research interests include spaces of mobile learning, assessment and learning design, open and distance learning pedagogies, formative uses for digital badges, educational potentials of 360-degree video, and learning visualisation. He is currently working on projects in the UK and India.

Kannika Daungcharone Dr is currently a Lecturer at the Division of Modern Management and Information Technology in College of Arts, Media and Technology, Chiang Mai University, Thailand. She is interested in technology-enhanced learning, mobile learning, digital game education, technology-enhanced programming learning, and adaptive learning.

Jonas Dreyøe is a phd student in mathematics education and methodology, focused on cognitive digital tools in mathematics teaching and participatory research designs incorporating big data

Mariki Eloff is a full professor at the University of South Africa (UNISA) since 2009. She is the chair of the Institute of Corporate Citizenship at Unisa. In 2010 she received the Unisa Women in Research award for Research Leadership. She participated in many information security management research projects She has presented research papers at international and national conferences mostly focusing on information security.

Emmanuel Freeman is the Head of Centre for Online Learning and Teaching (COLT) and a Lecturer at Ghana Technology University College, Accra-Ghana and PhD Scholar at the University of South Africa. Emmanuel has published and co-authored several publications in the area of e-leaning, blended learning, m-learning, technology enhanced learning, e-commerce, big data analytics etc.

Michelle French is an Associate Professor, Teaching Stream in the Department of Physiology and Special Adviser to the Dean on Innovation in Undergraduate Education in the Faculty of Medicine at the University of Toronto. She teaches courses in the life sciences, and her scholarly focus is on improving student learning and engagement.

Sonja Gabriel works as a professor for media literacy at University Teacher College Vienna/Krems (Austria). Her primary focus of research is on digital game-based learning and using serious games for teaching different subjects at school and university as well as evaluation of various projects for learning with games and game-design approaches.

Neil Glen MA(RCA) is a Designer, Academic and Learning Technologist for Bath School of Art and Design at Bath Spa University, creating, developing and researching technology-enhanced learning experiences, to which he brings a design-led approach. Currently, Neil is working on the implementation of a TEL for the school's new campus opening 2019.

Dorina Gnaur is an Associate Professor at the Department of Culture and Learning at Aalborg University, Denmark. Her research interests include technology-enhanced learning and innovative approaches to education and learning in various contexts. She is active within The Research group IT and Learning Design and the IT and Learning Design Lab and the Research Group Processes and Processes and Learning in Organizations, at Aalborg University.

Valerie Priscilla Goby, PhD (Australia), is a professor in the College of Business, Zayed University, Dubai. She has published widely in the fields of communication, ethics, business, IT, and education, and has taught organizational communication, intercultural communication, and organizational behavior for twenty-five years in universities in Singapore, Cyprus, the UAE, Ireland, Brunei, Samoa, and Australia.

Sandra Burri Gram-Hansen, Ph.d.is Assistant professor at Aalborg University and daily manager of AAU's center for Computational Thinking. She specializes in behavior design, persuasive technologies, information architecture and computational thinking. Her research is published in international journals and conferences.

Maaike Grammens is a PhD student at the Department of Educational Studies at Ghent University. Her PhD project focuses on the professional development of teachers who teach in synchronous online learning environments. More specifically, the research objective is to study which specific competences those teachers need with the aim of improving their professional learning.

Mounika Guntu, a Pharm-D graduate, currently pursuing my Master's degree in Health Informatics at IUPUI. My areas of interest are EHR systems and clinical data analytics. I have worked on projects like Role of clinical pharmacist mediated care in diabetes mellitus: a new community-based model of care, Evaluating clinician referrals made by a natural language conversational bot from patient narratives.

Vojtěch Gybas, Ph.D. is an assistant professor at the University of Ostrava. I focus on mobile touch technologies in preparing future teachers.

Allam Hamdan: Professor of Accounting, Acting Dean of college of Business and Finance, Ahlia University. He has many papers published in regional and international journals that discussed several accounting, financial and economic issues concerning the Arab world.

Heidi Hautopp is a PhD student and teacher in visual facilitation, design, learning, play and games. Heidi is a member of the Research Lab: ICT and Learning Design, at the Department of Learning and Philosophy, Aalborg University Copenhagen. Her research interest revolves around how drawing and visual methods can be used as idea generating and communication tools across different academic disciplines.

Tatiana Havlásková works as the Assistant Professor at University of Ostrava, Faculty of Education, Department of Information and Communication Technologies. She is scientifically dedicated to the issue of individualization in teaching, the involvement of ICT in teaching and the development of algorithmic thinking in pre-primary and primary education.

Karl Holm Prior to acquiring a PhD in Biology at the Evolutionary Biology Centre at Uppsala University, Dr Holm received a MEd in English and Swedish Languages and Literature at Stockholm University. His research interests include the understanding of threshold concepts in the natural sciences, the teaching of the academic writing process, independent learning and critical thinking.

Zuzana Homanová is the Assistant Professor at the University of Ostrava in the Czech Republic, Department of Information and Communication Technologies in Education. Among the research interest include the introduction of social media into education at elementary schools and multimedia in education.

Niklas Humble is a PhD student at the Department of Computer and System Science at Mid Sweden University.

İlknur İstifçi holds both MA and Ph.D. degrees in English Language Teaching. She is currently working as an Associate Professor at Anadolu University. Her research interests include teacher training, discourse analysis, speech acts, cross-cultural studies, teaching language skills, distance education and using ICTs in ELT.

Antonin Jancarik works as an associate professor in the Department of Mathematics and Mathematics Education, Faculty of Education, Charles University in Prague. He is working in the areas of algebra, use of ICT in mathematics education, combinatorics and game theory.

Katerina Jancarikova works as a senior lecturer in the Department of Biology and Environmental Studies, Faculty of Education, Charles University in Prague. She is working in the areas of environmental education and science education.

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

Vibe Jelsbak, interests are basically video in learning. Students recording videos and also learning in a livestreamed teaching setup. I have an interest in digital video conferencing and methods supporting reflective learning processes. My focus is on the virtual learning space and technological transparency in the digital video conferencing.

Michael Jensen, I'm an Associate Professor and PhD Student at ResearchLab: IT, Learning & Design, Department of Learning and Philosophy, Aalborg University, and Centre for Applied Research, Education and Social Sciences, UCL University College. My research interests are sociomaterial theory, digital literacy, posthuman writer identity, and writing as assemblage.

Thashmee Karunaratne is a senior researcher at the Department of Computer and Systems Sciences, Stockholm University, Sweden. Her main research interests focus on learning analytics and mining educational data. Thashmee holds a Ph.D. in machine learning and data mining and currently involved in teaching courses and supervising in both on-campus and online settings.

Saifuddin Khalid is an Associate Professor in digital design and movement at University of Southern Denmark. He is also an External Lecturer in Service Design at the department of digitalization, Copenhagen Business School. Khalid's research contributes in the multi-disciplinary fields of interaction design, service design, educational technology, sports technology, health informatics, and techno-anthropology.

Siu-Cheung Kong is a professor in the Department of Mathematics and Information Technology at The Education University of Hong Kong. He is the Editor-in-Chief of the internationally refereed journals Research and Practice in Technology Enhanced Learning (RPTEL) and Journal of Computers in Education (JCE). His main research areas are e-Learning and computational thinking education.

Ulla Konnerup is Project Manager for PBL Digital @HUM at the Faculty of Humanities, Aalborg University, Denmark. The project is focusing on development of ICT-mediated pedagogy and ICT competencies among teachers. She holds a Ph.D. in Technology-mediated Speech Therapy and a Master in ICT and Learning. In 2012, she was a Visiting Researcher at H-star, Stanford University (2012).

Fred Ku is a Senior Lecturer in Business Economics, who teaches EMBA, MBA and UG programmes. As a pioneering educator, he has produced and developed various T&L resources including educational videos and interactive classroom games. His prominent contribution to T&L has been recognised by various teaching awards in CUHK.

Nataliia Kysil is the Ph.D. student of the Department of Music Education at the University of Ostrava in Czech Republic. In her research she focuses on the development of creativity and entrepreneurship of university students preparing for the profession of music teacher of primary and secondary schools. She experimentally verifies the benefits of current digital tools in this process.

Viola Larionova, PhD in Physical and Mathematical Sciences, Associate Professor, Deputy Vice-Rector for Educational Technologies, Head of Academic Department of Economics and Management in Construction and Real Estate Development of the Graduate School of Economics and Management (Ural Federal University, Ekaterinburg, Russia). She has authored more than 140 publications and 4 monographs.

Amy S. C. Leh, Ph.D., is Professor at California State University, San Bernardino. She has taught more than 10 different courses in Instructional Technology, has written more than 30 articles, and has made more than 100 presentations at international/national conventions. She has taught online/hybrid courses since 1999 and is Quality Matters' certified Master Reviewer.

Maria Limniou Dr is Lecturer in Digital Education and Innovation at the University of Liverpool and Senior Fellow of the Advance Higher Education. She is interested in how students learn through the use of technology in-class and/or outside class and how students can be facilitated to learning by integrating different learning tools into Higher Education.

Nuria Lopez works as Research Assistant for Blended Learning at Copenhagen Business School. She has a PhD in English and twenty years' experience teaching languages and academic writing in higher education. Her research focuses on pedagogical issues and is particularly interested in finding ways to link pedagogical research with classroom practices.

Thanya Lunchaprasith is currently a lecturer at Silpakorn University International College, Bangkok. Thanya obtained Ph.D. from Glasgow University. She has a very broad interest in the field of tourism, including but not limited to anthropology of tourism, cultural heritage tourism, gastronomic tourism and royal tourism Her previous research in gastronomic tourism in touristic markets has been published in a number of international journals.

Sebastian Mader, M.Sc., born 1988, studied computer science at the Ludwig Maximilian University of Munich where he currently works as a research associate at the Institute for Informatics since 2016.

Rikke Magnussen is an associate professor at Department of Communication, Aalborg University. Her main research interest is how digital learning design can open for new types of collaborative science practice and innovation processes to support community driven science in and outside formal education. She currently leads the research and development project *Community Drive.*

Gunver Majgaard is Associate Professor at Embodied Systems for Robotics and Learning Unit, University of Southern Denmark. Gunver has background in electrical engineering and a PhD-degree in robots and learning. Research interests: emerging technologies such as virtual reality in education, game-based learning; design of digital educational tools; participatory design processes; learning processes; program and curriculum development.

Josef Malach Associate Prof. is the head of the Department of Educationand Adult Education at the University
of Ostrava in Czech Republic. His research activities cover the application of ICT in education, educational assessment and entrepreneurship education. He works as a co-editor of the New Education Review and he is a member of many editorial boards.

Victoria Mirata. Researcher in the field of Personalized and Adaptive Distance Learning , UNESCO Chair on Personalized and Adaptive Distance Education (PADE). Her research interests include e-learning innovations, technology-enhanced learning, development and implementation of personalized and adaptive learning in online environments, MOOCs. The methodology draws on qualitative and mixed-methods approaches, Delphi studies.

Pooyeh Mobini is a project leader at DSV, Stockholm University. Her main focus is on large scale pilot projects in e-Governance, Innovation-Action projects, ICT for Social Inclusion, IT transformation and integration of ICT in education and coordinating the EU projects "eSkillsMacth" and "SkillsMacth" on Mapping/validating knowledge and develop/demonstrate a European-wide assessment and learning, guiding technologies.

Peter Mozelius is a PostDoc researcher at the Department of Computer and System Science at Mid Sweden University.

Kazuhiro Muramatsu is an Assistant Professor at Electronics and Communication Engineering Department, College of Science and Technology, Royal University of Bhutan. His research interests include collaborative e-Learning and m-Learning environments.

Melody Neumann is an Associate Professor, Teaching Stream in the Department of Cell and Systems Biology at the University of Toronto. She is the creator of Team Up!, and designs, teaches and directs molecular and cell biology courses in face-to-face and fully online formats. She is a recipient of a University of Toronto teaching award.

Iolie Nicolaidou Dr is an academic member at the Department of Communication and Internet Studies at the Cyprus University of Technology. She received her PhD in Educational Technology from Concordia University, Montreal, Canada in 2010. She has over 60 publications related to the field of emerging technologies for learning.

Jarmila Novotná is a Professor at Charles University, Faculty of Education, Prague, Czech Republic. Her main fields of interest include: Didactical conditions of transformation of students' models of activities when grasping knowledge and skills. Transfer of research results into practice.

Lena-Maria Öberg, PhD in computer and System science is a researcher at Mid Sweden University. Her main research interests are technology enhanced learning, blended learning, technology enhanced collaboration and crisis management and exercises. Lena-Maria has also been involved in the digitalization process of the informatics program at Mid Sweden University.

Michael P. O'Brien Dr is a lecturer in Information Management at the University of Limerick, Ireland. He teaches on undergraduate and postgraduate modules in the area of Information and Knowledge Management. His research interests include data analytics, cognitive and educational psychology, software comprehension strategies, empirical studies of programmers and software evolution.

Anders Øgaard Born in Denmark 1970. PhD and assistant professor at Institute for Learning, Ilisimatusarfik, University of Greenland. Øgaard has studied pedagogy, adult education and history at Roskilde University in Denmark. He has been teaching pedagogy and history at teacher colleges in Denmark. 2015 Øgaard finished a PhD about distance teaching in the school in Greenland. Øgaard is teaching and researching distance teaching at Institute for Learning in Nuuk

Takeshi Okada is Professor of Applied Linguistics at Graduate School of International Cultural Studies, Tohoku University. After working on the development of Japanese-specific English spellchecker at Birkbeck College, University of London, his recent concern is the application of corpus analysis technology to EFL teaching in Japan.

Ulf Olsson is an Associate Professor at The Department of Computer and Systems Sciences and Deputy Director at The Centre for the Advancement of University Teaching at Stockholm University. He teaches professional development courses for teachers and his main research interest is implementation and digital competence in higher education.

Tania Ouariachi. Professorship Communication, Behaviour & the Sustainable Society, Center of Expertise Energy, Hanze University of Applied Sciences, Groningen, The Netherlands. Professor and researcher at Hanze University of Applied Sciences in Groningen. Her research focuses on new media, gamification and climate change communication. In this field, she has published more than a dozen scientific articles in prestigious journals and participated in international congresses around the world.

Maria Luisa Pérez Cavana (PhD, SFHEA) studied Philosophy, history and Education in Spain and Germany. Lecturer in Languages at Open University. Research interests have been promoting learner autonomy and learner centred pedagogy through use of ePortfolios in relation to language learning. Part of expert team for European Language Portfolio (ELP) at European Centre for Modern Languages (ECML) in Graz. Also developed model of Personal Development Planning (PDP) adapted to distance education. Currently using phenomenology as a research method to study the lived experience of learning a language.

Morten Raahauge Philipps is associated with University College Copenhagen and have been a part of the flipped learning research and development team since 2012. Since 2017 he have been a project leader in developing learning materials in surrounding natural sciences out-of-school contexts near Copenhagen – e.g. Experimentarium.

Karla Phlypo is currently employed by Walden University as an Academic Coordinator responsible for educational innovation and new curriculum development in the PhD in Management program. Her PhD is in Applied Management and Decision Science and she has had over 25 years of automotive product and manufacturing development, and management experience.

Michal Pilgaard associate professor at VIA University College, Social Education and VIA's research program for Learning and Digital Technologies. Michal is involved in developing learning designs and IT-based teaching. His research is focusing on the use of IT in learning and education. Methodically he is oriented towards user-oriented approaches.

Radim Polasek works at the Department of Information and Communication Technologies at the Faculty of Education of the University of Ostrava. He teaches courses focused on computer architecture, computer networks and web technologies. His research is focused on using web solutions to enhance e-learning and make use of MicroLearning in higher education and workplace.

Arunotai Pongwat is a lecturer at College of Arts, Media and Technology, Chiang Mai University, Thailand. Her research and teaching interests include digital technology in tourism management, tourism experience, smart destination, and digital marketing, focusing on co-creation tourism experience. She runs the MOOCs project at her school to enhance students' learning experience.

Maria Cecilia Reyes PhD in Digital Humanities and Communication Sciences. Researcher at the Institute for Educational Technology (ITD) of the Italian National Research Council (CNR). Content editor at the E-Learning and Multimedia Contents office of the University of Genoa (Italy). Research area: Interactive Digital Narratives, Communication Sciences and Film Studies.

Holly Rick is an Academic Coordinator in the PhD Management program at Walden University. She holds a PhD in organization and management specializing in leadership studies from Capella University and is working on a second PhD in Education at Walden University focusing on organizational research, assessment and evaluation.

Dmitry Rudenkin is an associate professor at the Ural Federal University, Russia. He received his PhD in sociology in Ural Federal University in 2013. His main research areas include digital society, social media and youth studies. In 2017-2019 he is involved in 5 sociological researches in the area of Internet activity of Russian youth.

Maya Satratzemi is a professor at the Department of Applied Informatics, University of Macedonia, Greece. Her current main research interests lie in the area of Educational Programming Environments and Techniques, Collaborative Learning Systems, Serious Games, Adaptive and Intelligent Systems. She has published a significant number of papers in international journals and conferences.

Sedef Sezgin has been working as an English instructor at School of Foreign Languages . She is a member of the Technology Integration Unit in her institution, giving some workshops about Web 2.0 tools. She graduated from Linguistics and doing her master at Distance Education. Her interest are distance education technologies, online learning, technology integration.

Zifikile Phindile Shangase Dr lecturer at the University of KwaZulu-Natal, South Africa. She has over 9 years Higher Education teaching and research supervision experience. Her current research projects focus on digital learning in the form of creating virtual classrooms in order to share and create knowledge that will transform the curriculum in Higher Education towards inclusivity.

Carina Sjödin is a lecturer and a PhD student in Innovation Science and Management. Her previous research addressed user involved service innovation and organizational challenges. Previously, Carina has been a self-employed consultant within trend watching and business environmental scanning. Carina is part of a project seeking to improve international positioning of the university via eLearning.

Heinrich Söbke is a researcher in the field of Serious Games at Bauhaus-Institute for Infrastructure Solutions (b.is), Weimar, Germany. Following an interdisciplinary approach, his work focuses on game-based learning, on gamification, and on educational technology in engineering education.

Maria José Sousa (PhD in Management) is a University Professor and a research fellow of CIEO (Algarve University) and BRU-ISCTE/IUL. She has co-authored over 70 articles and book chapters and published in several scientific journals (e.g. Journal of Business Research, European Planning Studies, and others), and she is the guest-editor of several Special Issues.

Gridaphat Sriharee received Ph.D. in Computer Engineering from Chulalongkorn University, Thailand. She is a tenured associate professor at the department of Computer and Information Science, King Mongkut's University of Technology North Bangkok, Thailand. Her interests include software engineering, learning game, semantic computing, and financial data analytics.

Ming-Jiun Sung is Assistant Professor of Chaoyang University of Technology, Taiwan. They gained their PhD with a major in Early Childhood Special Education; Assistive Technology in 2000 from Department of Special Education, National Changhua Normal University

Jirapipat Thanyaphongphat is currently a Lecturer of College of Arts, Media and Technology, Chiang Mai University, Chiang Mai, Thailand. His research interest includes digital material supported u-learning, adaptive games-based learning, detection of learning style, and robotic STEM.

Krittawaya Thongkoo is a lecturer at the Division of Modern Management and Information Technology in College of Arts, Media and Technology, Chiang Mai University, Thailand. She is interested in technology-enhanced learning, ubiquitous learning, inquiry-based learning, mobile and digital learning, learning analytics, web-based technology.

Michiko Toyama Dr is a professor of English language at Bunkyo University, Japan. She received her Ph.D. in linguistics from Sophia University. Her research interests include blended learning and applied phonetics and phonology

Anisa Vahed Dr is a dental technologist and senior lecturer at the Durban University of Technology in South Africa. Her research interests include undergraduate research and teaching nexus, the metallographic structure of dental materials, and the teaching and learning through discipline-specific games to facilitate the provision of epistemological access.

Dario van Gammeren is Digital Learning Manager at Trinity Laban Conservatoire of Music and Dance, where he leads on the development and implementation of digital technologies that support a blended approach to curriculum delivery. In addition, he is Programme Leader for the Independent Study Programme (Advanced) and the Postgraduate Advanced Diploma.

Dalize van Heerden is a lecturer within the School of Computing at the University of South Africa. She started working for UNISA in 1999 and has been teaching programming modules ever since. Her main research interests include e-learning, m-learning and technology-enhanced learning. She is currently busy with her masters degree in Technology Education.

Yi-Qing Wang is a senior research assistant in Centre of Learning, Teaching and Technology at The Education University of Hong Kong, HKSAR. Her research interests include Job Demands-Resources theory, leadership, and programming education. She is also interested in quantitative research methods in social sciences.

Barbara Wimmer, Head of E-Learning & Web Support Center at FernFH Distance-Learning University of Applied Science, currently studying Educational Technology at Donau University Krems. Focus on digital media production, multimedia e-learning scenario designs, game based learning, and immersive learning.

Dr Yoshitaka Yamazaki is a professor of management at Bunkyo University, Japan and is currently serving as the department chair of Business Administration. He received his Ph.D. in organizational behavior from Case Western University.

Anastasia Yufereva is an assistant of the Department of Integrated Marketing Communications and Branding (Ural State University, Russia). She is the author of the 76 scientific articles. Her main research areas are social media in the education process, journalism, big data analytics, and political communications.

Helena Zhemchugova is a project assistant at the Department of Computer and Systems Sciences and at the Centre for the Advancement of University Teaching at Stockholm University, Sweden. She received her MSc in Computer and Systems Sciences from Stockholm University in 2018 and her MA in Linguistics from Dubna International University, Russia, in 2010.

EFL Blended Learning Course: Implementing a Discussion Forum to Enhance Students' Self-Direction

Dina Adinda[1], Pascal Marquet[1] and Thaddee Ntihinyuzwa[2]
[1]LISEC EA-2310, University of Strasbourg, France
[2]Centre de Ressources et d'Apprentissage des Langues, University of Strasbourg, France
d.adinda@unistra.fr
pascal.marquet@unistra.fr
tntihinyuzwa@unistra.fr
DOI: 10.34190/EEL.19.047

Abstract: The current paper reports on empirical research investigating undergraduate students' readiness to self-directed learning as a response to the use of online discussion forums in an English Foreign Language (EFL) blended learning course. It is known that the asynchronous interactions offered through an online discussion forum allows students to have time to process their thoughts and invites them to think critically (Ritchie and Black, 2012). This critical thinking skill facilitates students' metacognition which is required to develop their self-direction in learning. For that reason, it is hypothesized that the implementation of a discussion forum has a positive impact on students' self-direction. A pre and post-test questionnaire was used to confirm this aspect and the results have shown that only students of the experimental groups have developed their self-direction. This latter is represented by a significant improvement of students' level of readiness to a self-directed learning at the end of the course period.

Keywords: blended learning, discussion forum, self-direction, English foreign language learning

1. Introduction

In active learning method teachers are focused on encouraging students to actively participate in the learning process (Wilson and Sipe, 2014) so that they can develop their knowledge or even engage into a conceptual change. In the current digital era, blended learning has become one of the options to facilitate active learning. Its positive impact to enhance students' engagement in learning (Page, Meehan-Andrews, Weerakkody, Hughes and Rathner, 2017), to support their active participation (Deschryver and Charlier, 2012; Kintu, Zhu, and Kagambe, 2017), to improve the flexibility of teaching and learning (Jun and Ling, 2011), and students' self-direction in learning (Uz and Uzun, 2018) are quite persuasive for its implementation. However, the success of a teaching model does not only rely on the use of digital technology. From a pedagogical point of view, Marquet (2011) stated that the teaching content can be one of the determinant aspects of this latter objective.

The duty of a student is related to the mastery of working strategies and methods (Alava, 1999) as well as the knowledge of learning tools and institutional rules. Being capable to perform these competences requires autonomy. According to Annoot (2012) autonomy can be built and acquired through experiences and the influence of environment (Freire, 2014; Meirieu, 2015). Raucent, Verzat, and Villeneuve (2010) have summarized constitutive skills related to autonomy into three categories: 1°) the ability to develop a strategy by oneself, 2°) the self-awareness and the knowledge of the working environment, 3°) the competence to cooperate and to collaborate. These three skills can be related to self-direction, which according to Carré (2003) is defined as an aptitude by oneself to take a strategic control over their own actions, objectives or goals. According to the Triadic Reciprocal Causation (TRC) of Bandura (cited in Ponton and Carr, 2012), students' behaviour in learning is influenced by their personal characteristics and their environment. As a matter of fact, since autonomy and self-direction represent learners' behaviour, it is important for the teachers to structure learning contents and delivery methods as a scheme to encourage the expected acquisition attitudes.

The online discussion forum is a tool that is frequently used to include students' collaborative activities in learning (Thomas, 2002). According to Carré, Jézégou, Kaplan, Cyrot and Denoyel (2011), a collaborative dynamic allows learners to practice self-directed attitudes in the group: it encourages them, for example, to participate in making choices and organizing all aspects of their collaborative space while controlling their behaviour and actions during interactions. In relation to the implementation of a computer-mediated communication (CMC) application, such as the online discussion forum, Temperman, Walgraeve, Lièvre and Boumazguida (2017) state that to support a productive interaction among students in a learning scenario, the use of this tool must be adapted to the tasks or the subjects studied. Consequently, this work aims to seek answers to the question: how does the use of the online discussion forum promote students' self-direction in a blended learning context? It is hypothesized that the implementation of a discussion forum, in two levels of interaction, has a positive impact on students' self-direction.

1.1 Online discussion forum and students' self-direction

Temperman *et al.* (2017) have shown that the use of an online discussion forum has a positive impact on students' competence of analysis and conceptualization. By implementing the online discussion forum, Gettliffe, Dittel, and Delhaye (2012) have demonstrated its impact to increase students' self-reflexivity in learning and to maximize their participation in a blended learning course. Other researchers also confirm that the online discussion forum can be used to help students to review or discuss course materials prior to the face-to-face meetings, to bolster active learning (Macdonald, 2018), to promote the completion of a collaborative task (Thomas, 2002), to encourage students' interactions on an online learning platform (Cohen, Shimony, Nachmias and Soffer, 2018), and to enhance students' motivation (Ritchie and Black, 2012).

All of those positive aspects of a learning tool cannot be achieved without an effective instructional design (Jun and Ling, 2011) and the organization of the course content (Marquet, 2011). According to Ng, Cheung, and Hew (2012), there are three types of students' interactions in an online discussion forum, and each of them targets a different level: 1°) Participation (Low interaction level), 2°) Interaction (Medium interaction level), and 3°) Construction (High interaction level). Norris and Ennis (1989) cited in Thomas (2002) also distinguish students' interaction into three levels. However, they highlight the different levels of critical thinking, which spans from the lack of critical thinking in the message posted (low interaction level), to a higher level. Concerning collaborative tasks, Henri (1992) cited in Thomas (ibid) classifies students' interaction in an online discussion forum under four categories: 1°) Independent, 2°) Quasi-interactive, 3°) Interactive-elaborative, and 4°) Interactive-negotiating. Table 1 below summarizes various categories of interactions in an online discussion forum.

Table 1: Collection of interactions' categories in an online discussion forum

Category	Description related to the level of interaction (Ng, Cheung, and Hew, 2012)	Description related to the critical thinking and collaborative tasks (Norris and Ennis (1989), and Henri (1992) cited in Thomas, 2002)
Independent participation	Low interaction level. This category of interaction does not require collaboration because the tasks of each participant are to post a comment independently without any reference to the comments of others	This type of interaction does not encourage collaborative activities and critical thinking (lack of critical thinking opportunities)
Interaction	In this category, participants are invited to post a message by referring to others' messages as a preliminary point of reference but any possible analysis they do in this category of interaction is done in an isolated way.	This type of interaction leads a quasi-interactive collaboration which involves medium interaction level and critical thinking.
Construction	High interaction level. The activities provided are focused to encourage interaction among participants. The aim of the interaction on this level is to establish an understanding of a phenomenon and build or develop a knowledge by interacting with others.	This type of interaction promotes 1°) an interactive-elaborative collaboration which aims to develop the subject discussed, 2°) the interactive-negotiating collaboration, which focuses on encouraging students to debate and negotiate. The interaction in this category matches the characteristic of a high interaction level which involves a high level of critical thinking.

Self-direction is defined as a concept related to the ability of oneself to self-determine and self-regulate one's own actions or objectives (Carré, 2010). In self-direction, personal control is exercised entirely (Hadji, 2012); this makes self-direction a proactive form of autonomy. As defined by Littlewood (1999), proactive autonomy implies learners to manage the direction and their learning activities. According to the Triadic Reciprocal Causation (TRC) of Bandura (1986, cited in Ponton and Carr, 2012), students' behaviour in learning is influenced by their personal characteristics and their environment. Self-direction in a learning context can be understood as a behaviour resulting from a self-directed learning process (Ponton and Carr, 1999). This process, takes place in the environmental determinant of the TRC, provides students with the opportunities to have a control on the planification, the implementation and the evaluation of their own learning experience (Brockett and Hiemstra, 1991). To develop self-direction in learning, it is necessary for students to elicit critical thinking towards themselves and their environment. If each category of interaction in an online discussion forum encourages different levels of critical thinking, the medium level of interaction can be a stepping stone to this objective. Furthermore, it can be reached by implementing the high interaction level (construction). This starting point constructs the scenario involving two types of interaction in an online discussion forum (the medium and the high level of interaction) which are the experimental scenario of the present study.

2. Methods

2.1 Population observed

The study is about undergraduate students majoring in Arts, Modern Languages, or Social Sciences, and who enrolled in the Centre de Ressources et d'Apprentissage des Langues (CRAL) to learn English during the 2018-2019 academic year. At the beginning of the first semester in September, a placement test was submitted to the students to determine their language level. Then they were selected to form groups following their results on the test.

CRAL provides blended learning model for their students: every semester, students must spend 12 hours of work in the multimedia centre, 12 hours of workshop with the teacher, and 51 hours of autonomous work. These autonomous working hours are expected to be managed from anywhere (university campus, home, library…). All written or audio materials and exercises are provided on Moodle. In general, on this platform, activities focus on comprehension (listening and reading), while production tasks (writing and speaking) take place in workshops.

The materials constitute various thematic learning tracks that cover several weeks. Each learning track addresses the four language skills (reading, listening, speaking, and writing) which are also evaluated on Moodle and in the classroom (the workshop). Students can undertake from anywhere (on campus or at home) the activities provided on Moodle during their 51 hours of autonomous work. However, to complete the 24 on-site working hours, students must continue their activities on Moodle in the multimedia centre before attending the workshops under the supervision of the teacher. Some of the exercises on Moodle as well as the examinations are only accessible in the multimedia centre, which makes students' attendance compulsory.

The subjects of this study are students with B1 level of English proficiencies. According to the Common European Framework of Reference for Languages (CEFR), B1 level implies the capacity to undertake interaction by the expression of suggestions or opinions in informal discussion between friends. B1 students are also capable do discuss, negotiate, and to solve problems of daily life such as resolving an unpredictable situation in public transportation, organizing a trip, taking initiatives and expressing discontent (Council of Europe, 2018).

62 undergraduate students, from various fields of studies have participated in this experiment, on a voluntary basis. There were 19 students in the control groups and 43 students in the experimental groups (See Table 2). All the 62 participants were assured that their participation was confidential and anonymous. The forum was used by the experimental groups as an extension of the tasks that all the students have to perform. Therefore, the control groups were exposed to similar teaching strategies without the use of the online forum.

Table 2: Study sample

Course	Number of enrolments	Participants of the pre-test	Participants of the post-test	Participants of the pre and post -test	Participation rate of the pre and post-test (in %)
Control Groups					
Control Group 1	28	9	9	9	32%
Control Group 2	16	13	15	10	63%
Total	44	22	24	19	
Participation rate of Control group students (in %)					
In relation to the total student enrolment for the course			43%		

Course	Number of enrolments	Participants of the pre-test	Participants of the post-test	Participants of the pre and post -test	Participation rate of the pre and post-test (in %)
In relation to the total number of pre-test participants			86%		
Experimental groups					
Experimental Group 1	30	29	24	23	77%
Experimental Group 2	30	28	20	20	67%
Total	60	57	44	43	
Participation rate of experimental group students (in %)					
In relation to the number of enrolled students for the course			72%		
In relation to the total number of pre-test participants			75%		

Some of the pieces of information given at the introduction session of the forum to the experimental groups were: where to find the forum on Moodle; how to proceed once students have a post from another participant; the rules of politeness on Moodle; the languages styles (written, rather than spoken); the minimum length of messages.

The subjects discussed on the forum are devised as applications of the thematic learning tracks of the CRAL. The online discussion forums are organized in two levels of interaction involving two different subjects. Each level of interaction corresponds to a different subject. To deal with the first subject, the students are asked to engage in the level of “Interaction” (medium level of interaction): they respond to comments/messages of other students; and they use them as a starting point to post a comment without necessarily building knowledge together. For the second discussion subject, the interaction is more elaborated (high level of interaction, so-called “Construction”). The students are divided in small groups of 5 to 6 participants and are asked to discuss on a given topic, and to suggest solutions to problems. This task requires to determine together a common objective and a shared strategy. Actually, the goal of the second subject is to lead the students to express an idea or to elaborate on the discussed topic through arguments and negotiations. Chou and Chang (2018) suggest that a group of 5 students is the most appropriate for a study on learning through problem solving, but a group of 2 to 6 students is the most common. As a follow-up to the online forum, a discussion workshop was organized by the teacher to give feedback on the topics and to ask the students to express themselves in the target language. Table 3 details the schedule for each discussion which occurred every 3 to 4 weeks.

To sum up, for each discussed subject, students belonging to the experimental groups have to work on the forum, at least for two hours in the multimedia centre. During the workshops, they also have to discuss their activities in the online discussion forum for one hour. Furthermore, students are also encouraged to work on the online discussion forum during their 51 hours of autonomous work.

Table 3: Example of an online forum activities schedule for the experimental group 1

Topic studied Topic for the forum Level of interaction	: Personality : Dream flat mate : Medium		
Week #	Learning time	Estimated time for work on the forum	Description
Week 2	Workshop with the teacher	30 minutes	Introducing the forum
Week 3	Autonomous work in the multimedia centre	60 minutes	Work on the forum
Week 4	Autonomous work in the multimedia centre	60 minutes	Work on the forum
Week 5	Workshop with the teacher	30 minutes	Summary, discussion on arguments posted on the forum

Topic studied Topic for the forum Level of interaction	: Personality : Dream flat mate : Medium		
			and eventual feedback on written production
Week 6: Evaluation of oral and written comprehension 1			
Topic studied Topic of the forum Level of interaction	: Japan : Prepare a trip to Japan : High level		
Week #	Learning time	Estimated time for work on the forum	Description
Week 7	Workshop with the teacher	30 minutes	Introducing the forum
Week 8	Autonomous work in the multimedia centre	60 minutes	Work on the forum
Week 9	Autonomous work in the multimedia centre	60 minutes	Work on the forum
Week 10	Workshop with the teacher	30 minutes	Summary, discussion on arguments posted on the forum and eventual feedback on written production
Week 11: Evaluation of oral and written comprehension 2 Week 12: Review for CLES 1 and evaluation of oral production Week 13: CLES 1 examination			

2.2 Data and analysis procedures

As mentioned above, the main hypothesis of this research is that the implementation of a discussion forum, in two levels of interaction, has a positive impact on students' self-direction. To test this hypothesis, one type of data was collected and used through the Self-directed Learning Readiness Scale (SDLRS). This instrument, aimed to identify students' level of self-direction in learning, was created by Guglielmino (1977). It is a 58-item scale with a 5-point Likert scale, presenting one's attitudes ranging from "almost never true" to "almost always true".

For data analysis the paired samples t-test was applied to each group in order to determine any significant development of students' self-direction level. To better describe the results, an Analysis of difference that provides a gain score for each group was also conducted. The overall methodology is summarized in Table 4.

Table 4: Research methods and analysis framework

Objectives	Instruments	Analysis framework
Evaluate students' self-direction in learning before and after the course module	Self-Directed Learning Readiness Scale (SDLRS) (Guglielmino, 1977)	Paired samples t-test for the control and experimental groups

3. Online discussion forum and students' readiness to a self-directed Learning

This work aims to evaluate the impact of an online discussion forum for students' readiness to a self-directed learning. To highlight this aspect, students' answers to the SDLRS are compared. The variables of the observed groups are their level of self-direction before and after the course period. With the 86% of participation rate of the control groups and 75% of the experimental groups, a student t-test was conducted to identify any development or regression of students' self-direction over a semester.

3.1 Control groups

According to the results of the Analysis of difference, 55.6% of students from Control Group 1 have progressed, and only 33.3% students of the same group have regressed (See Table 5). This group has a gain score of 2.1% but according to the t-test results, their progression is not at a significant level yet (See Table 7). However, compared to the percentage of their regression, the score progression of Control Group 2 is very low (See Table 6). Indeed, their t-test result is not at a significant level (See Table 7). Figure 1 below represents the results' plot of each control group.

Table 5: Results overview for pre and post-test (control group 1)

	Number of students in %
Progression	55.6%
Regression	33.3%
Stable	11.1%
Total	100%
Gain score	2.1%

Table 6: Results overview for pre and post-test (control group 2)

	Number of students in %
Progression	30%
Regression	60%
Stable	10%
Total	100%
Gain score	-0,94%

Table 7: T-test results of control group 1 and 2

Control group	Mean score of the pre-test	Mean score of the post-test	t-test results
1	201.2	203.1	t=-0.524, p = 0.307
2	201.1	199.2	t=0.503, p = 0.686

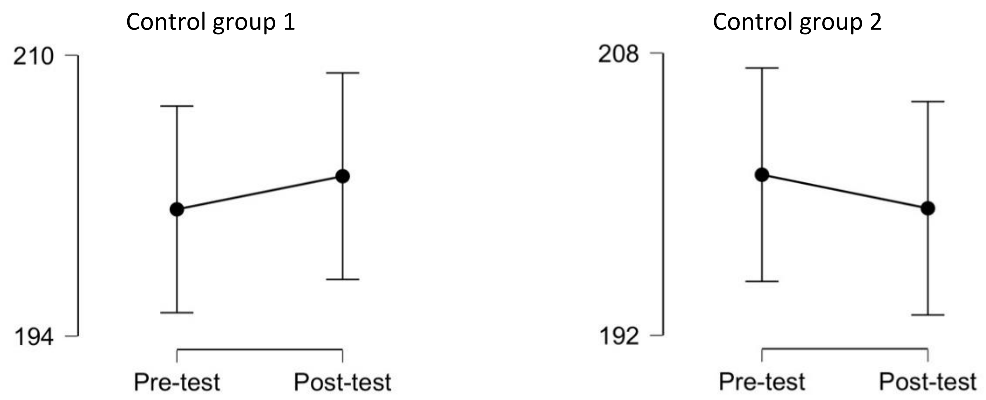


Figure 1: Illustration of t-test results for control group 1 and 2

3.2 Experimental groups

According to the results of the Analysis of difference, 65.2% of students from Experimental Group 1 have progressed, and 30.4% students of the same group have regressed (See Table 8). This group has a gain score of 6.8% and according to the t-test results, their progression is at a significant level (See Table 10). Compared to the percentage of the progression score of this group, students of Experimental Group 2 have a higher progression rate (See Table 9). Referring to the t-test results, students in this group have also significantly developed their self-direction over a semester (See Table 10). Figure 2 below represents the results' plot of each control group.

Table 8: Results overview for pre and post-test (experimental group 1)

	Number of students in %
Progression	65.2%
Regression	30.4%
Stable	4.3%
Total	100%

	Number of students in %
Gain score	6.8%

Table 9: Results overview for pre and post-test (experimental group 2)

	Number of students in %
Progression	75%
Regression	25%
Stable	0%
Total	100%
Gain score	9.5%

Table 10: T-test results of experimental groups 1 and 2

Experimental group	Mean score of the pre-test	Mean score of the post-test	t-test results
1	201.7	207.7	t=-1.557, p <.10
2	203.4	211.7	t=-2.328, p <.05

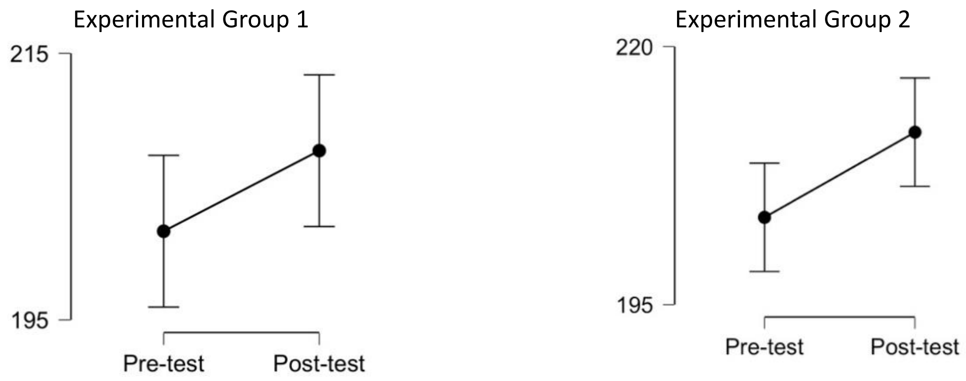


Figure 2: Illustration of t-test results for experimental groups 1 and 2

Figures 3 and 4 below show the dynamics of students' self-direction levels at the pre and the post-test of each experimental group. For Experimental Group 1, it appears that students' post-test results are more scattered, and the progression is more likely to be noticed through the number of students who develop their self-direction to a high level. For Experimental Group 2, however, it is clear that the progression is identified through an increase in the number of students who are at the intermediate level and a decrease in those who are at the low level of self-direction.

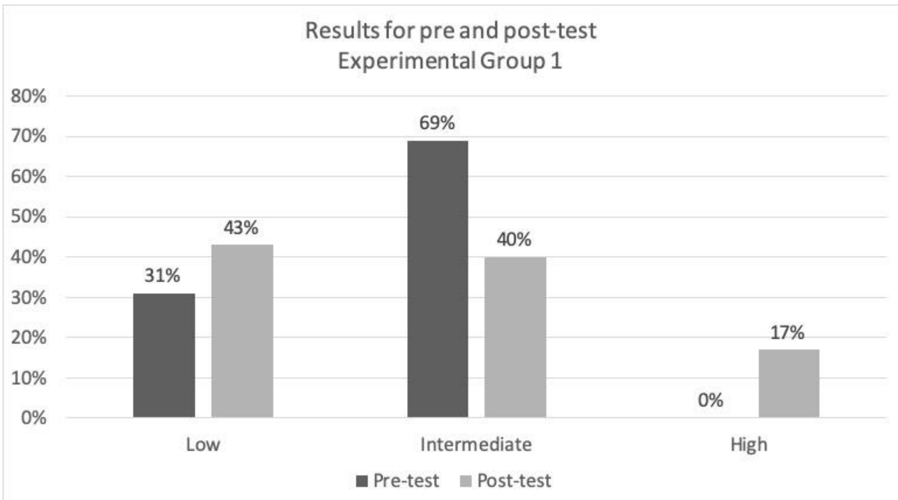


Figure 3: Students' self-direction levels at the pre and the post-test (experimental group 1)

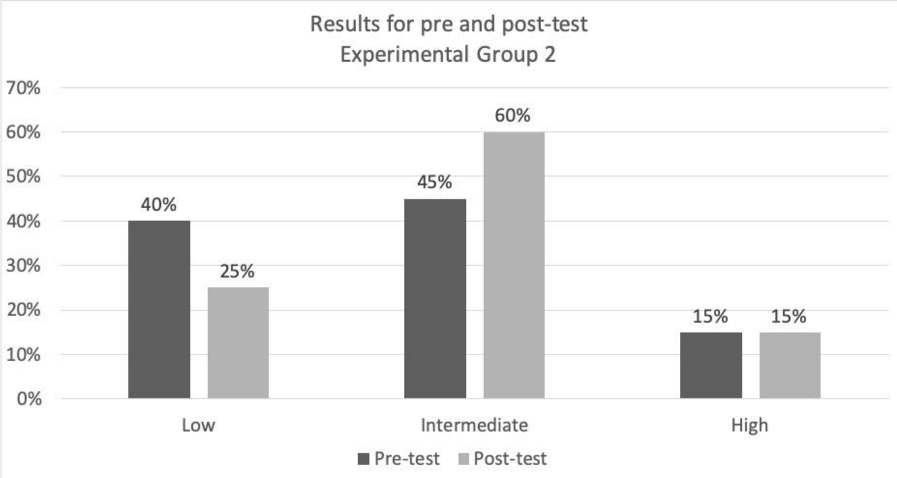


Figure 4: Students' self-direction levels at the pre and the post-test (experimental group 2)

4. Discussion and conclusion

The t-test results show that the development of students' self-direction occurs within the two experimental groups. The use of the forum invites students to complete some collaborative tasks on the online platform. Without the implementation of an online discussion forum, the general learning scenario that control groups have is slightly different from that of the experimental groups: the control groups still have online tasks, and they are related to their face-to-face activities with the teacher, but they are not invited to work on an online collaborative task which is available only in the forum.

For this experiment, the online discussion forums are organized in two levels of interaction. At the medium interaction level, so-called "Interaction" participants are invited to respond to a comment or a message from others. The aim of this stage is to encourage students to review the vocabulary items and the concepts learned. During the introduction of the course and the forum to the experimental groups at the beginning of the semester, most of the students declared that they did not have any experience in participating to an online discussion forum, in academic or non-academic contexts. Indeed, this stage can also be considered as essential to introduce how the forum works and to prepare students for the high level of interaction called "Construction".

At the level of "Construction", students are divided into smaller groups of 5 to 6 participants. One of the reasons of the implementation of an online discussion forum that has been highlighted from the beginning of this project is to support collaborative learning and students' critical thinking that may be beneficial for students' self-direction. Indeed, the group work is not synonymous of collaborative activities. On this matter, Summers and Volet (2010) state that the prerequisite of collaborative learning activities is the shared commitment of the participants to complete the task together. This includes a common understanding of the task in which the cognitive process required to complete it may be (heterarchically) divided into intertwined layers (Dillenbourg et al., 1996). The reason why the interaction level of "Construction" fits the most to support collaborative learning is because it aims to establish an understanding of a phenomenon and develop knowledge or an idea. At this stage of interaction, students are invited not only to discuss a subject but also to solve a problem or to negotiate by using their arguments and critical thinking.

According to Chou and Chang (2018), working in small groups shows a high satisfaction in individual's learning, skill development, and overall learning. Their work also shows that students in small groups demonstrate high satisfaction for learning performance, including writing proficiencies and problem solving. Indeed, referring to the findings of this project, it can be concluded that small group work, critical thinking, and collaborative learning activities introduced through an online discussion forum are beneficial for students' self-direction in learning.

Furthermore, this study offers instructional implications for EFL teachers who are willing to employ an online discussion forum in EFL blended learning contexts, and for instructional designers who attempt to implement collaborative learning. First, applying two levels of interaction in a discussion forum may enable a beneficial collaborative task. Second, collaborative learning involving activities that encourage critical thinking in the small-group format may enable students to develop their self-direction in learning. However, this instructional suggestion may only be suitable for another second language learning if the participants are recruited by the level of their second language, and the learning scenario provided follows the Common European Framework of Reference for Language, respectively.

According to Temperman *et al.* (2017), the participation to a discussion forum in which the tasks relate to the construction of an argument requires a high cognitive work. The work of Chou and Chang (2018) state also that small group works introduce various benefits for students' learning related to their performance, writing proficiencies, and skill development. Indeed, it can be assumed that the instructional design suggested by this study may also influence students' learning outcomes, but future research is required to verify this hypothesis.

Acknowledgments

This research is financed by the Indonesian Endowment Fund for Education (LPDP) and supported by LISEC EA-2310, University of Strasbourg.

References

Alava, S. (1999) "Médiation (s) et Métier d'Étudiant". *Bulletin des bibliothèques de France (BBF)*, pp 8–15.
Annoot, E. (2012) *La Réussite à lUuniversité: du Tutorat au Plan Licence*. De Boeck, Bruxelles.
Brockett, R.G., Hiemstra, R. (1991) *Self-direction in Adult Learning: Perspectives on Theory, Research, and Practice*. Routledge, London.
Carré, P. (2003) "La Double Dimension de l'Apprentissage Autodirigé, Contribution à une Théorie du Sujet Social Apprenant", *Canadian Journal for the Study of Adult Education*, vol 17, No. 1, pp 66–91.
Carré, P. (2010) *L'autodirection des Apprentissages, in L'Autoformation, Perspectives de Recherche*, Press Universitaire de France, Paris.
Carré, P., Jézégou, A., Kaplan, J., Cyrot, P. and Denoyel, N. (2011) "L'Autoformation: The State of Research on Self-Directed Learning in France", *International Journal of Self-Directed Learning*®, vol 8, No. 1, pp 7–17.
Chou, P.-N., Chang, C.-C. (2018) "Small or Large? The Effect of Group Size on Engineering Students' Learning Satisfaction in Project Design Courses", *Eurasia Journal of Mathematics, Science and Technology Education,* vol 14, No.10.
Cohen, A., Shimony, U., Nachmias, R., Soffer, T. (2018) "Active Learners' Characterization in MOOC Forums and Their Generated Knowledge, *British Journal of Educational Technology,* vol 50, No. 4, pp 1–22.
Council of Europe (2018) *Common European Framework of Reference for Languages: Learning, Teaching, Assessment. Companion Volume with New Descriptors*, Cambridge University Press, Strasbourg.
Deschryver, N., Charlier, B. (2012) *Dispositifs Hybrides, Nouvelle Perspective Pour une Pédagogie Renouvelée de l'Enseignement Dupérieur* (Rapport final No. S03228- LLP- I-2009-1- FR- ERASMUS- EMHE), 2012. HY-SUP.
Dillenbourg, P., Baker, M.J., Blaye, A., O'Malley, C. (1996) *The Evolution of Research on Collaborative Learning, in Learning in Humans and Machine: Towards an Interdisciplinary Learning Science*. Elsevier, Oxford, pp. 189–211.
Freire, P. (2014) *Pédagogie de l'Autonomie*. Eres, Toulouse.
Gettliffe, N., Dittel, J. and Delhaye, A. (2012) "Guider l'Autonomie par les Forums de Discussions Électroniques", *Les langues modernes,* vol 3, pp 47–54.
Guglielmino, L. (1977) *Development of the Self-Directed Learning Readiness Scale*, (Doctoral thesis), University of Georgia, United States.
Hadji, C. (2012) *Comment Impliquer l'Elève dans ses Apprentissages: l'Autorégulation, une Voie pour la Réussite Scolaire*. ESF éditeur, Issy-les-Moulineaux.
Jun, L. and Ling, Z. (2011) "Improving Flexibility of Teaching and Learning with Blended Learning: A Case Study Analysis", *Hybrid learning*, pp 251–261.
Kintu, M.J., Zhu, C. and Kagambe, E. (2017) "Blended Learning Effectiveness: The Relationship Between Student Characteristics, Design Features and Outcomes", *International Journal of Educational Technology in Higher Education,* vol 14, No.7.
Littlewood, W. (1999) "Defining and Developing Autonomy in East Asian Contexts", *Applied Linguistics*, vol 20, pp 71–94.
Macdonald, S. (2018) "Online Discussion Forum", [online], Graduate Student Instructor: Teaching and ressource center. Berkeley University, https://gsi.berkeley.edu/gsi-guide-contents/technology-intro/gsi-examples/online-discussion-forums/
Marquet, P. (2011) "e-Learning et Conflit Instrumental: Entre Didactique, Pédagogie et Technique", *Recherche & formation*, vol 68, pp 31–46.
Meirieu, P. (2015) "Dictionnaire des Definitions", [online], Philippe Meirieu <http://www.meirieu.com/DICTIONNAIRE/autonomie.htm>, et <http://www.meirieu.com/CLASSEAUQUOTIDIEN/formationautonomie.htm>
Ng, C.S.L., Cheung, W.S. and Hew, K.F. (2012) "Interaction in Asynchronous Discussion Forums: Peer Facilitation Techniques", *Journal of Computer Assisted Learning*, vol 28, pp 280–294.
Page, J., Meehan-Andrews, T., Weerakkody, N., Hughes, D.L. and Rathner, J.A. (2017) "Student Perceptions and Learning Outcomes of Blended Learning in a Massive First-year Core Physiology for Allied Health Subjects, *Advances in Physiology Education*, vol 41, pp 44–55.

Ponton, M.K. and Carr, P.B. (1999) *A Quasi-Linear Behavioral Model and an Application to Self-Directed Learning*, Nasa Center for AeroSpace Information, Virginia.

Ponton, M.-K. and Carr, P.B. (2012) "Autonomous Learning and Triadic Reciprocal Causation: A Theoretical Discussion", *International Journal of Self-Directed Learning*, vol 9, No. 1, pp 1–10.

Raucent, B., Verzat, C. and Villeneuve, L. (2010) *Accompagner des Étudiants : Quels Rôles pour l'Enseignant ? Quels Dispositifs? Quelles Mises en Oeuvre ?* De Boeck, Bruxelles, Belgique.

Ritchie, M. and Black, C. (2012) *Public Internet Forums: Can They Enhance Argumentative Writing Skills of Second Language Learners?* Foreign Language Annals, vol 45, pp 349–361.

Summers, M. and Volet, S. (2010) "Group Work Does Not necessarily Equal Collaborative Learning: Evidence From Observations and Self-Reports", *European Journal of Psychology of Education,* vol 25, pp 473–492.

Temperman, G., Walgraeve, S., de Lièvre, B. and Boumazguida, K. (2017) "Développer des Compétences de Conceptualisation et d'Analyse avec un Forum de Discussion et un Etherpad"*, sticef,* vol 24, pp 151–179.

Thomas, M.J.W. (2002) "Learning within Incoherent Structures: The Space of Online Discussion Forums", *Journal of Computer Assisted Learning,* vol 18, pp 351–366.

Uz, R. and Uzun, A. (2018) "The Influence of Blended Learning Environment on Self-Regulated and Self-Directed Learning Skills of Learners", *EUROPEAN J ED RES*, vol 7, pp 878–886.

Wilson, L.E. and Sipe, S.R. (2014) "A Comparison of Active Learning and Traditional Pedagogical Styles in a Business Law Classroom", *Journal of Legal Studies Education*, vol 31, pp 89–105.

The Impact of m-Learning on Business Students' Performance

Amani Albinali and Allam Hamdan
Ahlia University, Manama, Bahrain
allamh3@hotmail.com
DOI: 10.34190/EEL.19.178

Abstract: Recent developments in the field of technology have led to a renewed interest in classroom learning method. there has been a dramatic increase from the use of electronic lessons to the integration of mobile learning "M-learning" into the education which has vastly been adopted by students. Despite its convenience, flexibility and portability. Lack of empirical evidence has appeared to drawback the effectiveness of mobile learning on students' academic performance and learning attitude. The purpose of this paper is to explore the impact of M-learning in the form of learning applications and social media platforms on teaching and learning commercial subjects in high school students and their performance in the kingdom of Bahrain. It is conducted to understand how M-learning affects the learning process, and in which way it affects the learner's' ability and how it facilitates the learner's' understanding of the different subject matter. This paper attempts to demonstrate the argument of using M-learning as a as a break from routine or if it does have a stronger more positive impact on students' performance. The importance of this research paper is to help raise student's grade point average and grades. Furthermore, eliminate any methods that are redundant and that have a poor impact on the learning process and affect students understanding of the subject material negatively.

Keywords: m-learning, education, e-learning, smart phones, smart boards, performance

1. Introduction

In this modern age of technological advancements that have become a part of our daily lives, it is prudent to take note of the incorporation of technology into the educational system (Seamean & Tinti-Kane, 2013;Davis et al. 2012; Kim, 2012). We have come a long way from the traditional teaching method of a teacher providing a group of students with subject materials where the students have little to no participation in the learning process, to an interactive student centered learning environment, that fuses e-learning with numerous teaching strategies in the teacher's lesson plans (Mockus et al ,2011).

The educational system in the kingdom of Bahrain has improved quite rapidly during the past 10 years, From the use of computers to the instillation of smart boards and projectors in the classrooms to assist educators in presenting and showcasing main lesson concepts and information in a simplified and clear manner that is allegedly supposed to help students grasp the intended learning objectives easily. As well as the ministry of education's implementation of many projects mainly "His Majesty King Hamad's Schools of the Future" as part of the Government's 2030 vision (Dutta,2016).

Recently, there has been a shift towards the inclusion of Mobile learning "M-learning" in the classroom, which includes incorporating mobile devices in teaching strategies, where the use of Game based learning applications like Kahoot!, Plickers and Qr codes as well as YouTube to create an interactive tech savvy learning environment that students can also access at home through their smart phones and tablets(Nikou & Economides, 2018). Many workshops and sessions are held to train and assist teachers in implementing M-learning in their lessons (Anderson & Horrigan, 2016). Despite the credibility and status gained by E-leaning across many contextual setting in the West ; however there is a scarcity of research in the Middle East about the effectiveness of applying mleanring at educational aspects in particular at the classroom. Therefore there is a call for further research to investigate this phenomena at the educational setting and the impact of m learning at several areas such as humanities, science, and art(Peng et al., 2009; Amry, 2014). This paper seeks to review literature on understanding the effects of m-leaning process at educational and facilitating the learners potential in using using mobile devices such as tablets, smartphones, and laptops (McCombs & Liu, 2011; Ostashewski et al., 2011; Pelet and Papadopoulou, 2014).

2. Literature review

2.1 E-learning

The use Educational technologies encompasses e-learning pedagogy and are becoming widespread in the learning process and teaching practices by for researchers and practitioners (Gedik, Karademirci,Kursun, & Çağıltay, 2011). The use of personal computers has evolved over time and amplified the use of mobile devices and social media platforms at teaching. The emergence of the latter devices and media and amplified encouraged a new learning methodology at schools and Universities i.e mobile-learning (M-learning) (Sharples, Taylor, & Vavoula, 2007: 224). At the present time e-learning applied at teaching and delivering aspects, it illustrates the use of three classical levels:

Traditional Classroom	This method pertains in using technology at leaning to support face to face by shifting from using slides to portals to save documents related to the courses.
Blended Learning	This method stresses on reducing face to face method between the students and the lecturer. it combines using technology to replace part of face to face communication
Online Learning	This approach replaces face to face interaction between the students and the lecturers with Online Learning. (Pelet and Papadopoulou, 2014).

Numerous studies have attempted to explain the application of technology at different contextual setting (Pelet and Papadopoulou, 2014). At the present time even the traditional classroom setting is being supported by computers and software such as Power Point which could affect the leaning process positively in terms of communication, and collaboration among learners (Frey & Birnbaum, 2002 ;Sung,Chang, & Liu, 2016; Adams Becker et al., 2017).

Pelet and Papadopoulou (2014) draws our attention to distinctive categories of using slides for teahcing which often observed in causing rigidity to the teaching and limiting the instructor flexibility and interactivity for teaching with using only the slides as a tool for delivering the material. Elsewhere, Chee, Yahaya, Ibrahim, & Noor Hassan (2017) and Wu et al., (2012). Have argued about students preference on using mobile devices frequently than any other devices in the classroom. Pelet and Papadopoulou (2014) maintains using blended learning including online learning and face-to-face approach claiming its positive impact on students interaction and involvement in the learning process.

Recent researches have focused on devices such as tablets, studying usage of this new generation of mobile devices in teaching in a classroom (e.g. McCombs & Liu, 2011; Ostashewski et al., 2011). Blended Learning uses online learning activities in addition to face-to-face or in replacement of face-to-face time. This approach has been found to increase understanding, interaction, and involvement in the learning process (Kenney & Newcombe, 2011).this view is supported by (Kenney & Newcombe, 2011 McCombs & Liu, 2011; Ostashewski et al., 2011) who centred devices such as mobile devices and tablets in teaching in the classroom.

Pelet and Papadopoulou (2014) identifies the courses delivered online with no face-to-face interaction where leaning can be asynchronous by using videos, forums, live sessions by allowing virtual face to face interaction with the instructor and students.

In many researches about forms of e-learning (Siqueira, Braz & Melo, 2007; Bernardin, 2012) a debate continues about the multifaceted aspect of e-learning between using it in the field of higher education and at business perspective (Scott et al., 2007). The controversy about scientific evidence for Pelet and Papadopoulou (2014) has raged unabated since the invention of wireless communication indicating deploying e-leaning in business opportunities Gedik, Karademirci, Kursun, & Çağıltay, 2011; Bernardin, 2012).

2.2 M-Learning

M-learning technology or mobile learning has developed rapidly over the present time. Inspire of its different perspectives including e-learning, mobility, individualism, and ubiquitousness. The initial definitions of m-leaning has been related to the act of learning across multiple contexts through social and content interactions, using personal electronic devices, (Koszalka & Ntloedibe-Kuswani, 2010; Crompton, 2013).

M-learning technologies consist of using tablets, smart phones, IPods and many hand held devices. (Trentin &Repetto, 2013). It focuses on using various platforms and applications to increase the learner's interactions and mobility in the learning environment. In an educational context, these devices offer varied learning opportunities such as mobility, social interactivity, portability, connectivity, context sensitivity, individuality in both an academic and non-academic environment (Crompton, 2013). Mobile devices are used to create a student centered learning process, and to enhance group and team collaborations. (Murray & Olcese, 2011).

2.3 Learners' perceptions of m-Learning

The past fifteen years have seen increasingly rapid advances in M-learning. Several studies pre 2005 in this area was few and sporadic, M-learning research has recently spread globally with studies in North America, Africa, Europe, Asia and Scandinavia to name a few. Chronologically, research concerning mobile learning has been classified into the following phases: firstly, focus regarding the mobile devices, Secondly, learning outside the classroom. And lastly, the portability and mobility of the learner (Cochrane,2013).

Several studies revealed that Mobile learning has become widely used in an array of places and institutes such as schools, training centers, museums, universities and more (Mandeep,2010). Presently, areas of growth include location based and contextual learning, mobile educational gaming, social network mobile learning, testing, surveys and Just in time learning (Tenya,2011).

The methods of utilizing m-learning varies, it encompasses several approaches such as in class applications of handheld devices with different educational gaming applications and voting systems. As well as, classroom management and distance learning (Robinson & Reinhart, 2014).

In addition, studies found several benefits to m-learning including lower costs due to decrease in training costs and mobile devices relative inexpensiveness in comparison to Pc's and laptops. As well as, multimedia content creation and delivery and continuous support from fellow learners and teachers (Tenya, 2011; Crescente & Lee, 2010; Tenya, 2011). Though m-learning does provide some advantages, it also has some challenges that must be taken into regards when considering utilization, such as connectivity, screen size, battery life, security, limited memory and more Pelet and Papadopoulou, 2014 ;Gikas & Grant, 2013; Song & Kong, 2017).

It is made clear by (Nikou & Economides, 2018), after conducting an experiment on senior high school students that the effectiveness of Mobile based micro learning and assessment is greater than conventional paper-based methods. It was found that students showed enhanced competence and improved exam performance. Furthermore, (Montrieux & Schellens, 2018), concluded that the use of Tablet devices in the classrooms to relieve cognitive load had a positive effect on students gained knowledge and performance on the given assessment tasks. Moreover, (Ali & Arshad, 2017) investigated student's perception on the use of m-learning in Egyptian schools. The study revealed that students showed a positive attitude towards m-learning because it provides them with access to various information and creates an enjoyable learning experience.

However, in a study held by (Males, et al, 2017) found that mobile learning has had a minimal effect on student performance as gauged by standardized testing National Assessment Program for Literacy and Numeracy (NAPLAN). Though, it was made apparent that limitations on the study in the form of a limited timeframe as well as the study was limited to one geographical and social location represented in a single school, may have had an effect on the results. Thus, generalization of the findings should be preceded with caution. (Xue, Zhang & Luo,2018)'s study rejects the belief that mobile learning can yield greater academic performance as the results show no substantial difference in the test results. Conversely, this also proves that m-learning is suitable as an alternative to traditional teaching methods thus entailing similar learning results.

Hence, the application of mobile learning and their impact on student performance may yield some positive results through enhancing their gained knowledge, critical thinking as well as their overall exam and assessment performance. Though some studies have concluded no significant impact on students' performance, it may be prudent to consider M-learning as a substitute to conventional teaching methods to create a more interactive and flexible learning environment.

3. Conclusion

After reviewing various previously conducted researches, most have agreed on a common definition and benefits for utilizing mobile learning in and out of the classroom. Where learners are able to connect, interact as well as have the ad-vantage of portability while learning creating a socially interactive and versatile learning environment. However, some contradictions were found between some of the studies where some researchers' advocate the use of M-learning for the results produced an increase in student performance and satisfaction. As well as, enhanced competence and improved exam results. On the other hand, others found that using M-learning had little to no impact on student performance and served as merely a replacement for traditional learning techniques as students produced similar results. Though it might be vital to regard the geographic and sample limitations of the study. Finally, it is imperative to take not that though the results of the studies vary, it is essential to consider a break from routine and utilize M-learning to create an interactive learning environment in and out of the classroom.

References

Adams Becker, S., Cummins, M., Davis, A., Freeman, A., Hall Giesinger, C., & Ananthanarayanan, V. (2017). NMC horizon report: 2017 higher education editionAustin,Texas: The New Media Consortium.

Ajjan, H. & Hartshorne, R. (2008). Investigating faculty decisions to adopt web 2.0 technologies: Theory and empirical tests. The Internet and Higher Education, 11(2), 71-80.

Ali, R. A., & Arshad, M. R. M. (2017).Investigating the Perception of Students Regarding M-Learning Concept in Egyptian Schools. International Journal of Inter-active Mobile Technologies, 11 (6), 112–122.

Anderson, M. (2016). More Americans using smartphones for getting directions, streaming TV. Washington, D.C.: Pew Research Center Retrieved from http://www.pewresearch.org/fact-tank/2016/01/29/us-smartphone-use/.

Arpita Dutta. Effectiveness of E-learning in Public schools: Case of Bahrain. Journal of Empirical Research in Accounting& Auditing. ISSN (2384-4787) J. Emp. Res. Acc. Aud. 3, No. 2, October-2016.

Bernardin, E. (2012) Content usage and harmonization as factors for LMS adoption, ICIS Waset, Kuala Lumpur.

Chee, K. N., Yahaya, N., Ibrahim, N. H., & Noor Hassan, M. (2017). Review of mobile learning trends 2010-2015: A meta-analysis. Educational Technology & Society, 20(2), 113–126.

Cochrane. T. (2013). A Summary and Critique of M-Learning Research and Prac-tice.

Crescente, M.L., & Lee, D. (2010). Critical Issues of m-Learning: Design Models,Adoption Processes and Future Trends. Journal of Chinese Institute of Industrial Engineers, 28(2), 111-123.

Crompton, H. (2013). A historical overview of mobile learning: Toward learner-centered education. (pp. 3–14).

Davis, C., Deil-Amen, R., Rios-Aguilar, C., & Gonzalez-Canche, M. (2012).Social media and higher education: A literature review and research directions.Report printed by the University of Arizona and Claremont Graduate University.

Frey, B. A., & Birnbaum, D. J. (2002). PowerPoint-Based Lectures in Business Education: An Empirical Investigation of Student-Perceived Novelty and Effectiveness, Business Communication Quarterly, September 2008 71: 277-296, first published on July 17, 2008.

Gedik, N., Karademirci, A.H., Kursun, E., & Çağıltay, K. (2011). Key Instructional Design Issues in a Cellular Phone-based Mobile Learning Project.Computers & Education, 1149-1159.

Gikas, J., & Grant, M. M. (2013). Mobile computing devices in higher education: Student perspectives on learning with cellphones, smartphones & social media. The Internet and Higher Education, 19, 18–26 (∗).

Jean Eric Pelet, Jashim Khan, Panagiota Papadopoulou, Emmanuelle Bernardin. M-Learning: Exploring the Use of Mobile Devices and Social Media. Neeta Baporikar. Handbook of Research on Higher Education in the MENA Region: Policy and Practice, IGI Global, 2014, 9781466661981. ⟨hal-01132039⟩

Kenney, J., & Newcombe, E. (2011). Adopting a blended learning approach: challenges encountered and lessons learned in an action research study. Journal of Asynchronous Learning Networks. 15 (1), pp. 45-57.

Kim, H. (2012). A study on the possibility of development of social media literacies using Facebook. Korean Journal of the Learning Sciences, 6(2), 20-38.

Koszalka, T. & Ntloedibe-Kuswani, G. (2010). Literature on the safe and disruptive learning potential of mobile technologies,Distance Education, pp. 139-157.

Males, S., & Bate, F., & MacNish, J. (2017). The impact of mobile learning on student performance as gauged by standardized test (NAPLAN) scores. 27. 99-114.

Mandeep, S (2010). "M-learning: A New Approach to Learn Better". International Journal of Education and Allied Sciences. 2 (2): 65–72

McCombs, S. & Liu, Y. (2011). Channeling the channel: Can iPad meet the needs of today’s M-Learner. In Proceedings of Society for Information Technology & Teacher Education International Conference 2011 (pp. 522-526). Chesapeake, VA: AACE.

Mockus, L., Dawson, H., Malizia, S.E., Shaffer, D., An, J.S., & Swaggerty, A.(2011). The Impact of Mobile Access on Motivation: Distance Education Student Perspectives. Retrieved from http://learningdesign.psu.edu/research/MLRTWhitePaper.pdf

Montrieux, H., &Schellens, T. (2018).The impact of tablet devices on high school students’ cognitive load and learning.12th international technology, education and development conference (pp. 1591–1596).

Murray, T., & Olcese, N. (2011). Teaching and Learning with iPads, Ready or Not?

Nikou, S., & Economides, A. (2018). Mobile-Based micro-Learning and Assess-ment: Impact on learning performance and motivation of high school students. Jour-nal of Computer Assisted Learning. 34. 10.1111/jcal.12240.

Ostashewski, N., Reid, D. & Ostashewski, M. (2011). The iPad as mobile teaching device: multimedia database access in a classroom context. In Proceedings of Global TIME 2011 (pp. 49-53). AACE.

Peng, H., Chuang, P., Hwang, G., Chu, H., Wu, T., & Huang, S. (2009). Ubiquitous performance-support system as mindtool: A case study of instructional decision making and learning assistant. Educational Technology & Society, 12(1), 107–120.

Robinson, R. & Reinhart, J. (2014). Digital Thinking and Mobile Teaching: Com-municating, Collaborating, and Constructing in an Access Age.

Scott, B., Shurville, S., Maclean, P. and Cong, C. (2007). Cybernetic principles for learning design. Kybernetes, Vol. 36, N° 9/10, pp. 1497-1514.
Sharples, M., Taylor, J., & Vavoula, G. (2007). A theory of learning for the mobile age. In R. Andrews, & C. Haythornthwaite (Eds.), The sage handbook of Elearning research, (pp. 221–247). London: Sage.
Siqueira, S.W.M., Braz, M.H.L.B. and Melo, R.N. (2007). Modeling e-learning content, International Journal of Web Information Systems, 3, (1/2), pp. 140-152.
Song, Y., & Kong, S. C. (2017). Affordances and constraints of BYOD (Bring Your Own Device) for learning and teaching in higher education: Teachers' perspectives.The Internet and Higher Education, 32, 39–46. https://doi.org/10.1016/j.iheduc.2016.08.004.
Sung, Y., Chang, K., & Liu, T. (2016). The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis and research synthesis. Computers & Education, 94, 252–275.
Tanya, E (2011). "Universal Instructional Design Principles for Mobile Learn-ing". International Review of Research in Open and Distance Learning.
Trentin, G., & Repetto, M. (2013). Using Network and Mobile Technology to Bridge Formal and Informal Learning.
Wu, W., Wu, Y., Chen, C., Kao, H., Lin, C., & Huang, S. (2012). Review of trends from mobile learning studies: A meta-analysis. Computers & Education, 59, 817–827.
XUE, J., & ZHANG, X., & Luo, H.(2018). Effects of Mobile Learning on Aca-demic Performance and Learning Attitude in a College Classroom. DES tech Trans-actions on Social Science, Education and Human Science.

Online Environments for Supporting Learning Analytics in the Flipped Classroom: A Scoping Review

Muriel Algayres and Evangelia Triantafyllou
Department of Architecture, Design & Media Technology, Aalborg University, Copenhagen, Denmark
mgal@create.aau.dk
evt@create.aau.dk
DOI: 10.34190/EEL.19.063

Abstract: The Flipped Classroom (FC) is an instruction method, where "events that have traditionally taken place inside the classroom now take place outside and vice versa", which has known a significant surge of popularity in the past decade. In FCs, different types of activities may take place depending on the session type (pre-class, in-class, or after-class), the learning objectives to fulfil, the type and size of the class, the available infrastructure, the time available etc. In order to support the activities taking place in FCs, instructors can use various technological tools and online environment, especially to support the preparation of students before class. A marked recent trend in the FC is the increased use of Learning Analytics (LA) to support the development of the FC and students' reflexive learning. However, there has been no systematic investigation into combining LA and the FC, and it appeared that there was a lack of research on the issue. The aim of this paper is to investigate the literature on applications of LA in FCs, and to determine the best practices and needs for technological development supporting LA in the FC. In order to perform this study, we did a scoping review of literature in the subject to determine research trends in the use of LA in the FC. We conclude that there is great potential to use LA in the FC, and try to project where further research is heading.

Keywords: active learning, flipped classroom, learning analytics, virtual learning environment, MOOCs

1. Introduction

The FC is possibly one of the most emblematic endeavours to overhaul educational practices in recent years. Faced with the need to engage students, and with disaffection from the traditional lecture-based model, educational institutions turned towards active learning to shift "…the focus of learning from passively receiving content information to diligently participating in learning activities" (Frey, 2018). In that regard, the FC, where "…events that have traditionally taken place inside the classroom now take place outside the classroom and vice versa" (Lage et al., 2000) is a concrete application of the principles of active learning. After a first decade of developments and tests of the model, the FC is undergoing further developments, amongst which the increased use of LA (Fernández et al., 2018).

1.1 The Flipped Classroom (FC)

Interest for the FC however rose sharply in the early 2010s, following its popularization in secondary education in the Unites States (Bergmann & Sams, 2009). It is now frequent in higher education, as a means to engage an increasingly diverse and flexible population of students (Reidsema et al., 2017). Abeysekera and Dawson (2015) provide a "lowest common denominator" definition; defining the FC as "a set of pedagogical approaches that (1) move most information-transmission teaching out of class, (2) use class time for learning activities that are active and social and (3) require students to complete pre- and/or post-class activities to fully benefit from in-class work."

The FC methodology has been frequently reviewed and studied, and interest in the methodology has remained constant in the past decade (Bishop & Verleger, 2013; O'Flaherty & Phillips, 2015; Zainuddin & Halili, 2016). The FC has been recognized as an effective learning approach in various courses: it gives teachers more time for personalized interactions with students, improves students' creative thinking and communication skills, and encourages students' responsibility in their learning (Lin & Hwang, 2018).

1.2 Learning analytics

Based on the most commonly cited definition, "LA is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs." (Siemens & Long, 2011). Figure 1 presents the different steps in the LA process.

Figure 1: The different steps in the LA process

LA aim at providing ways to gather and make sense of educational data, which is is generated while educators and learners interact with digital technologies, in order to improve the learning experience for learners and teachers, and better adapt courses' design. Although LA is a relatively young field, it might prove crucial in further developments of the FC since it can inform teachers about the learning process of the students, and teachers can in turn use this information to make informed pedagogical decisions (Van Leeuwen, 2018). The method also encourages adaptive learning and self-regulated learning: learners can improve their meta-cognitive abilities with information to reflect on their own learning, and teachers can create a feedback loop between online and classroom phases to assess the progress and needs of students (Klemke et al., 2018).

1.3 Combining the flipped classroom and learning analytics

Although both the FC and LA have both been active fields of studies, research in combining them is still rare. According to Fernández et al. (2018), early research focused on the results obtained in the FC, or used specific indicators to obtain useful information for the FC. However, that research did not indicate precisely what the best tools were, or what specific learning activities they could support.

This article means therefore to complete the existing literature by examining the potential in combining the FC and LA through a scoping review of the existing literature. We believe that examining previous use of LA in the FC will allow us to determine how LA have been used successfully, and where use of LA is still lacking. There are several advantages to using a scoping review. According to Arksey and O'Malley (2005), it allows researchers to examine the extent, range and nature of the research activity, to determine the value for undertaking a full systematic review, to summarize and disseminate research findings, and to identify gaps in existing literature. We will therefore research the implementation of LA in the FC, and determine the best practices, the limitations, and how it can be improved.

2. Methodology

For this paper, we have used Arksey and O'Malley's methodology (2005), as expanded by Levac et al. (2010). The scoping review method uses the stages presented in the following sections.

2.1 Stage 1: Identifying the research question

The focus of this research is to explore the key factors to use LA in the FC. We also want to examine how LA can improve the FC model. To ensure that a substantial range of literature was examined, we followed the initial research questions to guide the search:

- Which type of data and learning theories can be used to implement LA in the FC?
- What were the educational outcomes of using LA in the FC?
- What were the main limitations in the use of LA in the FC?

2.2 Stage 2: Identifying relevant studies

Arksey and O'Malley suggest that a wide definition for search terms should be used. Therefore, we opted for a large selection of related terms, which covered various forms of LA. The following research string was thus devised:

("flipped classroom") AND (("learning analytics") OR ("engagement data") OR ("educational data") OR ("activity data") OR ("data mining")). The selection was then restricted to research that specifically used LA in the FC.

The selected databases for this study were Scopus, Proquest, Web of Science and Google Scholar. Only peer-reviewed articles and papers, accessible in English, and in the period 2009-2019 (which coincides with the exponential development of the FC and LA) were researched.

2.3 Stage 3: Study selection

Using the key search descriptors, we identified 90 articles. Duplicates, papers covering theoretical models, reviews or workshop descriptions lacking any results were excluded. We finally ended with a final selection of 39 articles.

2.4 Stage 4: Charting the data

The data extracted from the selection of articles was mapped using the following criteria: Study ID, Database, Paper title, Journal/proceeding, Author, Year, Country of study, LA algorithms, Data extracted, Feedback to students, Position in the FC, Level of class, Subject, Size of class, Control group (if applies), Outcomes, Evaluated variables, Methodology, Evaluation of performance (grade, knowledge test, learning outcomes), Evaluation of students perception (self-reported opinion, interviews, interest, attitudes), Student experience (motivation, stress level, engagement, participation, cognitive load), Theoretical framework, Limitations.

2.5 Stage 5: Collating, summarizing and reporting the results

The final stage of the scoping review summarizes and reports findings.

3. Findings

The 39 selected articles represented 15 countries of study. Most studies were conducted in the USA (8 articles), then in China (including Hong Kong) (7 articles), then Australia (5 articles), and many other countries such as the UK, Spain, and Brazil. The oldest article is from 2014, illustrating the rather recent interest of development of LA in the FC. The majority of articles, 15 out of 39, were published in 2018, and with 5 articles for the first half of the year 2019, the trend remains solid. All but three studies were conducted in University classes, with a significant majority of STEM related subjects: Computer science (9 articles), Engineering (8 articles), Math (4 articles) and Science (3 articles). We may explain this finding by the fact that such subjects allowed researchers easier access to data mining algorithms, technical support, and statistical proficiency.

3.1 Which type of data and learning theories can be used to implement LA in the FC?

Data mining and exploitation of Learning Management System (LMS) traces, especially in Moodle, is the main source of data in the articles we reviewed, appearing in 29 articles (e.g. Gelan et al., 2018; Yamada & Hirakawa, 2015). LMS traces can be varied, but usually cover such basics as time spent on lesson (Matcha et al., 2019), completion of online activities (e.g. Poon et al., 2017; Ayres et al., 2018), and regularity and frequency of engagement with the platform (e.g. Jovanovic et al., 2019).

A significant number of studies focused on the pre-class preparation through engagement with the video lectures, with 9 articles (e.g. Xiao et al., 2015). In these articles, the focus was on data as interactive notetaking (Hecking et al., 2017; Pardo et al., 2015), the results from embedded multiple choices questionnaires in the video (e.g. Giannakos et al., 2015), multiple views and unique viewers per video (Gilliland, 2017), or the assessment of the video quality by the learners (Giannakos & Chrisochoides, 2014).

Three studies focused on social interactions as a means to engage learners in the learning process, using data as their comments on the Facebook page used to present the pre-class material (Lin & Hwang, 2018), the interactions with peers or teachers in the MOOC platform (Ji & Han, 2019), or the volume of submissions on the system (Isomöttönen & Tirronen, 2017).

Some articles focused also on student metrics, such as the completion rate and success rate in the course (Kaw, et al. 2019; Yang et al., 2016), students self-reported satisfaction in the experience (Lei et al., 2017; Van Leeuwen, 2018), students self-assessment regarding their performance (Corrias & Hong, 2015) or self-regulation in learning (Hwang & Chen, 2019).

While we underline for this review the focus for each study, most studies used data from several sources, and almost half completed their exploitation of LA with qualitative data (18 articles).

As for the theoretical background, few articles connected their research to a clearly identified theoretical background. Most articles introduced fundamental notions such as the flipped classroom, MOOCs (Ng & Xie, 2017), video-based learning (Garrick, 2018), two articles referenced the principle of active learning (Kaw et al., 2019; Hui et al., 2018), and another two referenced Bloom's taxonomy to analyze the efficiency of the FC (Hwang & Chen, 2019; Giannakos et al., 2015). However, less than half of the articles (14 over 39) made a specific use of educational or learning theories. The self-determination theory as developed by Deci & Ryan (1985) thus appeared in two articles (Sergis et al., 2018); Isomöttönen & Tirronen, 2017). The main theoretical frame, however, was undoubtedly the notion of Self-Regulated Learning (SRL) and learning strategies, presented in 11 articles (e.g. AlJarrah et al., 2018; Silva et al., 2018; Saint et al., 2018; Fincham et al., 2018; Jovanović et al., 2017; Sun et al., 2016; Pardo et al., 2015).

The SRL theory (Pintrich & Garcia, 1994) establishes that students can have better learning outcomes, cognition, and behaviour with planning, monitoring, and regulating strategies, but also that these strategies are not inherent traits but aptitudes that can be learned and brought under control. Therefore, many studies used this theory as a means to encourage the use of LA to support students' self-regulation in learning and metacognitive strategies.

The choices made in terms of LA algorithms and exploitation of data supports this notion. Indeed, we identified in these studies three main interests in data exploitation: clustering, predictive analysis using especially the linear regression model and, less frequently, sequential analysis. We classified these data algorithms according to the following uses:

- *Sequential analysis* was used to determine the general trends in online engagement, especially the distribution of online engagement and activities over the duration of the whole course
- *Clustering* was used to define students' profiles depending on their online engagement habits and frequency
- *Predictive statistics* were used to correlate students' profiles with the students' results or pass grade and try to predict students' success based on their learning profile and engagement in the FC and online activity.

3.2 What were the educational outcomes of using LA in the FC?

Based on the aforementioned elements, we can now question what the learning outcomes observed by integrating LA in the FC were. Most studies, 16 out of 39, focused on the correlation between students' learning performances and online activity, and found positive results correlating the highest grades and pass rates with the most active learning strategies (e.g. Hsiao et al., 2018; Martínez-Muñoz & Pulido, 2015; Smallhorn, 2017). Two studies among these especially highlighted the positive impact of students engaging with online feedback on their learning process on higher levels of SRL and better learning outcomes (Matcha et al., 2019; Silva et al., 2018). Studies who also investigated the students' perception of the process found high level of students' satisfaction in the learning experience (Lei et al., 2017; Corrias & Hong, 2015; Smallhorn, 2017).

The second most represented outcome of these studies, with 13 articles, was the use of LA as a means to improve the learning experience and the FC process. Such studies offered LA to help teachers improve the course (e.g. Van Leeuwen, 2018), to enable adaptive learning by selecting the best material and exercises according to the student's profile (e.g. Xiao et al., 2015), or to select the best learning materials and videos (e.g. Lau et al., 2018; Kravchenko & Cass, 2017). Within this group, some studies focused on the temporality of students' engagement with the learning material to issue recommendations for adaptive learning and improvement of the learning material (e.g. Garrick, 2018).

Therefore, the majority of studies presented positive results and made a compelling argument to the idea that LA can be used effectively to predict students' success based on their online engagement and learning strategies in the FC. Furthermore, these studies showed that using LA in the FC could reinforce the method by providing an adaptive learning framework to students, and encourage SRL.

3.3 What were the main limitations in the use of LA in the FC?

Although the impact of implementing the FC and the use of LA seemed overwhelmingly positive, this review allowed us to observe several limitations, especially the issues connected to students' engagement with the learning material, limited use of feedback and LA on learning strategies, and students' difficulties to adopt the methodology. Twelve articles out of 39 presented similar issues, which we can decompose into the following specific problematics:

- *Quality of engagement:* several studies (e.g. Marasco et al., 2018) underlined that the measures from LA were mostly click-based, and did not evaluate the quality of students' engagement with the learning material.
- *A utilitarian engagement:* two studies (Ayres et al., 2018; Smallhorn, 2017) underline the fact that many students only performed the learning activities before the exam, or if grades were attached to them.
- *Specific difficulties:* some studies underlined the difficulties of students to self-regulate their learning process (Isomöttönen & Tirronen, 2017), or the reluctance of already high-performing students to adopt new learning methodologies (Pardo et al., 2015).

Some studies also underlined negative or non-significant results. For example, there could be no statistical difference between passing and failing students (Gelan et al., 2018), no correlation between success rate and time spent online (Yang, et al., 2016), a disappointing pass rate due to lack of quality engagement with the learning materials (Lei et al., 2017), or no effect for the highest performing students (Jovanovic et al., 2017).

Finally, we observed the fact that only eight articles allowed students direct access to feedback information, or their own learning analytics (e.g. Jovanovic et al., 2019). This limited use of feedback to students shows that there is room to improve the use of LA and its potential to develop fully adaptive learning.

4. Discussion

4.1 Data and learning theories

This scoping review shows that there is great potential in using LA in the FC, especially as a means to reinforce the efficiency of the methodology. Improvements in technology allow instant access to a wide range of educational data. However, we observed that, because of its reliance on online educational data, most studies focused on the pre-class preparation, and approached the post-class process only through students' summative assessments and results. There is, therefore, a clear lack of research investigating the in-class process and activities.

Furthermore, to inform and improve educational practice, key researchers have underlined the need for LA to be rooted in research on learning and teaching (Gelan et al., 2018), and our research showed that studies in applying LA to the FC focused so far mostly on the technical aspects and didn't articulate their results with in-depth learning theories.

The most promising angle we observed is the use of SRL theory to analyse and understand patterns in students' behaviour and learning strategies. There is, therefore, an under-investigated potential in putting more emphasis on SRL, and giving better feedback and access to LA to students to develop fully adaptive learning.

4.2 Educational outcomes and limitations

The majority of studies presented positive learning outcomes and the capacity to predict students' success and pass rates based on their online engagement with the learning materials and activities with their peers and teachers. However, our analysis showed that there are still fields that remain underexploited regarding LA in the FC.

Few studies tried to investigate the long-term effects of the FC, and used only students' results on a given course. Indeed, some groups showed no significant improvement in short-term assessment in the FC, but improved results in long-term assessment (Hsiao et al., 2018). Similarly, few studies investigated the effect on different populations of students. Some only used the video metrics without evaluating individual users' engagement (e.g. Kravchenkoc & Cass, 2017), and only two studies presented a different population. Kaw et al. (2019) investigated students “other than white male” and Ng & Xie (2017) showed that the FC was slightly more efficient with female students.

Finally, our research shows that there are still issues that need to be resolved to implement efficiently LA in the FC. For example, click-based data can only measure superficial online engagement and should be completed by either qualitative data, focus groups, or students’ social interactions. Marasco et al. (2018) even suggested that the whole system of evaluation should evolve to fit the new paradigm.

5. Conclusion

Faced with the necessity to promote and develop active learning, educational institutions have turned massively towards the FC to encourage self-regulated learning in students. As the efficiency of the FC became well established, the potential of improving the FC by using LA seems a logical step forward. Our literature revealed that there is potential in using LA in the FC, especially as a means to predict students’ learning outcome and to support adaptive learning and improvement on the curriculum. However, further research and development is necessary to encourage self-directed learning in students and to develop the whole of the FC for a more diverse population of students.

Acknowledgements

This research was funded by the FLIP2G project. This project has been funded with the support of the Erasmus+ programme of the European Union. This paper reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

References

Abeysekera, L., & Dawson, P. (2015). Motivation and cognitive load in the flipped classroom: Definition, rationale and a call for research. Higher Education Research & Development, 34(1), 1-14.

AlJarrah, A., Thomas, M. K., & Shehab, M. (2018). Investigating temporal access in a flipped classroom: procrastination persists. International Journal of Educational Technology in Higher Education, 15(1), 1.

Arksey, H., & O'Malley, L. (2005). Scoping studies: towards a methodological framework. International journal of social research methodology, 8(1), 19-32.

Ayres, I. M. E., Fisteus, J. A., Uguina-Gadella, L., Hoyos, C. A., & Kloos, C. D. (2018). Uncovering Flipped-Classroom Problems at an Engineering Course on Systems Architecture Through Data-Driven Learning Design. The International journal of engineering education, 34(3), 865-878.

Bergmann, J., & Sams, A. (2009). Remixing chemistry class: Two Colorado teachers make vodcasts of their lectures to free up class time for hands-on activities. Learning & Leading with Technology, 36(4), 22-27.

Bishop, J. L., & Verleger, M. A. (2013). The flipped classroom: A survey of the research. In 2013 ASEE national conference proceedings, Atlanta, GA, Vol. 30, No. 9, pp. 1-18.

Corrias, A., & Hong, J. G. C. (2015). Design and implementation of a flipped classroom learning environment in the biomedical engineering context. In 2015 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC) IEEE. pp. 3985-3988.

Fernández, A. R., Merino, P. J. M., & Kloos, C. D. (2018). Scenarios for the application of learning analytics and the flipped classroom. In 2018 IEEE Global Engineering Education Conference (EDUCON) (pp. 1619-1628). IEEE.

Fincham, O. E., Gasevic, D. V., Jovanovic, J. M., & Pardo, A. (2018). From study tactics to learning strategies: an analytical method for extracting interpretable representations. IEEE Transactions on Learning Technologies. Vol.12(1), pp.59-72

Frey, B. (2018). The SAGE encyclopaedia of educational research, measurement, and evaluation. Thousand Oaks, California: SAGE Publications, pp 39-40.

Garrick, R. (2018), Flipped Classroom Video Analytics, 2018 ASEE Annual Conference & Exposition, Salt Lake City, Utah. American Society for Engineering Education, pp1-9.

Gelan, A., Fastré, G., Verjans, M., Martin, N., Janssenswillen, G., Creemers, M., & Thomas, M. (2018). Affordances and limitations of learning analytics for computer-assisted language learning: a case study of the VITAL project. Computer Assisted Language Learning, 31(3), 294-319.

Giannakos, M. N., & Chrisochoides, N. (2014). Challenges and perspectives in an undergraduate flipped classroom experience: Looking through the lens of learning analytics. In 2014 IEEE Frontiers in Education Conference (FIE) Proceedings IEEE. pp. 1-5.

Giannakos, M. N., Chorianopoulos, K., & Chrisochoides, N. (2015). Making sense of video analytics: Lessons learned from clickstream interactions, attitudes, and learning outcome in a video-assisted course. The International Review of Research in Open and Distributed Learning, 16(1).

Gilliland, K. O. (2017). The flipped classroom and learning analytics in histology. Medical Science Educator, 27(1), 9-13.

Hecking, T., Dimitrova, V., Mitrovic, A., & Ulrich Hoppe, U. (2017). Using network-text analysis to characterise learner engagement in active video watching. In ICCE 2017 Main Conference Proceedings Asia-Pacific Society for Computers in Education. pp. 326-335.

Hsiao, C. C., Huang, J. C., Huang, A. Y., Lu, O. H., Yin, C. J., & Yang, S. J. (2018). Exploring the effects of online learning behaviors on short-term and long-term learning outcomes in flipped classrooms. Interactive Learning Environments, 1-18.

Hui, Y. K., Mai, B., Qian, S., & Kwok, L. F. (2018). Cultivating better learning attitudes: a preliminary longitudinal study. Open Learning: The Journal of Open, Distance and e-Learning, 33(2), 155-170.

Hwang, G. J., & Chen, P. Y. (2019). Effects of a collective problem-solving promotion-based flipped classroom on students' learning performances and interactive patterns. Interactive Learning Environments, 1-16.

Isomöttönen, V., & Tirronen, V. (2017). Flipping and blending—an action research project on improving a functional programming course. ACM Transactions on Computing Education (TOCE), 17(1), 1.

Ji, Y., & Han, Y. (2019). Monitoring Indicators of the Flipped Classroom Learning Process based on Data Mining-Taking the Course of" Virtual Reality Technology" as an Example. International Journal of Emerging Technologies in Learning, 14(3).

Jovanović, J., Gašević, D., Dawson, S., Pardo, A., & Mirriahi, N. (2017). Learning analytics to unveil learning strategies in a flipped classroom. The Internet and Higher Education, 33(4), 74-85.

Jovanovic, J., Mirriahi, N., Gašević, D., Dawson, S., & Pardo, A. (2019). Predictive power of regularity of pre-class activities in a flipped classroom. Computers & Education, 134, 156-168.

Kaw, A., Clark, R., Delgado, E., & Abate, N. (2019) Analyzing the use of adaptive learning in a flipped classroom for preclass learning. Computer Applications in Engineering Education.

Klemke, R., Eradze, M., & Antonaci, A. (2018). The flipped MOOC: using gamification and learning analytics in MOOC design—a conceptual approach. Education Sciences, 8(1), 25.

Kravchenko, M., & Cass, A. K. (2017). Attention retention: Ensuring your educational content is engaging your students. In International Conference on Smart Education and Smart E-Learning (pp. 358-370). Springer, Cham.

Lage, M. J., Platt, G. J., & Treglia, M. (2000). Inverting the classroom: A gateway to creating an inclusive learning environment. The Journal of Economic Education, 31(1), 30-43.

Lau, K. V., Farooque, P., Leydon, G., Schwartz, M. L., Sadler, R. M., & Moeller, J. J. (2018). Using learning analytics to evaluate a video-based lecture series. Medical teacher, 40(1), 91-98.

Lei, C. U., Yau, C. W., Lui, K. S., Yum, P., Tam, V., Yuen, A. H. K., & Lam, E. Y. (2017). Teaching Internet of Things: Enhancing learning efficiency via full-semester flipped classroom. In 2017 IEEE 6th International Conference on Teaching, Assessment, and Learning for Engineering (TALE) IEEE. pp. 56-60.

Levac, D., Colquhoun, H., & O'Brien, K. K. (2010). Scoping studies: advancing the methodology. Implementation science, 5(1), 69.

Lin, C. J., & Hwang, G. J. (2018). A learning analytics approach to investigating factors affecting EFL students' oral performance in a flipped classroom. Journal of Educational Technology & Society, 21(2), 205-219.

Marasco, E. A., & Moshirpour, M., & Moussavi, M., & Behjat, L., & Amannejad, Y. (2018), Evidence-based Best Practices for First-year Blended Learning Implementation, 2018 ASEE Annual Conference & Exposition, Salt Lake City, Utah, pp1-10.

Martínez-Muñoz, G., & Pulido, E. (2015). Using a SPOC to flip the classroom. In 2015 IEEE Global Engineering Education Conference (EDUCON) IEEE. pp. 431-436.

Matcha, W., Gašević, D., Uzir, N. A. A., Jovanović, J., & Pardo, A. (2019). Analytics of Learning Strategies: Associations with Academic Performance and Feedback. In Proceedings of the 9th International Conference on Learning Analytics & Knowledge ACM. pp. 461-470.

Ng, V., & Xie, S. (2017). Student Engagement With Video-Watching and Flipped Class Behaviors. In ICEL 2017-Proceedings of the 12th International Conference on e-Learning Academic Conferences and publishing limited., pp. 163-168).

O'Flaherty, J., & Phillips, C. (2015). The use of flipped classrooms in higher education: A scoping review. The internet and higher education, 25, 85-95.

Pardo, A., Mirriahi, N., Dawson, S., Zhao, Y., Zhao, A., & Gašević, D. (2015). Identifying learning strategies associated with active use of video annotation software. In Proceedings of the Fifth International Conference on Learning Analytics and Knowledge ACM. pp. 255-259.

Pintrich, P. R., & Garcia, T. (1994). Self-regulated learning in college students: Knowledge, strategies, and motivation. Student motivation, cognition, and learning: Essays in honor of Wilbert J. McKeachie, pp 113-133.

Poon, L. K., Kong, S. C., Wong, M. Y., & Yau, T. S. (2017). Mining sequential patterns of students' access on learning management system. In International conference on data mining and big data Springer, Cham. pp. 191-198.

Redondo, D., Muñoz-Merino, P. J., Ruipérez-Valiente, J. A., Delgado Kloos, C., Pijeira Díaz, H. J., & Santofimia Ruiz, J. (2015). Combining Learning Analytics and the Flipped Classroom in a MOOC of maths.

Reidsema, Carl, et al., eds. The flipped classroom: Practice and practices in higher education. Springer, 2017.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American psychologist, 55(1), 68.

Saint, J., Gašević, D., & Pardo, A. (2018). Detecting Learning Strategies Through Process Mining. In European Conference on Technology Enhanced Learning Springer, Cham pp. 385-398..

Sergis, S., Sampson, D. G., & Pelliccione, L. (2018). Investigating the impact of Flipped Classroom on students' learning experiences: A Self-Determination Theory approach. Computers in Human Behavior, 78, 368-378.

Siemens, G., & Long, P. (2011). Penetrating the fog: Analytics in learning and education. EDUCAUSE review, 46(5), 30.

Silva, J. C. S., Zambom, E., Rodrigues, R. L., Ramos, J. L. C., & de Souza, F. D. F. (2018). Effects of Learning Analytics on Students' Self-Regulated Learning in Flipped Classroom. International Journal of Information and Communication Technology Education (IJICTE), 14(3), 91-107.

Smallhorn, M. (2017). The flipped classroom: A learning model to increase student engagement not academic achievement. Student Success, 8(2), 43-53.

Sun, Z., Lu, L., & Xie, K. (2016). The Effects of Self-Regulated Learning on Students' Performance Trajectory in the Flipped Math Classroom. Singapore: International Society of the Learning Sciences. ICLS 2016 Proceedings, pp66-73.

Van Leeuwen, A. (2018). Teachers' perceptions of the usability of learning analytics reports in a flipped university course: when and how does information become actionable knowledge?. Educational Technology Research and Development, 1-22.

Xiao, X., Pham, P., & Wang, J. (2015). AttentiveLearner: adaptive mobile MOOC learning via implicit cognitive states inference. In Proceedings of the 2015 ACM on International Conference on Multimodal Interaction ACM, pp. 373-374. Yamada, Y., & Hirakawa, M. (2015). A case Study of analyzing Logs of LMS in Flipped Classroom. In 2015 IIAI 4th International Congress on Advanced Applied Informatics IEEE. pp. 374-378.

Yang, Y., Wu, H., & Cao, J. (2016). Smartlearn: Predicting learning performance and discovering smart learning strategies in flipped classroom. In 2016 International Conference on Orange Technologies (ICOT) IEEE, pp. 92-95.

Zainuddin, Z., & Halili, S. H. (2016). Flipped classroom research and trends from different fields of study. The international review of research in open and distributed learning, 17(3).

Visual Representations Supporting Implementation of a K12 Programming Curriculum in Open and Democratic Educational Institutions

Benjamin Brink Allsopp and Morten Misfeldt
Aalborg University, Department of Learning and Philosophy, Denmark
ben@learning.aau.dk
misfeldt@learning.aau.dk
DOI: 10.34190/EEL.19.072

Abstract: In this paper we explore the use of a visual representation to support the discussion of computational thinking and programming curriculums, for implementation in open and democratic education institutions. Several countries are implementing curricular elements from computer science in K12 education. There are several obvious challenges that this change needs to address (e.g. the lack of teachers with sufficient content knowledge). But at their root is a lack of clarity about and tradition for what needs to be learned. The process of forming these curricula can be challenged by 1) a lack of participation because inputs from many different people become overwhelming, 2) a lack of transparency, with respect to the decisions (such as demarcations and trade-offs) leading to the curriculum, and finally the 3) ambiguity surrounding the names and elements of the curriculum, leaving teachers with uncertainty about what specific labels and names involve, and complicating comparisons between curricula. In this paper, we take outset in a splitting of the process of creating curricula into two parts: 1) a mapping of possible/desirable competencies to be developed in a subject and, 2) decisions about which competencies to actually include in a curriculum. We use an existing map previously developed to show central programming, to discuss progression levels. Our work with negotiating learning progression suggests that this approach supports discussion among stakeholders as well as clear declaration of knowledge respecting the many relations between knowledge elements. We use this work to discuss how our division between mapping and curriculum design relates to and addresses challenges in the more well-known division between curriculum design and teacher decision making about what to prioritise.

Keywords: computational thinking, K12 education, programming curricula, progression, concept specialisation maps

1. Introduction

Several countries are currently implementing computer programming as a subject area in compulsory education. Elements of computer science such as decomposition, data representation, pattern recognition, abstractions and algorithms (Wing, 2006) are to be addressed in a structured way (e.g. in national strategies and curriculums). The purposes of this massive movement are often to support students' technological literacy, incline students to pursue careers in technical areas, and to update the educational sector (Williamson, 2017). Furthermore, it builds actively on existing educational approaches aiming at liberating and educating through the active use of computer based constructions (Papert, 1980), as well as on a complex interplay with existing school topics, especially mathematics (Misfeldt & Ejsing-Duun, 2015; Wilson et al., 2017).

Investigations of the relation between programming and learning of core topics such as mathematics, have previously focused on potentials of using programming as a vehicle for developing mathematical competence (Papert 1980, Dubinsky and Harel, 1992), but the current situation is almost the converse; programming is included in the national curricula and standards of some cases (such as Sweden and Norway) and mathematics is used as a vehicle to obtain that goal, in other cases (such as the UK and Denmark) new school topics are developed to meet that end. This means that programming has changed from being a tool, whose value is judged on the extent to which it supports valued developments, such as learning and motivation, to a desirable end calling for implementation in its own right.

Currently both policy and research makes clear cases for the value of working with programming. Policy documents choices (Bocconi, Chioccariello, Dettori, Ferrari, Engelhardt, 2016; Vahrenhold, Nardelli, Pereira, Berry, Caspersen, GalEzer, Kölling, McGettrick & Westermeier, 2017) professional organisations (such as Code.org or hourofcode), as well as some researchers (Brennan and Resnick 2912, Grover & Pea, 2013) all agree that learning programming and coding are relevant as a supplement to primary and lover secondary education. The reasons or suggesting such a focus on programming are manifold, but all evolves around preparing students to future society and work life, as well as nursing their intellectual development.

The current implementation of programming as a topic in compulsory education has been followed by researchers investigating the educational and organisational results of these changes. Misfeldt, Szabo & Helenius (2019) has explores how well prepared Swedish teachers feel regarding the current changes, pointing to a need for significantly more in-service training. Furthermore Nouri, Zhang, Mannila, Norén (2019) explores how Swedish teachers have worked with programming before the curriculum change. The British Royal Society (2017) has described the potentials, results but also the continuous problems regarding implementing computing into the British school curriculum.

This makes at least two questions apparent/pressing. One question is, which group of teachers should teach it? Another, and probably deeper question, is how to address the lack of clarity and tradition about what needs to be learned. In the current situation different countries make different choices (Bocconi, Chioccariello, Dettori, Ferrari, Engelhardt, 2016; Vahrenhold, Nardelli, Pereira, Berry, Caspersen, GalEzer, Kölling, McGettrick & Westermeier, 2017), and these decisions are typically made in the political/educational administrative layer in central/national institutions. From a democratic and school organizational perspective the latter of these questions is especially important. It relates to ensuring that relevant voices are heard in the process of developing the curriculum, and to supporting the engagement and voice of the teachers and students that are expected to implement the curriculum.

In this paper, we explore an opportunity to address these two problems using a visual representation to support the discussion of programming curriculums, for implementation in open and democratic education institutions. Additionally, we describe the trend of programming in schools and zoom in on a specific case about working with programming and mathematics in Sweden. We introduce a type of visualization for mapping learning content, and a specific instance for the type that we have used in relation to our case and address the following question: How can the use of structured visualizations support curriculum development, negotiation and decisions in relation to the implementation of programming and computational thinking? We use the case study approach to address this question.

The visual approach developed and explored in relation to the case presented here, can have practical implications in a number of use scenarios. We know from other areas that visualisations and representations can support collaboration and negotiation of meaning, and we also know that such processes are critical when implementing new cuticular resources (Misfeldt et. al, 2018)

2. Method

Case studies are a widely adopted approach in social sciences, psychology, education and technology development, and are used to generate generalizable knowledge from an in-depth description and analysis of one or more situations. Yin (2011) defines case studies as research endeavours that addresses a contemporary phenomenon in a real-life context, and where the boundary between phenomenon and context are not entirely clear. Case studies have many forms and support different levels of generalization, ranging from explorative to more confirmative case studies.

This paper presents a case study where we use structured visualization to support work with the computer science curriculum that is currently being implemented in Swedish mathematics teaching. The case allows us to explore the potentials of the approach in a particular clear situation where a new topic is introduced and the need for clarity is high. The computer science topic is foreign to most teachers of mathematics, and hence the descriptions of what concepts to include, and in what order of progression, needs clarity, both in the sense of elaboration and exemplification, and in the sense of overview of the internal relations between the critical elements. It is this latter aspect that we focus on here.

Adopting the method of a critical case study (Yin, 2011) shows how and why structured visualization can support curriculum work in a particular appropriate case. The explanatory power of a critical case is of a qualitative nature, describing the potentials, obstacles and inner structure of the phenomena investigated. However, this also means that the work we present here does not in any way suggest that the approach we investigate outperforms any alternative approaches. Rather, we try to describe how the approach related to the context of developing and integrating programming and computational thinking in the mathematics curriculum in Sweden.

Described below, the case we explored is part preparatory work for developing an in-service training course in programming and computational thinking for Swedish mathematics teachers. We have used a map like structure to, firstly, overview critical programming concepts in relation to each other and to, secondly, identify and discuss progression levels for when different concepts are taught. The map has been used internally in the development team and we are currently working on offering it as a resource for Swedish teachers, where the case study presented here can be viewed as preparation for such a development.

However, the case primarily serves the function of allowing us to explore the potential benefits of using visual representations for curriculum work in a particularly well-suited situation and reflect on the nature of the values of such an approach. We use the case to address the question of using maps and visualization to support the implementation of national curricula, and since the mapping we adopt is highly structured and since the changes to the mathematics curriculum are so significant the level of articulation and clarity needed to discuss the progression levels in this change is very high.

3. Case background

In early 2017 the Swedish government, initiated the work of implementing programming and computational thinking in the school system, it was decided that programming should be included in the mathematics curriculum from grade 1 to grade 12. The integration of programming is connected to an attempt to raise the students' level in algebra (Kilhamn & Bråting, 2019), and the implementation concerns all teachers and students of mathematics from grade 1 to 12.

Hence, the Swedish educational system is facing a major implementation problem that is also known from the international literature about considering programming as part of mainstream compulsory education – the lack of teachers, and the lack of clarity about the specific content (e.g. knowledge, skills and competencies).

In order to address the first of those concerns, the Swedish government has initiated a number of in-service training activities. Some of these activities are conducted by universities and teacher education colleges whereas others are available under the programmes for teacher in-service training. The authors of this paper have been involved in developing some of the materials that are part of this latter program. Despite these initiatives, Swedish mathematics teachers state rather clearly that they do not feel ready to conduct teaching in programming (Misfeldt, Szabo & Helenius, 2019).

Moreover, addressing the lack of clarity about content and competencies we have developed a description of progression in computational and programming concepts - this is the core of the case that we will present. The progression description has been useful for the team that has developed the material for in-service training, but the case suggests that such a tool has a wider scope. In the following section we will present the representation and how it was used.

4. Mapping progression

In our case we explored curriculum development through the use of a concept specialization map (*CSM)* showing key concepts relevant for computer programming. This section describes CSM maps in general, and the specific map that we used. We describe how we used the map in an iterative process to suggest and discuss progression levels for learning programming. Finally, we show the result of these discussions as a CSM with enclosures showing what is contained in individual progression levels.

4.1 Concept specialization maps

CSMs are a highly structured visualization of concepts related to each other to better see when they overlap, and when they differ (Allsopp 2017). The concepts are the ones considered important for a given subject matter and are represented by nodes. Arcs are drawn from one node to another node when the first node is considered to represent a more general version of the second more specialized concept; no intermediary concept can be inserted as both a specialization of the first node and a generalization of the second node.

Arcs are normally drawn in approximately the same direction as shown in Figure 1, so that we: a) do not need arrow heads, and b) so that the map as a whole has a direction or can be seen as having levels of specialization.

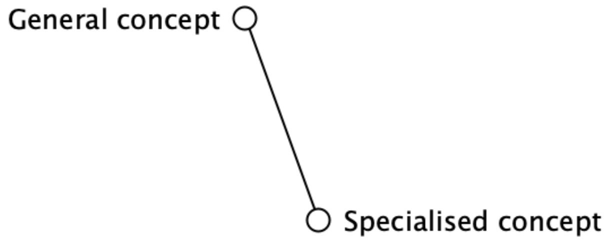


Figure 1: A CSM arc pointing downwards from a general concept to a specialization of that concept

Actual maps are formed because a concept that is a specialization of one concept can be a generalization of another concept and so on indefinitely. Concepts can also have any number of parent (generalization) concept, and child (specialization) concepts. The main constraint is that no concept can be drawn as a direct or indirect generalization ancestor to itself. In short, CSMs are based on directed acyclic graphs (Di Battista et al. 1999). It is important to note that CSMs do not themselves show a progression in how the included concepts should be learnt. The role of the CSM is to overview and spatially disambiguate the concepts.

From our case, a single CSM is used as a central visual representation and is shown in Figure 2. It was developed between 2016 and 2017 to identify the most important programming concepts exercised in a number of playful programming environments (Allsopp, 2017).

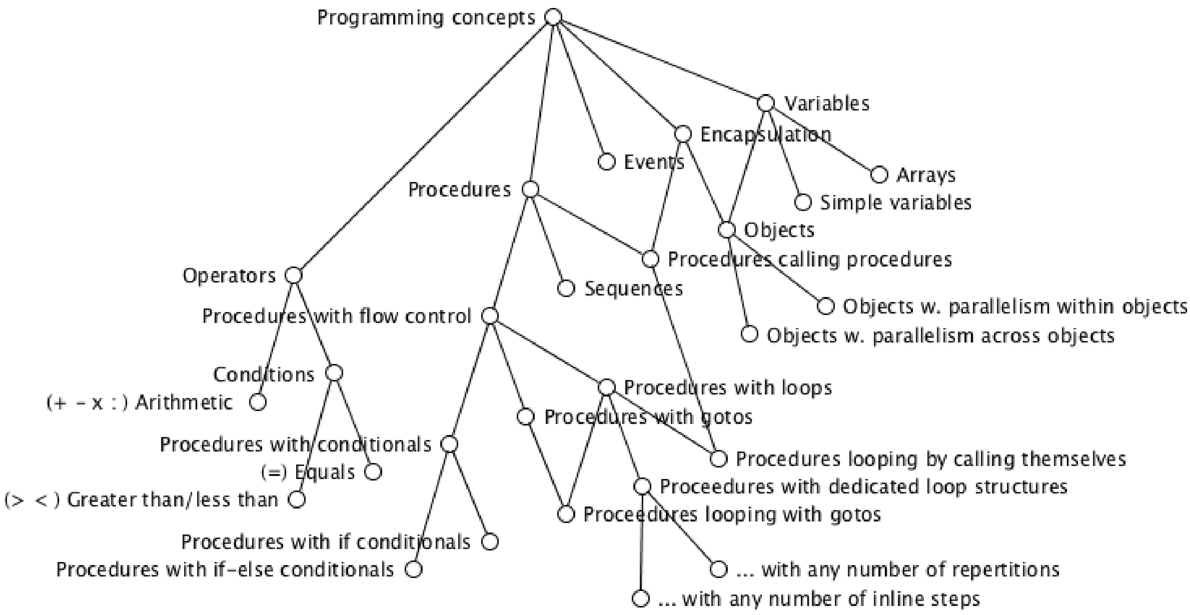


Figure 2: The CSM used to deliberate on progression when learning programming concepts

Examining the CSM above allows us to see how specialization is shown. For example, we can see how the more general concept called *operators* is both specialized as *arithmetic* operators and as *conditions*. On the other hand, events are included without any specializations, because the concept of events are apparently not seen as needing specialisation for learning purposes (although this could be questioned).

4.2 Deliberation

Our process of deliberation about progression involved identifying sub maps from the CSM that encompass the concepts for a given level. Introductory levels include general concept, but only superficially, because they are introduced with only a few specialized concepts that exemplify the simpler aspects of the general concept. An obvious example of this is it to introduce procedures, but only focus on one special and most simple type of procedures, the sequence. Events can similarly be introduced in their entirety, because there is no specialization that can be postponed. With this thinking the concepts for the first level could be those shown in reduced map shown in Figure 3.

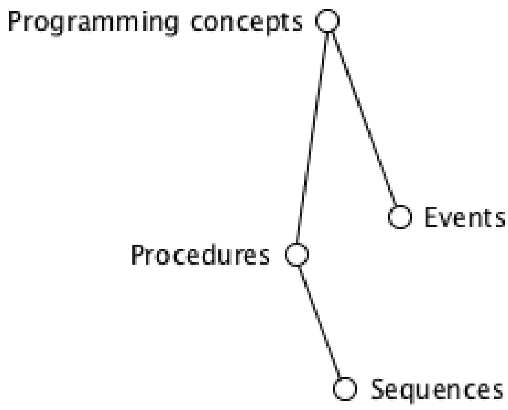


Figure 3: A sub map showing an introductory curriculum

More advanced grades consist of larger sub maps containing more and more concepts with the highest level consisting of the entire map.

In practice, identifying sub maps for different levels involved drawing lines around sub maps in pencil. In our case it was appropriate to identify four levels, with the highest levels' concepts represented by the entire map. These pencil-drawn enclosures include each other, following a principle that higher levels include all the concepts of lower levels, as well as including additional specialization concepts. This means that the more general concepts are revisited in each level, there relations to previously specialized concepts are also reaffirmed, but most importantly, they are re-understood with the additional new specialized concepts. Progression in this context means developing the scope of general concepts rather than only introducing new concepts – the scope grows rather than moves.

Of course, being able to show progression as pencil enclosures did not ensure that we choose the best progression. What the showing of progression as pencil enclosures did is allow us to quickly and clearly specify a possible progression. This allowed us to easily compare grades, but more importantly see alternative enclosures including or excluding concepts near to a grade boundary. In practice, our process involved erasing and redrawing level boundaries many times to reflect our understanding of what constituted a reasonable amount of new conceptual material. After at least ten iterations we agreed on the enclosures shown in Figure 4.

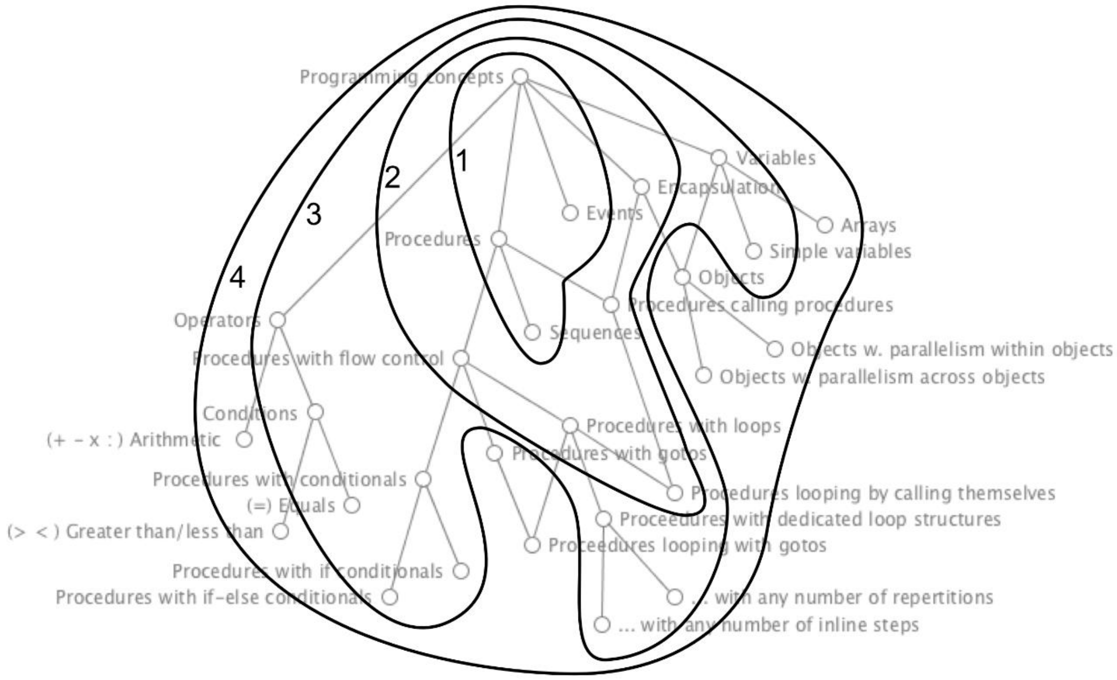


Figure 4: The modified CSM with grade boundaries reflecting our most up to date preference for a progression

Working as above raised some interesting discussions about how such visual tools can address implementation problems related to programming and computational thinking as they occur worldwide in the school systems. More specifically how they can (1) empower more voices to be heard in political discussions about curriculum and standards, (2) provide clarity, coherence and constraints when deciding on curriculum, and (3) create situations where more people can participate, localize, adapt and hence also comply with curricular decisions.

5. Discussion

There are many issues relating to progression in programming that have not been the focus of this paper. The designing of a powerful progression is dependent on many factors including, but not limited to understandings of the readiness of a student to embrace any one concept available, the material for explaining any one concept, and the time needed for exploring any one concept. These factors and others, are not in the scope of this paper and require the extensive expertise of skilled teachers. We can also question if the concepts and their relations shown in our chosen CRM are indeed the accurate or sufficiently complete description of desirable programming concepts. The original map was developed exclusively while examining playful programming environments and other approaches may have revealed other concepts. Our interest is more on the tools and the process, and especially with respect to how they can empower voices in the negotiating of curricular.

5.1 Empowering voices

Creating CSM maps may play a role in empowering more voices in identifying potential learning goals. They open up the discussion about the range of what could be included in a curriculum rather than simply presenting the last decided-on curriculum, where the curriculums history and what has not been included is lost. This has not been as obvious in the above as it could be because, a) we used an existing map and b) the highest grade ended up including all the concepts identified. However, it is easy to imagine situations where more stakeholders can be involved in creating the maps and where the inevitably more comprehensive maps end up only having a small part of them selected for use in an actual curriculum.

A benefit of separating out a map making process from a progression/curriculum deciding process is that more voices can be heard in the identification of leaning goals. The involving of many more stakeholders in the creating of a map is positive, even if in many cases the content they contribute may not actually be included in a curriculum. They have a *chance* to have their content included. It is however also important to consider that beyond having an opportunity to suggest content, the maps may also help more stakeholders to have a say in the process of deciding on what is actually included in a curriculum. However, this possibility is best considered as a by-product of the maps' potential for providing increased clarity, coherence and constraints when using them to actually decide on a curriculum.

5.2 Precision

We have identified a number of ways that an already created maps may help in the constructive negotiation of actual curriculums (also in cases where more stakeholders are involved). The relational nature of the maps requires contributors to consider these relations when adding concepts. It is possible that considering these reactions will force contributors to be more aware of the scope of the concept and therefor be more precise in their labelling of the concepts. For the participants negotiating what to include in a curriculum, having more precisely labelled concepts and being able to see them in relation to other concepts may help to reduce ambiguity and unproductive conversations where participants are actually talking about different learning content. A different possibility that also relates to eliminating ambiguity, is that when discussing curriculums in maps participants can actually point to individual concepts. This pointing, as opposed to refereeing to concepts precisely in words, may also save time otherwise spent talking passed each other. Assumedly this would also translate into more effective collaboration of greater numbers of stakeholders.

Working with CSM maps also seem to provide more direct benefits to each participant involved in making decisions about what to include in a progression stage or curriculum. The visuospatial arrangement of the learning content in the maps affords greater overview than if the concepts were presented as a list. Every concept has its own location where its closeness in space to other concepts also indicates a closeness of character. On top of this the ability to draw circles around areas with pencil or digitally allows the immediate comparison of progression levels or even alternative curriculum candidates without having to duplicate any content. The reduction of negotiating curricula or progression to a simple matter of drawing enclosures in the

CSM map seems to add the clarity and constraints that can help to make better decisions. This simplification in combination with the issues of disambiguation discussed earlier suggests that using CSM maps to negotiate curriculums or learning progressions can support faster and more deliberate decisions.

5.3 Adoption

Once curriculums or learning progressions have been decided on the next step is to support implementation and adoption of the curriculum. CSM provides some affordances that support this. The main challenges for adoption of programming in compulsory education in many countries is the lack of teachers who have the necessary knowledge to take care of the implementation (Wilson et al 2010, Vahrenhold et al 2017). However, some of the problems are also related more directly to the curriculum and the representation of it. There is a huge difference in prerequisites in relation to programming because (at least in Sweden) some schools and teachers have worked on it for a long time whereas others are just beginning. This also means that teachers in for instance secondary education might meet students with little or no knowledge about programming in the same class as students with high level skills in the area. This situation calls both for clarity in content of the curriculum so that teachers are able to discriminate and talk about the diverse competencies among the students, but more particularly it calls for clear representations of the progressions involved in the curriculum, since a structure highlighting this aspect will allow teachers to combine progression with recap. Hence the *clarity* regarding possible student learning trajectories support adoption.

Another key issue related to curricular representations is that of teachers' ability to participate, localize, adapt and hence also comply with curricular decisions. This we believe is a critical aspect in relation to adoption and one where the approach we have attempted here is counter to typical thinking about curriculum adoption anticipating a division of labour between curriculum design and teacher decision making about what to prioritise (Remillard, Herbel-Eisenmann & Lloyd, 2011). The approach we have followed here will highlight the presence of many voices in representation of the curriculum. In that sense we suggest the localisation and adoption of curriculum build on not only accepting or transforming the curriculum but also on seeing and acknowledging teachers own voice in the representation of the curriculum.

6. Conclusion

In this paper we have described a case where a visual representation (CSM) has been used as a mean to discuss and clarify work with implementing programming in Swedish mathematics education. The representation was found to be relevant and to support the development of progression levels in programming (following up on Allsopp 2017) in several ways. The representation allows for a multiplicity of voices to be present in the the curriculum and shows clearly some of the decisions made when constructing the curriculum. Furthermore, the representation allows progression and learning trajectories to be shown with a great deal of precision.

We believe the case shows a potential in using visual representation in curriculum work. Furthermore, we believe that the core affordances of such curriculum representations can be described with (1) its ability to support and respect many voices in the development of the curriculum, (2) the precision levels in showing learning progression and trajectories, as well as (3) the degree to which a curriculum representation support adoption and implementation. We believe that technologies and representations that support ridged and precise – jet teacher/school specific – visualisations holds a promise for supporting the implementation of programming in schools.

References

Allsopp, B. B. (2017). A Playful Programming Products Vs. Programming Concepts Matrix. I M. Pivec, & J. Gründler (red.), Proceedings of the 11th European Conference on Game-Based Learning (1 udg., Bind 1, s. 1-8). Reading, UK: Academic Conferences and Publishing International. Academic Bookshop Proceedings Series

Bocconi, S., Chioccariello, A., Dettori, G., Ferrari, A., Engelhardt, K. (2016). *Developing computational thinking in compulsory education – Implications for policy and practice*; EUR 28295 EN; doi:10.2791/792158

Brennan, K., & Resnick, M. (2012). New frameworks for studying and assessing the development of computational thinking. *In Proceedings of the 2012 annual meeting of the American Educational Research Association*, Vancouver, Canada (Vol. 1, p. 25).

Dubinsky, E., & Harel, G. (1992). *The Concept of function: aspects of epistemology and pedagogy*. Washington, DC: Mathematical Association of America.

Grover, S., & Pea, R. (2013). Computational thinking in K–12: A review of the state of the field. *Educational researcher*, 42(1), 38-43.

Kilhamn, C. & Bråting, K. (2019) Algebraic thinking in the shadow of programming Surveying teachers' conception of programming as a mathematics topic following the implementation of a new mathematics curriculum. *To appear in CERME 11 proceedings*.

Misfeldt, M., & Ejsing-Duun, S. (2015). Learning Mathematics through Programming: An Instrumental Approach to Potentials and Pitfalls. In K. Krainer & N. Vondrová (Eds.), *Proceedings of the Ninth Congress of the European Society for Research in Mathematics Education* (pp. 2524–2530). Prague, Czech Republic: Charles University in Prague.

Misfeldt, M., Tamborg, A. L., Qvortrup, A., Petersen, C. K., Svensson, L. Ø., Allsopp, B. B., & Dirckinck-Holmfeld, L. (2018). Implementering af læringsplatforme: Brug, værdier og samarbejde. *Læring og Medier*, 10(18). https://doi.org/10.7146/lom.v10i18.97013

Misfeldt, M., Szabo, A., & Helenius, O. (2019). Surveying teachers' conception of programming as a mathematics topic following the implementation of a new mathematics curriculum. *To appear in CERME 11 proceedings.*

Nouri, J, Zhang,L., Mannila, L., Norén, E. (2019): Development of computational thinking, digital competence and 21st century skills when learning programming in K-9, *Education Inquiry*, DOI: 10.1080/20004508.2019.1627844

Papert, S. (1980). *Mindstorms: children, computers, and powerful ideas*. New York: Basic Books.

Remillard, J. T., Herbel-Eisenmann, B. A., & Lloyd, G. M. (Eds.). (2011*). Mathematics teachers at work: Connecting curriculum materials and classroom instruction*. Routledge.

Royal Society. (2017). After the reboot: Computing education in UK schools. *Policy Report.*

Vahrenhold, J., Nardelli, E., Pereira, C., Berry, G., Caspersen, M. E., Gal-Ezer, J., Kölling, M., A. McGettrick, A., & Westermeier. M. (2017). *Informatics Education in Europe: Are We All in the Same Boat?* New York: Association for Computing Machinery.

Williamson, B. (2017). *Big data in education: The digital future of learning, policy and practice*. Sage.

Wilson, C., Sudol, L. A., Stephenson, C., & Stehlik, M. (2010). *Running on empty: The failure to teach K-12 computer science in the digital age.* New York: Association for Computing Machinery.

Wing, J. M. (2006). Computational thinking. *Communications of the ACM*, 49(3), 33–35.

Yin, R. K. (2011). *Applications of case study research*. sage.

The Impact of Cultural Familiarity on Students' Social Media Usage in Higher Education

Dhuha Al-Shaikhli[1], Li Jin[1],Alan Porter[2], Andrzej Tarczynski, Dilshod Ibragimov[3], Deneze Bektasheva[3] and Mikhail Shpirko[3]
[1]Dept of Computer Science and Engineering, University of Westminster, London, UK
[2]Dept of Psychology, University of Westminster, London, UK
[3]Dept of Business Information Systems, Westminster International University in Tashkent, Tashkent, Uzbekistan
w1273572@my.westminster.ac.uk
L.Jin02@westminster.ac.uk
A.Porter@westminster.ac.uk
dibragimov@wiut.uz
d.bektasheva@wiut.uz
mshpirko@wiut.uz
DOI: 10.34190/EEL.19.080

Abstract: Using social media (SM) in Higher education (HE) becomes unavoidable in the new teaching and learning pedagogy. The current generation of students creates their groups on SM for collaboration. However, SM can be a primary source of learning distraction due to its nature, which does not support structured learning. Hence, derived from the literature, this study proposes three learning customised system features, to be implemented on SM when used in Higher Education HE. Nevertheless, some psychological factors appear to have a stronger impact on students' adoption of SM in learning than the proposed features. A Quantitative survey was conducted at a university in Uzbekistan to collect 52 undergraduate students' perception of proposed SM learning customised features in Moodle. These features aim to provide localised, personalised, and privacy control self-management environment for collaboration in Moodle. These features could be significant in predicting students' engagement with SM in HE. The data analysis showed a majority of positive feedback towards the proposed learning customised SM. However, the surveyed students' engagement with these features was observed as minimal. The course leader initiated a semi-structured interview to investigate the reason. Although the students confirmed their acceptance of the learning customised features, their preferences to alternate SM, which is Telegram overridden their usage of the proposed learning customized SM, which is Twitter. The students avoided the Moodle integrated Twitter (which provided highly accepted features) and chose to use the Telegram as an external collaboration platform driven by their familiarity and social preferences with the Telegram since it is the popular SM in Uzbekistan. This study is part of an ongoing PhD research which involves deeper frame of learners' cognitive usage of the learning management system. However, this paper exclusively discusses the cultural familiarity impact of student's adoption of SM in HE.

Keywords: social learning, localised, personalized, privacy, SM, familiarization

1. Social learning theory

Social learning theory has been proven intensively as the primary construct of learners cognition (Bandura, A. and Walters, R.H., 1977). One of the fundamental learning key elements is peer social interaction (Vygotsky, L.S., 1980), including the online learning field (Abrami, Philip C. et al., 2011). Furthermore; cognitivist, who are fundamental learning theories specialists, suggest that the human being is an active learner who select, filter and evaluate based on their needs and goals (Collins, a, Greeno, J.G. & Resnick, L.B., 2001). Moreover, social learning overlaps with significant positive learning skills such as learning self-regulation LSR. Learning self-regulation is described as a "learners' ability to independently and proactively engage in self-motivating and behavioural processes that increase goal achievement" (Zimmerman, 2000). Self-regulated learners have the ability to "initiate meta-cognitive, cognitive, affective, motivational, and behavioural processes in order to take actions, achieve their learning goals and persevere until they succeed".

Peer collaboration is expected to increase when free and open SM (SM) is available (Veletsianos, 2017). For example; Twitter has been used in previous studies to support learners' collaboration (Tur and Marín, 2015). Twitter has default features that are advantageous for learning-oriented socialisation. Twitter allows only 140 characters per tweet, which, in this study, is presumed to increase peer collaboration effectiveness by reducing text length. Recent studies have empirically demonstrated that using SM in learning improves learners' self-regulation, cognition, and meta-cognitive skills (Blaschke, 2014).

2. Learning collaboration in SM

The learning process in higher education has changed in the SM era (Popescu, 2014). Students are more interactive and present on SM platforms than any other platform (Selwyn, N., 2012). While some researchers question whether SM can be used as a learning platform (Hrastinski, S. & Aghaee, N. M., 2012), others believe it is widely adopted among learners in higher education, as some students view it as a successful LMS, like Facebook (Ouya, S. et al., 2015) . Furthermore, it can potentially cater to several (social) learning theories (Goodyear et al., 2014). For example, it is an effective platform for the inquiry-based approach and is an ideal tool for peer collaboration, and to be an effective platform for resources and peer knowledge sharing (Mazman, S.G., and Y.K. Usluel, 2010).

Some researchers believe that SM does not necessarily provide learners with cognitive learning, as they use it more for socialising and non-academic activities (Selwyn, N., 2012). Furthermore, other researchers have argued that only a minority of learners, in fact, utilise SM for precise learning purposes (Prescott, J., S. Wilson, and G. Becket, 2013). These arguments have been changing rapidly in the SM learning field, as SM integration into formal (and non-formal) education investigating the integration of SM into LMS has limited empirical studies (Greenhow, C. and Lewin, C., 2016).

According to a recent study, some students show resistance toward using SM in their learning. The qualitative survey reported that students tend to separate their personal life from their learning. Also, they are concerned about their shared content's judgment, and they are not keen on the extra time and information constraints that SM might add (Jones, Norah. et al., 2010) . Also, other research has identified privacy and anonymity as other hindering factors in students' usage of SM in their learning (Smith, 2016).

Authors have argued against the adoption of SM as a peer collaboration platform in formal learning. For example, one study revealed that time spent on Facebook negatively impacted students' achievements (Kirschner, P. A., and A. C. Karpinski , 2010) and assignment completion (Junco, R., and S. R. Cotton, 2013). However, it is worth mentioning that the LMS environment is continually evolving towards more social connection and faster access to contents. For example, a recent LMS is 'Tagging', which allows for personalised and more accessible collaboration among peers (Klašnja-Milićević, A. et al., 2018).

3. Learning social engagement features

Recent researches are investigating the integration of SM into HE (Cooke, 2017). However, the nature of the SM platforms remains a questionable collaboration environment for students in HE. Accordingly, this study proposes three features to be implemented on the integrated SM as they are presumed, based on the literature, to enhance students adoption of SM in HE. The four features are; localized collaboration, content personalised collaboration, and privacy self-management.

Researchers have investigated the potential of SM in formal learning, as it conserves a significant amount of contents (Dabbagh and Kitsantas, 2012). Although SM does not support the pedagogical approach to learning (Liu, Y., 2010), the recent generations of university students are using it as the leading tool for content creation and reflection (Tess, 2013). Although SM has been described as a new form of a decentralised learning platform (Junco, R., and S. R. Cotton, 2013), in HE, using SM could be disadvantageous for the students' learning process as it can easily cause students' attention to drift (Abe, B. P. and Jordan, N. A., 2013).

The volume of shared content and the diversity of learners' backgrounds can negatively influence the learning experience on SM (Chen, X. et al., 2014). The decentralised learning process is another drawback of using SM in HE, as the relocation of students from the LMS to an SM platform can quickly isolate them from structured learning. Also, many students believe that all information should be in one place when it comes to formal learning (Salmon, G. et al., 2015). Accordingly, this study proposes an integration of SM platform (which is Twitter in this case) into an LMS (Moodle) with three learning customised features. These features are discussed next.

3.1 Localised Collaboration LC

An LC is represented by implementing a localized SM collaboration panel in each section of the LMS. It is presumed to improve learners' perceived ease of use. Also, this may support students' LSR skills (such as focus, time management), as they will have fewer tasks to manage themselves (such as moving between the SM platform and the LMS).

3.2 Content personalised collaboration

One of the repeatedly reported barriers to learners' use of SM in learning is content overload (Ri, Son and Kyu, 2016). A large amount of SM user-generated content can limit its benefit as a source of information. In this research, SM panel is enabled in each section, as discussed above. Moreover, each section's SM panel personalises the contents generated on it.

3.3 Learners' privacy self-management

Tu (2002) describe privacy as the perception of respect across psychological, mental, cultural, and conditional boundaries and dimensions' (Tu, C.H., 2002). In the literature, user privacy in SM is defined as an individual's autonomy over his or her personal information, including any relevant exchanged content (Shin, 2010). The current research investigates the main reported aspects that have prevented learners from using SM in HE if any. Since SM is a two-communication-channel platform, the present study examines common negative influence factors in each channel (inspired by (Leonardi, 2017)); barrier factors that influence information contribution (post, reply, like), and factors that affect information retrieval (read, search).

Based on the literature, one of the main (information contribution) barriers for learners to use SM in learning is privacy concerns (Blaschke, 2014) . The behaviour of using SM is significantly influenced by the individual's perspectives of the SM community (Taddicken, 2014). This inhibits and restricts user activity and interaction over the platform and might limit or divert their actual behaviour (Vitak, 2012). Few studies like (Prinsloo, P. and Slade, S., 2015) have investigated learners' privacy self-management methods to overcome their identity disclosure concerns in using SM. Hence, the present research examines learners' perception of privacy self-management in SM as a predictor of their acceptance of using SM in HE.

4. Methodology

4.1 Questionnair's aim and objective

The aim of this questionnaire is to measure the students' proposective feedback toward the research proposed method. The method is an integration of SM in formal learning learning manangement system. In addition, three features are proposed to be implemented on the integrated SM to support learners' engagement. In order to achieve the questionnaire aim, each feature were represented on the questionnaire to enable the students' view. In addition, the students were required to respond to a standard technology acceptance model questionnaire items which were extracted from the literature. These items empirically proved to measure high accuracy acceptance level of the sample.

4.2 Population

The population is the entire group of individuals, events, or elements of focus that the researcher intends to evaluate. A sufficient sample is selected from the wider population to investigate it (Trochim, 2002). Current research population comprises the undergraduate students (male and female) at the International University of Westminster in Tashkent (WIUT). The WIUT is a partnership branch of the University of Westminster in UK, and it is based in Tashkent, Uzbekistan. The participants of this questionnair have a similar age group of (17-22 years old) since they are enrolled to the same undergraduate course. All of the students have previous experience with IT and Moodle as they have used it in previous years for their learning.

4.3 Sampling

Sampling is "the process of selecting a sufficient number of elements from the population" (Sekaran, U., 2003). Sampling is important when it is surveying the entire research population is not achievable due to its vast size, time frame limitation, or regional boundaries (Saunders, M. et al., 2009).

The targeted sample of this research is concerned within a case study of undergraduate students at WIUT from Business Information system department. The sample is undertaking two computer science courses. And they access their learning contents on Moodle. There will be two cohorts to undergo the case study of the current research; prior experiment and post-experiment on the same Moodle. The total number of student for the prior experiment, which is cohort 2019, is 457 students.

4.4 Data collection

A quantitative questionnaire was used in this study in the form of an online survey which has the advantage of approaching a more extensive range of the population. Also, it is time and effort valid. However, it also eliminates the presence of the researcher on the site where the survey is being conducted, which might negatively affect participants' completion rate. Also, it eliminates the potential direct communication between the researcher and the participants (such as providing clarification on specific questions), which may disadvanteg the quality of the survey responses (Cooper, C.J. et al., 2006). Furthermore, quantitative questionnaires are practical for large populations. Finally, recently developed online survey tools provide enough support to collect a sufficient quantitative data from a large sample.

Statisticians have discussed five criteria of a sufficient questionnaire; these concern respondents' attributes, respondents' impact, false respondents, sample size, sample type, and how many items are in the questionnaire. A technique that makes a questionnaire successful is to conduct a pilot survey to obtain feedback on the design and the comprehension of the survey questions (Robin Flowerdew, 2013).

By implementing the criteria above for a sufficient questionnaire, an online self-reporting Likert-scale questionnaire was used since this study is conducted remotely from London. Also, an online survey has been chosen because of the large sample size as well as the number of survey items is relatively high.

4.5 Questionnaire development

4.5.1 Validity and reliability

Questionnaire design is vital to the data collection phase as it can impact data response scale, data validity, and data reliability (Heale and Twycross, 2015). Questionnaire validity is concerned with the accurate presentation of the data to be measured, which is the researcher responsibility. On the other hand, a questionnaire is reliable if it requests the same specific type of data using the same approach and standardised format through different periods and across the various environment, and if it collects the responses to the questionnaire using one unified method of data collection (Richardson, J.T., 1990). Finally, a questionnaire is reliable and valid when the items are understood and perceived by the respondent precisely as intended by the researcher. Conversely, the collected data should be perceived by the researcher precisely as intended by the respondent (Mark S. Litwin, 1995).

4.5.2 Survey Items

In the current study, the questionnaire evolved through several phases to establish its validity and reliability. Fifty-two items were developed to cover all model variables. Although the questionnaire items were driven from the literature, they have been through several phases of editing and re-wording to remain within this research context.

4.5.3 Survey scale type

The second phase of the questionnaire development was to determine the survey scale type. Likert scale requires individuals to respond to a direct statement with a range of agreeing to disagree answers; the scale can be on five or seven points. In this study, a five-point Likert scale was adopted, with strongly disagree as to the lowest score and strongly agree as to the highest one. Furthermore, each question is formed as a statement with which the students must indicate whether they strongly agree or strongly disagree using five scale points.

4.5.4 Survey design and tools

The third phase focused on the design of the questionnaire layout. Questionnaire attributes such as question layout, general presentation, and short and simple question formation (considering simplicity and specificity) have a significant impact on completion rate and on minimising error (Lietz, 2010). The questionnaire in this study was developed as an online survey using the Qualtrics online survey tool. Moreover, Rada (2005) highlights the effects of a well explained cover letter on survey response rate (Rada, 2005). In corespondance to that, the invitation email of this study described the aim of the research and the intention of the survey, the voluntary contribution, and the personal privacy code of the collected data.

4.5.5 Questionnaire pre-testing phase

The last phase of the questionnaire development involved pre-testing for validity, reliability, errors, and mistakes (Presser, S. et al., 2004). The questionnaire went through the following pre-testing phases. The preliminary version of the questionnaire was examined by the supervisory team of this study. Feedback was suggested concerning the questionnaire design, layout, and the use of more straightforward language. Based on the received recommendations, the questionnaire was revised. The next pre-test method was a pilot study. A pilot study is an essential practice as it mimics the data collection process to detect potential pitfalls in order to improve and prepare the survey for the actual data collection phase (Van Teijlingen et al., 2001). In this study, the pilot study was operated by recruiting postgraduate psychology students from the University of Westminster, UK. A total of 16 responses were collected, of which seven did not include missing data. The sample size suggested in the literature for a pilot study ranges from100 to 200 responses; however, this size was not satisfied, which is one of the limitations of this study.

The final approach to examine the questionnaire was performed by the PhD researcher, PhD supervisory team, and the involved instructors of the Moodle signed up a course. The researcher reduced the survey size while maintaining the same number of items by using the matrix answer format in the survey. This approach decreases the amount of text and images. The survey design, matrix response format, and the included consent cover letter were reviewed and confirmed as ready for the actual data collection phase of the study.

5. Data analysis

This section provides the students' perspectives on the proposed features. It starts with the students' perception of the localized SM on each section on the Moodle; then it discusses the topic of the personalized collaboration feature of the integrated SM. The third presented data analysis is the students' perception of SM privacy self-management. The last discussion in this section tackles the students preferred SM platform for learning which explains why the integrated Twitter was not utilised by the students even when it is integrated on their Moodle.

5.1 Students perception of localized Twitter and topic personalised collaboration

Similarly, the students' perception of the localised integrated SM panel on each section on the Moodle was highly positive. The acceptance range of 52 students was between 82%-95%. However, this feedback is not aligned with the students' actual interaction with the localised Twitter panel on Moodle of this study. As discussed earlier, the students are not familiar with Twitter, this was the main reasons for not interacting with it even when it provided a learning customized features. Based on the students' feedback, the learning customized features have been perceived by the same students to support their learning positively. Below is data visualisation of the students' responses on the questionnaire followed by a summary table of their acceptance answers on the theorised relations.

Survey Items	Localised Twitter panel on each Moodle' section Total agree	Topic personalized collaboration Total agree
It makes my learning more effective	86%	98%
I can block out most other distractions when I use it	82%	92%
It is easy to access	90%	94%
It is useful for my learning. Therefore I use it	91%	94%
I utilise it as I find it is easy to use	93%	90%
I use it because I can block out most other distractions when I interact with it	93%	94%
I find it useful for my study skills as it helps me to plan for my learning tasks	95%	93%
It helps me to remain focused which improved my learning regulating skills such as study time management and study tasks planning	94%	92%
It helps me with setting my learning goals and to remain motivated toward learning	90%	94%

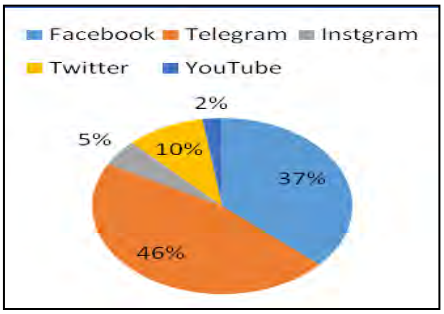
5.2 Students' perception of Privacy self-management

The students' perception of the SM privacy self-management feature was a little bit lower than the previously discussed SM features. However, it remains high perception as the affirmative acceptance ranged between 79%-89%. The following summary table provides further insight into this feature.

SM ID privacy management survey items	Percentage of Total agree
I feel less anxious when I can control my twitter ID privacy on Moodle	79%
I feel free to contribute on the Moodle-Twitter when I can control my twitter ID	81%
I use the integrated Twitter as I feel less anxious when I can control the privacy of my Twitter ID on Moodle	89%
I use the integrated Twitter as I feel free when I can control the privacy of my Twitter ID on Moodle	79%

5.3 SM for learning based on cultural preferences

In the literature, the cultural impact on users' adoption of SM has been explored from different aspects; such as political, economic, and the fundamental rules of internet usage of the country (Bolton, R.N., 2013). Accordingly, it is clear to identify a preferred SM in each country. For example; Facebook and Twitter are used by the majority of people in the USA, while in China, the majority of people use Weibo and RenRen (Forbush, E. and Foucault-Welles, B., 2016).



The last question on the survey explored the preferred SM by the WIUT students. The students provided

positive perspectives on the proposed features of the embodied Twitter on Moodle. However, their actual usage was significantly limited. As discussed earlier, the student's qualitative feedback revealed that they are not familiar with Twitter. This was confirmed in the survey as they voted for Telegram, followed by Facebook as their preferred SM platform for learning. Furthermore, the course leader reported that the students created their own Telegram groups as they are familiar with it for collaborative learning.

6. Conclusion and future work

The result of this study worths further investigation as it touches significant factor of learners' acceptance of SM in formal learning. This factor is Cultural familiarity of SM acceptance in formal learning which seems to override a positively accepted customized learning environment in unfamiliar SM. The WIUT students chose to collaborate on external SM platform even when they had an integrated (learning customised) Twitter on their Moodle. Moreover, regardless of their positive perspectives of the Twitter features, their familiarity with Telegram derived them to use it instead.

A wider sample population, and more case studies are required to be covered in order to formalize a conclusion on how much cultural traits influence SM acceptance in formal learning. The question this study rais is which feature that can be technically manipulated to segnificanlty influence learners' acceptance of new SM environment for collaborative learning? Future studies requires further investigation on the personal and cultural traits that can significantly influence learners' acceptance of SM in formal learning.

References

Abe, B. P. and Jordan, N. A. (2013). Integrating social media into the classroom curriculum, About Campus . *18* (1), 16–20.
Abrami, Philip C. et al. (2011). Interaction in distance education and online learning: Using evidence and theory to improve practice. *Computing in Higher Education , 23* ((2-3)), 82-103.
Bandura, A. and Walters, R.H. (1977). *Social learning theory (Vol. 1).* Englewood Cliffs, NJ: Prentice-hall.
Bolton, R.N. (2013). Understanding Generation Y and their use of social media: a review and research agenda. (A. H. Parasuraman, Ed.) *Journal of service management , 24* (3).
Boynton, P.M. and Greenhalgh, T. (2004). Selecting, designing, and developing your questionnaire. *Bmj , 328(7451)*, pp.1312-1315.
Blaschke, L. M. (2014) 'Using social media to engage and develop the online learner in self-determined learning', *Research in Learning Technology*, 22. Available at: https://journal.alt.ac.uk/index.php/rlt/article/view/1458.
Cooke, S. (2017) 'Social teaching : Student perspectives on the inclusion of social media in higher education', pp. 255–269. doi: 10.1007/s10639-015-9444-y.
Chen, B. and Bryer, T. (2012). Investigating instructional strategies for using social media in formal and informal learning. *The International Review of Research in Open and Distributed Learning , 13* (1), 87-104.
Chen, X. et al. (2014). Mining social media data for understanding students' learning experiences. (M. a. Vorvoreanu, Ed.) *IEEE Transactions on Learning Technologies , 7* (3), pp.246-259.
Collins, a, Greeno, J.G. & Resnick, L.B. (2001). *Educational Learning Theory Second Edition.* Elsevier.
Cooper, C.J. et al. (2006). Web-based data collection: detailed methods of a questionnaire and data gathering tool. (S. D. Cooper, Ed.) *Epidemiologic Perspectives & Innovations , 3* (1), 1.
Dabbagh, N. and Kitsantas, A. (2012) 'Personal Learning Environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning', *Internet and Higher Education*. Elsevier Inc., 15(1), pp. 3–8. doi: 10.1016/j.iheduc.2011.06.002.
Eynon, R. and L. Malmberg. (2011). A typology of young people's Internet use: implications for education. *Computers and Education , 56* (3), 585-595.
Forbush, E. and Foucault-Welles, B. (2016). Social media use and adaptation among Chinese students beginning to study in the United States. *International Journal of Intercultural Relations , 50*, pp.1-12.
Goodyear et al. (2014). Tweet me, message me, like me: using social media to facilitate pedagogical change within an emerging community of practice. (C. A. V.A., Ed.) *Sport, Education and Society , 19* (7), 927-943.
Guttman, L. (1945). A basis for analyzing test-retest reliability. *Psychometrika , 10* (4), pp.255-282.
Hrastinski, S. & Aghaee, N. M. (2012). How are campus students using social media to support their studies? An explorative interview study. *Education and Information Technologies , 17* (4), 451-464.
Heale, R. and Twycross, A. (2015) 'Validity and reliability in quantitative research Validity and reliability in quantitative studies', *Evidence-Based Nursing*, (August), pp. 1–4.
Jones, Norah. et al. (2010). Get out of MySpace! . *Computers and Education , 54* (3), 776-782.
Junco, R., and S. R. Cotton. (2013). No A 4 U: The relationship between multitasking and academic performance. *Computers & Education , 59*, 505–514.
Kirschner, P. A., and A. C. Karpinski . (2010). Facebook and Academic Performance. *Computers in Human Behavior , 26* (6), 1237–1245.
Klašnja-Milićević, A. et al. (2018). Social tagging strategy for enhancing e-learning experience. (B. a. Vesin, Ed.) *Computers & Education , 118*, 166-181.
Kopeinik, S. et al. (2017). Supporting collaborative learning with tag recommendations: a real-world study in an inquiry-based classroom project. *Proceedings of the Seventh International Learning Analytics & Knowledge Conference* (pp. pp. 409-418). ACM.
Liu, Y. (2010). Social media tools as a learning resource. *Journal of Educational Technology Development and Exchange (JETDE) , 3* (1), p.8.
Leonardi, P. M. (2017) 'Information and Organization The social media revolution : Sharing and learning in the age of leaky knowledge', *Information and Organization*. Elsevier Ltd, 27(1), pp. 47–59. doi: 10.1016/j.infoandorg.2017.01.004.
Lietz, P. (2010) 'Researchintoquestionairedesign: A summary of the literature', *Intenational Journal of Market Research*, 52(2), pp. 247–273.
Mark S. Litwin. (1995). *How to Measure Survey Reliability and Validity.* SAGE.
Mazman, S.G., and Y.K. Usluel. (2010). Modeling Educational Uses of Facebook. *Computers in Education , 55* (2), 444-453.
Ouya, S. et al. (2015). Social network integration to e-learning environment. *Computer Systems and Applications (AICCSA)* (pp. 1-4). IEEE/ACS 12th International Conference.
Prescott, J., S. Wilson, and G. Becket. (2013). Facebook use in the Learning Environment: Do Students want this? . *Learning, Media and Technology , 38* (3), 345–350.
Presser, S. et al. (2004). Methods for testing and evaluating survey questions. (M. L. Couper, Ed.) *Public opinion quarterly , 68* (1), pp.109-130.
Popescu, E. (2014) 'Providing collaborative learning support with social media in an integrated environment', *World Wide Web*, 17(2), pp. 199–212. doi: 10.1007/s11280-012-0172-6.
Prinsloo, P. and Slade, S. (2015). Student privacy self-management: implications for learning analytics. . *In Proceedings of the fifth international conference on learning analytics and knowledge* (pp. pp. 83-92). ACM.

Rada, V. D. de (2005) 'Influence of questionnaire design on response to mail surveys', *International Journal of Social Research Methodology ISSN:*, 8(1), pp. 61–78. doi: 10.1080/1364557021000025991.

Ri, A., Son, S. and Kyu, K. (2016) 'Computers in Human Behavior Information and communication technology overload and social networking service fatigue : A stress perspective', *Computers in Human Behavior*. Elsevier Ltd, 55, pp. 51–61. doi: 10.1016/j.chb.2015.08.011.

Richardson, J.T. (1990). Reliability and replicability of the approaches to studying questionnaire. *Studies in Higher Education , 15* (2), pp.155-168.

(2013). In D. M. Robin Flowerdew, *Methods in Human Geography: A guide for students doing a research project* (p. 87). Routledge.

Shin, D. (2010) 'Interacting with Computers The effects of trust , security and privacy in social networking : A security-based approach to understand the pattern of adoption', *Interacting with Computers*. Elsevier B.V., 22(5), pp. 428–438. doi: 10.1016/j.intcom.2010.05.001.

Smith, E. E. (2016) '"A real double-edged sword:" Undergraduate perceptions of social media in their learning', *Computers & Education*, 103, pp. 44–58. doi: 10.1016/j.compedu.2016.09.009.

Salmon, G. et al. (2015). The space for social media in structured online learning. *Research in Learning Technology , 23*, 1–14.

Saunders, M. et al. (2009). Research Methods for Business Students. (P. a. Lewis, Ed.) *FT Prentice Hall* .

Sekaran, U. (2003). *Research Methods for Business: A Skill Building Approach. 4th ed.* New Jersey: John Wiley and Sons.

Selwyn, N. (2012). Social media in higher education. *The Europa world of learning , 1*, pp.1-10.

Taddicken, M. (2014) 'The " Privacy Paradox " in the Social Web : The Impact of Privacy Concerns , Individual Characteristics , and the Perceived Social Relevance on Different Forms of Self-Disclosure', *Journal of Computer-Mediated Communication*, 19, pp. 248–273. doi: 10.1111/jcc4.12052.

Trochim, W. M. K. (2002) 'The Research Methods Knowledge Base, 2nd Edition', *William M.K. Trochim*, p. http://trochim.human.cornell.edu/kb/index.htm. doi: 10.2471/BLT.05.029181.

Tur, G. and Marín, V. I. (2015) 'Enhancing learning with the social media : student teachers ' perceptions on Twitter in a debate activity', *NEW APPROACHES IN EDUCATIONAL RESEARCH*, 4(1), pp. 46–53. doi: 10.7821/naer.2015.1.102.

Tu, C.H. (2002). The relationship between social presence and online privacy. *The internet and higher education , 5* (4), pp.293-318.

Van Teijlingen et al. (2001). The importance of conducting and reporting pilot studies: the example of the Scottish Births Survey. (R. A. E.R., Ed.) *Journal of advanced nursing , 43* (3), pp.289-295.

Vygotsky, L.S. (1980). *Mind in society: The development of higher psychological processes.* Harvard university press.

Veletsianos, G. (2017) 'Toward a generalizable understanding of Twitter and social media use across MOOCs: who participates on MOOC hashtags and in what ways?', *Journal of Computing in Higher Education*, 29(1), pp. 65–80. doi: 10.1007/s12528-017-9131-7.

Vitak, J. (2012) 'The Impact of Context Collapse and Privacy on Social Network Site Disclosures', *Journal of Broadcasting and Electronic Media*, 56(4), pp. 451–470. doi: 10.1080/08838151.2012.732140.

Weir, J.P. (2005). Quantifying test-retest reliability using the intraclass correlation coefficient and the SEM. *The Journal of Strength & Conditioning Research , 19* (1), pp.231-240.

Digital Literacy in Social Media: A Case Study

Rafaela Andreou and Iolie Nicolaidou
Department of Communication and Internet Studies, Faculty of Applied Arts and Communication, Cyprus University of Technology, Limassol, Cyprus
rafaela.andreou@opiumworks.com
Iolie.nicolaidou@cut.ac.cy
DOI: 10.34190/EEL.19.025

Abstract: Digital literacy skills with respect to the safe use of social media are of prominent importance for adults today, given social media's high frequency of use and given statistics showing rising percentages of "digital immigrants" who, at the present time, use social media. Previous research was based on people' self-reports, focused on specific professional groups or students, and did not systematically measure social media literacy. The present case-study attempted to address this gap and answer three research questions: 1) To what extent are citizens literate with respect to social media use? 2) How does people's perceived competence with social media relate to their social media literacy? 3) What are some factors associated with social media literacy? The main data sources were a demographics questionnaire and a 20-question online-test measuring people's social media literacy. The emphasis of the test was on the safe use of social media. It included questions relevant to adjusting privacy settings, recognizing and rejecting potentially harmful posts, recognizing the permanency of posts, etc. The instruments were completed by 178 Greek-speaking social media users in the Republic of Cyprus with an average age of 28 years old (SD=8.61, min=19, max=61). Findings suggested that participants' average social media literacy performance was 83 out of 100 (M=83.34, SD=9.67), therefore relatively high. Factors that related to people's social media literacy included age, which was negatively correlated with social media literacy (Pearson's r=-0.27, p<0.01), experience with social media (measured in years), (r=0.18, p<0.05) and frequency of use of social media (measured in hours per day) (r=0.26, p<0.01), which were both positively correlated with social media literacy. People's perceived competence with social media did not correlate with their performance on the social media literacy test, which provides an indication that people may underestimate or overestimate their competence. Provided that people who overestimate their competence will most probably not actively seek training on staying safe when using social media and provided that the older a person is the lower her level of social media literacy, this case study argues in favor of designing e-learning training addressed to digital immigrants on the safe use of social media. Findings are of value to e-learning designers and e-learning trainers for adults.

Keywords: social media, digital literacy, digital immigrants, safe use of social media, e-learning

1. Introduction

Many social media platforms, such as Facebook, Instagram, Twitter and Youtube, have now penetrated deeply into our lives and have transformed the way in which we communicate and engage with society (Murphy, Loeb, Basto, Challacombe, Trinh & Leveridge, 2014). Social media partly satisfy the psychological need of young people to belong. According to a recent study of Kim, Wang, and Oh (2016), students' need to belong positively related with their use of social media and smartphones, which in turn facilitated their engagement in social activities.

The concept of social media is top of the agenda for many businesses today, and decision makers, as well as consultants, try to identify ways in which companies can make profitable use of social media applications (Kaplan & Haenlein, 2010). This is particularly important in the present time given the rise of Social Media Influencers (Khamis, Ang & Welling, 2017), who are aptly used to publicize product information and latest promotions to online followers (Lim, Cheah & Wong, 2017), typically millennials (Chatzigeorgiou, 2017).

Digital literacy skills are of prominent importance for adults today. One dimension of digital literacy, which is highly pertinent to social media, refers to communication (Hague & Payton, 2011). According to Hague and Payton (2011):

> *"the internet and web 2.0 technologies have greatly extended the choice of communication media available to young people and adults, in forms such as email, instant messaging, social networking sites, forums, blogs and wikis. People therefore need to be able to judge when to use these tools and when to select more traditional communication media for any given task" (p.1)*

People's choice of media should be done based on the nature of the task rather than their interest in specific technologies. They also need to be supported to understand how their choice of media affects their ability to communicate (Hague & Payton, 2011).

Another important dimension of digital literacy, according to Hague and Payton (2011) is e-safety, which is pertinent to the *safe* use of social media. These skills are particularly important, especially given social media's high frequency of use and given statistics showing rising percentages of "digital immigrants" who, at the present time, use social media (Fietkiewicz, 2017).

2. Measuring social media literacy

There haven't been many attempts to measure digital literacy particularly with respect to social media use. Some of previous attempts have focused on the digital literacy skills of specific professional groups, such as health professionals (Murphy, Loeb, Basto, Challacombe, Trinh, Leveridge, & Bultitude 2014), librarians (Vanwynsberghe, Vanderlinde, Georges & Verdegem, 2015) or undergraduate students (Bridges, 2012) and university graduates (Yiannakopoulou & Mpatziou, 2012). Previous research was based on people' self-reports and did not systematically measure either digital literacy in general or social media literacy, in particular. For example, Yiannakopoulou and Mpatziou (2012) attempted to measure the digital literacy level of 100 adults who were university graduates but their instrument was based on how familiar participants felt that they were with respect to the use of specific tools. They found that some factors that affect digital literacy in adults include gender, age, experience and frequency of use of computers. They also found the participants aged between 18 and 40 who are experienced with respect to the use of computers and who use computers for more than 20 hours per week are the ones who have higher familiarity with specific tools.

However, self-reported instruments pose a risk of misreporting by respondents (Hagittai, 2009), therefore it is important to use standardized tests, to the extent that this is possible, to measure digital literacy in research studies. The present study attempted to address this gap by using an online instrument to measure social media literacy, based on the social media instrument developed by the Northstar Digital Literacy Assessment (https://www.digitalliteracyassessment.org/), as part of a case study focusing on a specific country, Cyprus. The online test was administered in an attempt to measure people's social media literacy in a more objective and systematic way as opposed to relying on self-reports. It is important to note that to the best of the authors' knowledge, no published study was found that attempted to measure Cypriot citizens' social media literacy skills. Therefore, the present study attempted to answer the question "To what extent are Cypriot citizens literate with respect to social media use?" Within the frame of this question, the study also attempted to test a hypothesis, which was based on the literature, which differentiates the social media literacy of undergraduate students as opposed to the social media literacy of older individuals. More specifically, there have been claims in the literature that "even though most students use social media regularly, many do not know how to use it professionally" (Callens, 2014), a claim that was also made previously by Bridges (2012). The hypothesis that was made in the present study, which is opposing to the claims made in the literature, was that undergraduate students and young people in general, being digital natives (Prensky, 2001), will know how to use social media safely and responsibly, by acting in a professional way that moreover doesn't compromise the safety of their personal data.

The present study also attempted to identify factors that relate to social media literacy and answer the question: What are some factors associated with social media literacy? Within the frame of this question, the second hypothesis that was made was that people who use social media more frequently will have higher levels of social media literacy. This was based on the findings of the research of Vanwynsberghe, Vanderlinde, Georges & Verdegem (2015), which focused on librarians, and found that frequency of use of social media and therefore higher self-efficacy in performing social media related activities was correlated to more advanced practical and cognitive competencies in the use of social media. In other words, the study found that the social media literates (with a high level of social media literacy) are librarians who frequently use social media at home and at work. Lastly, the present study also attempted to compare people's perceived competence with social media to their actual social media literacy.

3. Methodology

3.1 Research questions

The present case-study attempted to answer three research questions:

- 1) To what extent are Cypriot citizens literate with respect to social media use?
- 2) How does people's perceived competence with social media relate to their social media literacy?

- 3) What are some factors associated with social media literacy?

The study also attempted to test two hypotheses:

> *$H_{1:}$ Undergraduate students and young people in general will know how to use social media responsibly and safely.*
>
> *$H_{2:}$ People who use social media more frequently will have higher levels of social media literacy*

3.2 Data sources

The main data sources of this case-study were: a) a demographics questionnaire and b) a 20-question multiple choice test measuring people's social media literacy, which was based on the Northstar Digital Literacy Assessment.

The demographics questionnaire included closed questions such as: gender, age, educational level (ordinal variable), experience with the internet and social media (measured as a scale variable using numbers of years of internet and social media use), frequency of use of internet and social media (measured as a scale variable using hours of use per day), and predicted score on social media literacy test before this was administered, to measure people's perceived competence with social media.

The emphasis of the test measuring people's social media literacy was on the safe and responsible use of social media. The test was based on the standards set by Northstar Digital Literacy Assessment, a program of the Minnesota Literacy Council, which defines basic skills needed to perform tasks on computers and online. According to the standards for using technology in daily life as set by Northstar Digital Literacy Assessment:

> *"Users of social media should be able to:*
>
> *1. Identify different types of social media and their primary functions (especially Facebook, LinkedIn, Instagram, Twitter).*
>
> *2. Create a new account on a social media network and log in.*
>
> *3. Recognize information posted on social media networks that may present a risk to the user as consumer of information.*
>
> *4. Demonstrate knowledge of managing "friends" on Facebook: adding friends, accepting/declining "friend" requests, and the difference between that and "following" someone.*
>
> *5. Understand and change privacy settings.*
>
> *6. Demonstrate an understanding of the consequences of "liking" or commenting on something.*
>
> *7. Share and delete content, including photos, videos, and links.*
>
> *8. Identify information that is unwise to post and/or upload on social media (too much personal sharing, inappropriate photos/comments).*
>
> *9. Distinguish between public and private "spaces" on social media sites (e.g., Facebook messages vs. Facebook timeline).*
>
> *10. Post, share, like, or comment on content.*
>
> *11. Demonstrate knowledge of the permanence of anything posted on the internet" (Northstar Digital Literacy Assessment, n.d.).*

The test therefore included questions relevant to adjusting privacy settings, recognizing and rejecting potentially harmful posts, recognizing the permanency of posts, etc. The questions of the test were written in Greek to accommodate the needs of native speakers on the island of Cyprus. Eleven out of 20 questions focused on Facebook, one focused on Twitter, three focused on Instagram and one focused on LinkedIn. Four questions were based on a combination of these social media platforms. The passing score of the Northstar test was 85 out of 100. The same passing score was used as a standard for the instrument of the present study as well.

To test the validity of the scoring rubric of the social media literacy test, as part of a small pilot study, 15 participants took both the Northstar social media literacy test, which is provided for free for individual use, and the social media literacy test that was used in this study. Despite the small sample size, a Pearson's correlation coefficient was calculated between the scores of these individuals in the Northstar social media test (M=87.12, SD=7.87) and their scores in the social media test of the present study (M=85.33, SD=6.14). A statistically significant, positive, moderate relationship (Pearson's $r=0.53$, $n=15$, $p<0.05$) between the two scores is a preliminary indication of the test's validity, which needs to be further examined in future, large scale studies. The reliability of the scoring rubric has not been tested.

3.3 Data collection

The demographics data questionnaire and the online test on social media literacy were available for completion online for approximately two weeks, between the 28th of March 2018 and April 15th 2018.

3.4 Participants

A hundred and seventy-eight (n=178) social media users; 60 men (33.7%) and 118 women (66.3%), with an average age of 28 years old (M=27.9, SD=8.61, min=19, max=61) participated in the study by completing both instruments: the demographics questionnaire and the online social media literacy test. All participants were Greek speaking and lived in Cyprus.

With respect to their educational level, 41% of the sample were students (n=73/178), 21.3% were university graduates (n=41/178), 23% had a Master's (n=41/178) and 7.9% (n=14/178) had a PhD.

Participants were internet users for an average of 12 years (M=11.92, SD=4.5, min=2, max=25) and the vast majority (97.8%) used the internet on a daily basis, for an average of 7 hours (M=6.99, SD=4.22) per day. Participants were social media users for an average of 8.5 years (M=8.46, SD=2.74, min=2, max=20). They used social media for an average of 5.5 hours per day (M=5.52, SD=4.12).

3.5 Data analysis

The social media literacy test was manually scored and all data was input in a statistical package for analysis (IBM SPSS Statistics 24). The first research question was answered using descriptive statistics and population parameter estimates. The second and third research questions were answered by conducting correlation analyses using the Pearson's r coefficient, which is appropriate for testing the relationship between scale variables. The alpha level was set a priori to 0.05 for all statistical analyses.

4. Results

4.1 To what extent are Cypriot citizens literate with respect to social media use?

Findings suggested that participants' average social media literacy performance was 83 out of 100 (M=83.34, SD=9.67), therefore relatively high (Table 1). However, the average performance was below the passing score of the test (which was 85 out of 100).

The population parameters were calculated using interval estimates, based on a 95% confidence interval with unknown SD. The population's mean score on social media literacy is expected to lie between 81.91 and 84.77 (95%CI [81.91 - 84.77]).

Table 1: Social media literacy (systematic measurement and perceived level)

	M	SD	min	max
Social media literacy	83.34	9.67	37	100
Perceived social media literacy	79.56	14.88	7	100

To examine the first hypothesis of the study, the average score of social media literacy of participants who reported that they were students, who also tend to be relatively young in age (M=22.04, SD=3.46, n=73) was also calculated. This was found to be 84 out of 100 (M=84.44, SD=9.6, n=73), slightly higher than the average score of the rest of participants (M=82.58, SD=9.69, n=105). This indicates that students and in general young people can be considered social media literate to some extent and confirms the first hypothesis of the study.

4.2 How does people's perceived competence with social media relate to their social media literacy?

As can be seen from Table 1, the average scores between people's perceived social media literacy (M=79.56, SD=14.88), as this was predicted before taking the test, and actual social media literacy score (M=83.34, SD=9.67), as this was systematically measured from the online test are relatively close. A Pearson correlation coefficient was computed to assess the relationship between perceived social media literacy and social media literacy score. A Pearson's correlation between these two scale variables indicated a very weak relationship and did not yield a statistically significant result (Pearson's r=0.08, n=176, p=0.25). The fact that people's perceived competence with social media did not correlate with their performance on the social media literacy test provides an indication that people either underestimate or overestimate their competence in the use of social media.

4.3 Factors that relate to people's social media literacy

Several factors which could affect people's social media literacy were examined in this study. These included age, gender, experience with internet and social media, frequency of use of internet and social media, and educational level. No statistically significant relationships were found between the level of people's social media literacy and their experience with using the internet (measured in years), the frequency of using the internet or their educational level (Table 2). To examine whether there are differences between the level of social media literacy between men and women, a chi-square was conducted with two nominal variables (gender: male/female and passing score in test: yes/no) to compare the percentage of men and women who passed the test but, again this did not yield any statistically significant results.

As shown in Table 2, three factors related to people's social media literacy at a statistically significant level. The first one was age. A Pearson correlation coefficient was computed to assess the relationship between age (M= 27.9, SD=8.61) and social media literacy (M=83.34, SD=9.67). Age was negatively correlated with social media literacy (Pearson's r=-0.27, n=179, p<0.01). This means that the younger a person is the higher his/her social media literacy.

Table 2: Correlations between social media literacy and other factors

	Age	Experience with social media	Hours of use of social media	Experience with the internet	Frequency of internet use	Educational level
Social media literacy	-0.27 **	0.18*	r=0.26**	r=-0.026	r=0.108	r=0.007

* p < .05, **p < .01

The second factor that relates to social media literacy was experience with social media. A Pearson correlation coefficient was computed to assess the relationship between experience with social media measured in years (M=8.46, SD=2.74) and social media literacy (M=83.34, SD=9.67). A statistically significant, positive moderate relationship was found between experience with social media and social media literacy (r=0.18, n=177, p<0.05). This means that the more years people use social media the higher their social media literacy (Table 2).

The third factor that relates to social media literacy was frequency of use of social media. A Pearson correlation coefficient was computed to assess the relationship between frequency of use of social media (measured in hours per day) (M=5.52, SD=4.12) and social media literacy (M=83.34, SD=9.67). A statistically significant, positive moderate relationship was found between frequency of use of social media and social media literacy (r=0.26, n=156, p<0.01). This means that the more hours people use social media the more social media literate they are (Table 2) and confirms the second hypothesis of the study.

5. Discussion

This study attempted to measure Cypriot citizens' social media literacy based on a sample of 178 participants. Even though the sample that was used was small and it was not random, therefore limiting the generalizability of results, the study provided preliminary data suggesting that Cypriot citizens' social media literacy is at an adequate level, as the average score of participants in the sample was 83 out of 100, so slightly below the passing score of the test (85 out of 100).

The first hypothesis of the study, that undergraduate students and in general young students will know how to use social media responsibly and professionally, was confirmed, as the study indicated that their level of social media literacy is relatively high (M=84.44, SD=9.6, n=73), and at the same time, slightly higher than the average score of the rest of participants (M=82.58, SD=9.69, n=105). Moreover, with respect to age, a statistically significant negative correlation between age and social media literacy indicates that young adults tend to have higher social media literacy skills than older people. This finding comes in opposition to claims made in the literature that students do not know how to use social media professionally (Callens, 2014; Bridges, 2012).

The second hypothesis, which was confirmed in this study, was that people who use social media more frequently will have higher levels of social media literacy, a finding that is in accordance with what was reflected by the research of Vanwynsberghe, Vanderlinde, Georges and Verdegem (2015).

The power of social networking is such that the number of worldwide users is expected to reach some 3.02 billion monthly active social media users by 2021, around a third of Earth's entire population (eMarketer, 2017). Therefore more and more people, of various ages, are expected to be social media users in the future. With respect to the second research question of the study, examining the relation between people's perceived competence with social media and actual social media literacy, this study indicated that in general people either underestimate or overestimate their social media literacy skills. People who overestimate their competence will most probably not actively seek training on staying safe when using social media. Provided that the older a person is the lower her level of social media literacy, this case study argues in favor of designing e-learning training addressed to digital immigrants on the safe use of social media. However, the same type of training can easily be customized to address the needs of digital natives. The results of the online test measuring social media literacy may be used by e-learning designers and e-learning trainers for adults as part of a needs assessment to identify people's individual weaknesses on specific tasks and therefore offer personalized training sessions focusing on the skills that need to be developed.

It is important to acknowledge that the study had additional limitations, beyond the small sample size (n=178) and the fact that participants were self-selected, as there was no use of random sampling procedures. Specifically, the validity of the social media literacy test that was used was examined using a very small size of 15 participants and the reliability of the social media literacy test was not calculated.

In conclusion, this case study provided preliminary empirical data indicating that Cypriot citizens are social media literate at an adequate level, with the population's mean score expected to lie between 81.91 and 84.77 (95%CI [81.91 - 84.77]), but either underestimate or overestimate their competence with respect to safely using social media. Finally, factors that were positively associated with social media literacy were people's experience with social media and people's frequency of use of social media, while a factor that was negatively associated with social media literacy was people's age, indicating that older people tend to have a lower level of social media literacy.

References

Bridges, L. M. (2012). Librarian as professor of social media literacy. Journal of Library Innovation, 3(1), 48.

Callens, M. V. (2014). Using Bloom's taxonomy to teach course content and improve social media literacy. *Journal of Interdisciplinary Studies in Education*, *3*(1), 17.

Chatzigeorgiou, C. (2017). Modelling the impact of social media influencers on behavioural intentions of millennials: The case of tourism in rural areas in Greece.Heritage & Services Marketing , 3 (2), pp. 25-29.

eMarketer (2017). Number of social media users worldwide from 2010 to 2021 (in billions). Retrieved from: https://www.statista.com/topics/1164/social-networks/. Statista.com

Fietkiewicz, K. (2017). Jumping the digital divide: How do "silver surfers" and "digital immigrants" use social media?. *Networking Knowledge: Journal of the MeCCSA Postgraduate Network*, *10*(1), 5-26.

Hague, C., & Payton, S. (2011). Digital literacy across the curriculum. *Curriculum Leadership*, *9*(10).

Hargittai, E. (2009). An update on survey measures of web-oriented digital literacy. Social science computer review, 27(1), 130-137.

Kaplan, A. M., & Haenlein, M. (2010). Users of the world, unite! The challenges and opportunities of Social Media. *Business horizons*, *53*(1), 59-68.

Khamis, S., Ang, L., & Welling, R. (2017). Self-branding,'micro-celebrity'and the rise of Social Media Influencers. Celebrity Studies, 8(2), 191-208.

Kim, Y., Wang, Y., & Oh, J. (2016). Digital media use and social engagement: How social media and smartphone use influence social activities of college students. Cyberpsychology, Behavior, and Social Networking, 19(4), 264-269.

Lim, X. J., Cheah, J. H., & Wong, M. W. (2017). The impact of social media influencers on purchase intention and the mediation effect of customer attitude. Asian Journal of Business Research, 7(2), 19-36.

Murphy, D. G., Loeb, S., Basto, M. Y., Challacombe, B., Trinh, Q. D., Leveridge, M., ... & Bultitude, M. (2014). Engaging responsibly with social media: T he B ritish J ournal of U rology I nternational (BJUI) guidelines.

Northstar Digital Literacy Assessment (n.d.) Retrieved from https://assessment-legacy.digitalliteracyassessment.org/?module=9&cacheversion=1

Prensky, M. (2001). Digital natives, digital immigrants part 1. On the horizon, 9(5), 1-6.

Vanwynsberghe, H., Vanderlinde, R., Georges, A., & Verdegem, P. (2015). The librarian 2.0: Identifying a typology of librarians' social media literacy. *Journal of Librarianship and Information Science*, *47*(4), 283-293.

Yiannakopoulou, E. & Mpatziou, S. (2012). Adults' digital literacy. Investigation of adults' digital competence. Retrieved from: https://www.etpe.gr/custom/pdf/etpe1962.pdf Available in Greek as follows: Γιαννακοπούλου, Ε. & Μπάτζιου, Σ. (2012). Ψηφιακός Γραμματισμός ενηλίκων. Διερεύνηση ψηφιακής επάρκειας ενηλίκων. Χ. Καραγιαννίδης, Π. Πολίτης & Η. Καρασαββίδης (επιμ.), Πρακτικά Εργασιών 8ου Πανελλήνιου Συνεδρίου με Διεθνή Συμμετοχή. «Τεχνολογίες της Πληροφορίας & Επικοινωνίας στην Εκπαίδευση», Πανεπιστήμιο Θεσσαλίας, Βόλος, 28-30 Σεπτεμβρίου 2012

A Hybrid Fuzzy DEMATEL-AHP/VIKOR Method for LMS Selection

Sarra Ayouni[1, 3], Leila Jamel Menzli[1, 4], Fahima Hajjej[1]and Mohamed Maddeh[2]
[1]IS Department, College of Computer and Information Sciences, Princess Nourah bint Abdulrahman University, Riyadh, KSA
[2]Information Systems Department, College of Computer and Information Sciences, King Saud University, Riyadh, KSA
[3]LIPAH University of Tunis El Manar, 2092 Tunis, Tunisia
[4]Laboratory RIADI-GDL, ENSI, University of Mannouba, Tunisia
saayouni@pnu.edu.sa
lmjamel@pnu.edu.sa
fshajjej@pnu.edu.sa
mmaddeh@ksu.edu.sa
DOI: 10.34190/EEL.19.089

Abstract: Academic institutions, organizations, as well as government agencies are increasingly using the Internet and information technologies to provide the targeted beneficiaries with informational content and educational resources. Learning management systems (LMS) are some of the frequently used software for this purpose. Adopting such systems in higher education has become a major focus of interest and several educational institutions are heavily investing in their development and deployment. Selecting the most appropriate LMS is a strategic decision to gain stakeholder's traction and to enable decision makers to avoid bad choices, make predictions and accordingly optimize LMS investment. With the growth of LMS market and the increasing number of LMS features, an effective LMS evaluation method is needed to deal with this diversity and help decision makers to select the most appropriate one. Indeed, selecting the most appropriate LMS can be considered as a Multi Criteria Decision Making (MCDM) problem with the objective to rank a set of LMS and select the best system that fits educational system stakeholder requirements and promote learning at the institution. In this paper, three different LMS categories are considered (i.e.; proprietary, open source and web-based LMS) with a set of criteria inspired from ISO 9126 model for selecting systems quality characteristics and sub-characteristics.

Keywords: learning management systems, multi-criteria decision making, Fuzzy DEMATEL, Fuzzy VIKOR, Fuzzy AHP, ISO 9126 model

1. Introduction

The worldwide higher education sector has undergone several changes in recent years due to various factors such as internationalization, commercialization, developing communication technologies, increasing competition between universities, decreasing financial support of governments on universities and increasing demand for higher quality (Altbach et al. 2005). All these factors have prompted significant changes in learning methodology and the creation of new learning environment (Albarrak 2010). Numerous educational institutions and universities are increasingly using the Internet and Information technologies to provide the targeted beneficiaries with informational content and educational resources particularly through the use of Learning Management Systems (i.e.; LMS). Adopting LMSs in higher education has become a major focus of interest. Thus several educational institutions are heavily investing in the development and deployment of these LMSs.

A LMS is comprehensive, integrated software product that has a set of tools which support the development, delivery, assessment, and administration of education courses or training programs (Ramesh et al, 2013) in traditional face-to-face, blended, or online learning environments. LMSs encompass various tools and features (i.e.; content management, collaboration, communication, assessment and evaluation tools) that can enhance teaching as well as learning experience. They help meet FERPA, copyright compliance, and archival needs (Kroner 2014). On the market, there is a wide range of LMS options to select from, including proprietary, open source, free, cloud based or web-based systems. Each LMS is different in terms of tools, features and cost. Although LMSs have been developing for several years, the evaluation of such systems is still a crucial and cumbersome task for educational institutions. Therefore, the selection of the correct LMS is fundamental to support high quality teaching and learning experience. The problem of effectively choosing an LMS is becoming more common among universities and learning facilities where they have to closely examine the LMS tools and features and how they might be used. Making an appropriate selection of an LMS and identifying its most important features for an institution can be a complex process because the increasing number of LMS with different features that are now available on the market. The Multi-Criteria Decision Making (MCDM) method is widely used by researchers to solve various problems that involve different criteria. This study suggests a fuzzy DEMATEL-AHP-VIKOR model to determine the interrelations between LMS evaluation criteria, their effects on each other as well as which criteria are the most important. Twelve criteria selected as the most important by experts will be considered in the study. In the selection of an LMS, we have to establish a set of criteria and a number of considerations that LMS experts should scrutinize during the selection process. The major objective of this paper is to integrate the Fuzzy Decision Making Trial and Evaluation Laboratory Method (DEMATEL) the Fuzzy Analytic Hierarchy Process (AHP) and the Fuzzy VIKOR as efficient analyses and decision-making methods to (1) discover the interrelation between LMS evaluation criteria, (2) select the most important LMS evaluation criteria and (3) evaluate and rank a set of the most popular LMS (i.e.; alternatives) on the market. This paper presents a new hybrid approach based on the application of MCDM methodologies to improve decision making on LMSs selection.

The rest of the paper is organized as follows: Section 2 discusses the literature review related to LMS evaluation criteria and the use of MCDM methods to handle LMS selection problem. In section 3, the most important LMS evaluation criteria are selected by combining Fuzzy DEMATEL and Fuzzy AHP methods. In section 4, the Fuzzy VIKOR is used to evaluating and ranking different types of LMSs. Section 5 discusses the results and concludes the paper.

2. Literature review

Although LMSs with different specifications have been developed for several years, the identification of evaluation criteria as well as the selection of an appropriate LMS is still a crucial task among universities and learning facilities. Indeed, an effective method is required to identify the relationships between evaluation criteria and determine which criteria are more important than other. On the other hand a systematic method is needed to deal with the diversity of LMSs and help decision makers to select the most appropriate one.

LMS evaluation has been examined by several researchers from various perspectives, including those of administrators (Naveh et al, 2010), faculty members (Almarashdeh et al, 2011), learners/students (Naveh et al, 2012) and technical aspects of LMSs (Kurilovas 2009). In (Padayachee et al, 2010) a theoretical framework is proposed comprising domain specific quality criteria related to the ISO/IEC 9126 and used for some specific software systems namely learning management systems for higher education institutions. In (Djouab et al, 2016), the quality standard ISO 9126 is extended with the specific characteristics of the e-learning software product. The authors propose to define the quality characteristics of the e-learning system and integrate them in the ISO 9126 model. (Radwan et al, 2016a) reviewed two multi valued logic models which are fuzzy sets and intuitionistic fuzzy sets and suggest a new approach based on neutrosophic set for handling uncertainty in expert systems to derive decisions. The study analyses, compares and clarifies the differences of these models in terms of the application area of problem solving. The results show that the proposed approach is a more effective option than fuzzy and intuitionistic fuzzy logic for LMS evaluation due to its improved ability to stimulate human thinking. In their study, the authors are considering one main criteria of usability for the LMS evaluation, which is further divided into five attributes: efficiency, learnability, memorability, error tolerance and user satisfaction. In (Mehta et al, 2016), the proposed solution uses data mining techniques for analyzing log details and Fuzzy Inference System for evaluating and recommending LMSs. In this study three principle criteria: learners' behavior, learners' style and teaching evaluation are considered. In (Radwan et al, 2016b), the neutrosophic logic extension of the fuzzy logic is used for the evaluation of LMSs based on three system quality attributes (i.e.; usability, reliability, and accessibility) divided into eleven sub-criteria (i.e.; efficiency, learnability, memorability, error tolerance, user satisfaction, fault tolerance, maturity, recoverability, navigability, robustness and understandability). Compared to fuzzy logic, the neutrosophic logic is more capable of representing uncertainty in human thinking for evaluating Learning Management Systems.

In the literature, there is not sufficient studies that integrate fuzzy logic with MCDM methods for LMS evaluation. In fact, a fuzzy ANP based method is proposed in (Fardinpour 2014), to evaluate an intelligent learning management system (ILMS) based on thirteen criteria identified as the most significant ones. In (Işık 2015), the Fuzzy Analytic Hierarchy Process (FAHP) was used for the evaluation of the most appropriate LMS. In this study nine criteria (Multilingual support, cost, evaluation tools, compatibility, support, sustainability, reliability, source code, management) along with three alternatives (Joomla LMS, Moodle, and Blackboard) are considered. It was found that Joomla LMS is the most fitting LMS that meets the requirements. In (Muhammad et al, 2017), the fuzzy DEMATEL method is used to analyse and identify the most important LMS evaluation criteria. The results of the study demonstrate that accessibility, compatibility, evaluation tools, learnability, multilingual support, portability, reliability, security, support, sustainability, usability and user satisfaction should be considered for effective LMS evaluation that will satisfy users' (students, instructors, or educational institutions) needs. It has been found that learnability, reliability, usability, and user satisfaction should be given the highest priority for an effective LMS evaluation.

3. Research method

This study proposes a combined fuzzy MCDM approach based on the FUZZY DEMATEL, AHP, and VIKOR methods to select the suitable LMS for an educational institution based on a set of selected quality performance that are inspired from ISO 9126 standard. In this study six quality criteria and 15 sub-criteria as shown in table 1, are used to evaluate the 'quality in use' of LMSs.

Table 1*:* LMS quality criteria relating to characteristics of ISO 9126 model (*Padayachee* et al, 2010)

Criteria	Sub-Criteria	Description	Representation
Functionality	Suitability	'Does the system perform the tasks required with the expected result?'	C1
	Scalability	'Is the system able to handle a growing number of users and resources?'	C2
	Interoperability/Data Compatibility	'Can the system interact with another system?'	C3
	Compliance	'Does the system comply with different standards?'	C4
	Security	'Does the system prevent unauthorized access and ensure data integrity?'	C5
	Traceability	'Is the system capable of tracking user activities?'	C6
Reliability	Fault tolerance	'Is the system able to maintain a specified level of performance or continue functioning in case of software fault?'	C7
	Recoverability/ Error handling	'Does the system resume working and restore lost data after a failure? '	C8
Usability	Accessibility	'Is the system accessible for everyone including people with disabilities?'	C9
	Learnability	'Can the user learn to use the system easily?'	C10
	Operability	'Can the user use the system without much effort?'	C11
	Attractiveness	'Has the system a user-friendly interface?'	C12
Efficiency	Time behavior	'How quickly does the system respond?'	C13
Maintainability	Stability	'Can the system continue functioning if changes are made?'	C14
Portability	Adaptability	'Can the system be moved to other environments?'	C15

The criteria depicted in table 1 are evaluated by subjective human assessment expressed in linguistic terms. Therefore, imprecision due to the decision-makers vagueness and uncertainty is handled with the fuzzy linguistic approach. This paper proposes a new integrated MCDM model that combines Fuzzy DEMATEL, fuzzy AHP and fuzzy VIKOR. In the first phase, the fuzzy DEMATEL and Fuzzy AHP methods are combined to reveal the interrelations between LMS evaluation criteria and to select the most important ones (Figure 1). Thus, the overall complexity of the selecting problem is significantly reduced as the initial number of criteria is decreased. Then the fuzzy VIKOR method is used in the second part of the model for raking the alternatives (i.e.; LMSs) and selecting the best one. In this study three different LMSs (i.e.; Blackboard, Moodle, and Joomla LMS) are considered.

3.1 Fuzzy DEMATEL and Fuzzy AHP methods to select most important LMS evaluation criteria

The DEMATEL (Decision making trial and evaluation laboratory) technique developed by the Geneva Research Centre of the Battelle Memorial Institute (Gabus et al, 1972), is a comprehensive method for illustrating the structure of complicated cause and effect relationships and finding the critical ones through a visual structural model (Si et al, 2018). In the original DEMATEL the relationships of decision factors are assessed by crisp value. However, crisp values are generally inadequate to estimate the vagueness of the interdependence relationship between criteria and cannot reflect the subjective decision makers' judgments. Thus, the concept of fuzzy sets (Zadeh 1965) has been applied to the DEMATEL method by many researchers (Si et al, 2018). The fuzzy DEMATEL method has been implemented to respond to variety of situations that include developing global managers' competencies (Wu et al, 2007), airline safety measurement (Liou et al, 2008), evaluating the green supply chain management practices (Lin 2013) and green supply chain management implementation (Malviya 2016). However, fuzzy DEMATEL has not been integrated with other MCDM methods to deal with the evaluation and the selection of a LMS in higher education. Thus, this paper combines the practical application of DEMATEL with AHP and VIKOR methods in a fuzzy environment. The fuzzy DEMATEL method is used in this study to handle the experts' vague judgments about LMS features and evaluation criteria and to illustrate the interdependence between these criteria. On the other hand the FAHP is applied on the LMS evaluation criteria to calculate their importance weight

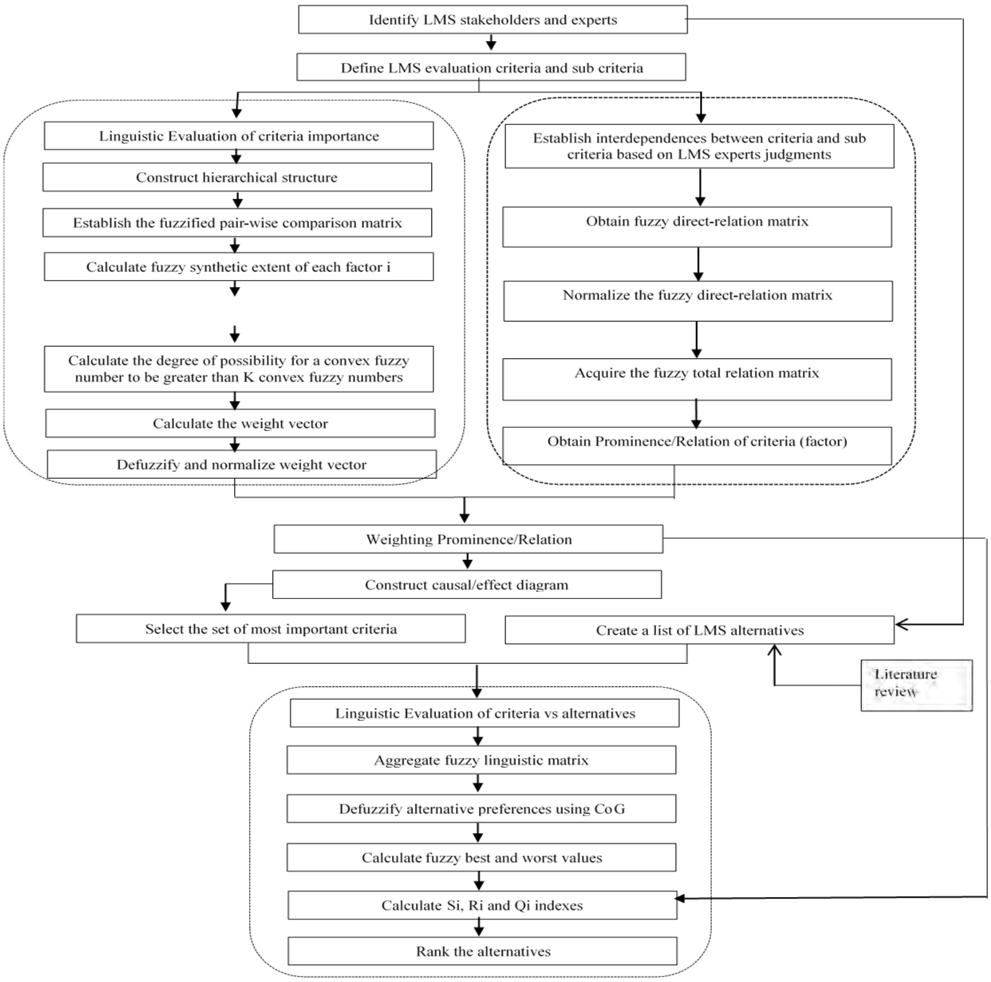


Figure 1: The proposed approach

The objective of using FAHP method is to decide on the relative importance of each pair of evaluation criteria. FAHP is used with the integration of the fuzzy analysis method (Chang, 1996). Indeed, in this step of the proposed approach, pair-wise comparison scale is handled based on triangular fuzzy numbers (TFNs) followed by the use of extent analysis method where synthetic extent values are used to obtain priority/importance weights. The fuzzy evaluation matrix of the criteria is constructed through the pair-wise comparison of different attributes relevant to the overall objective using the linguistic variables and TFNs as detailed in the next section. The results FDEMATEL and FAHP methods are combined to select the most important LMS evaluation criteria and discard the insignificant ones in next steps of LMS alternatives ranking. In this way the MCDM problem complexity is decreased by identifying the most important LMS selection criteria.

3.2 Fuzzy VIKOR to compare and rank LMSs alternatives

After determining the most important evaluation criteria, the Fuzzy VIKOR (AFFUL2014) is used to help selecting and ranking a set of LMSs among those present on the market. As mentioned above three different LMSs (i.e.; Blackboard, Moodle, and Joomla LMS) are considered.

4. Case study

This section presents the application of the different steps in the proposed approach in detail. Twelve questionnaires were distributed to LMS experts and 10 were recovered.

Step1: Define the LMS evaluation criteria and sub-criteria (Figure1).
Step2: Select a group of LMS experts to evaluate the effect between factors using pairwise comparison.

Phase 1: fuzzy DEMATEL

Step3: Determine the fuzzy linguistic scale for dealing with the LMS experts' judgment vagueness. The linguistic variable "influence" is used with a five-level fuzzy scale for measuring the relationship among the different criteria as shown in Table 2.

Table 2*:* The fuzzy linguistic scale for the LMS experts' evaluations (63)

Linguistic Terms	Corresponding Triangular Fuzzy Numbers (TFNs)
No influence (NO)	(0, 0, 0.25)
Very low influence (VL)	(0, 0.25, 0.5)
Low influence (L)	(0.25, 0.5, 0.75)
High influence (H)	(0.5, 0.75, 1)
Very high influence (VH)	(0.75, 1, 1)

Step 4: Obtain an initial direct relation matrix by the LMS experts' pairwise comparison of the criteria.

Separately, each expert is asked to fill a *n×n* linguistic direct-relation matrix. The pairwise comparison is made by using linguistics variables. An example of linguistic scores of an expert evaluation is shown in Table 3. The fuzzy linguistic matrix is then converted to a fuzzy scaled direct relation matrix T. Accordingly, the direct-relation matrix is established as T= (t_{ij}) where T is a n × n non-negative matrix; t_{ij} = (l_{ij}, m_{ij}, u_{ij}) represents the direct impact of factor i on factor j; and, when i = j, the diagonal elements t_{ij} = (0, 0, 0).

Table 3: Linguistic evaluation of criteria interdependence

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
C1	0	VL	L	L	H	NO	L	L	NO	VH	VH	H	NO	L	NO
C2	L	0	NO	NO	VH	VH	H	H	L	NO	NO	NO	VH	H	NO
C3	NO	H	0	H	H	NO	H	H	VL	VL	NO	H	VH	H	VL
C4	VL	NO	VH	0	H	NO	L	L	H	L	VL	NO	VL	H	H
C5	L	H	VH	VH	0	H	VL	VL	H	NO	VL	NO	H	H	VH
C6	L	NO	VL	NO	H	0	H	VH	NO	NO	NO	NO	VH	VH	VH
C7	VH	NO	VH	VL	VH	VH	0	H	L	VL	VL	H	VH	H	L
C8	VH	VL	VH	NO	H	VH	VH	0	NO	H	H	H	VH	VH	H
C9	H	NO	NO	VH	NO	NO	NO	NO	0	VH	VH	VH	NO	L	VL
C10	H	H	NO	L	NO	VL	NO	VL	L	0	VH	VH	VL	L	NO
C11	VH	VH	NO	VL	VL	VL	NO	VL	H	VH	0	VH	VL	L	NO
C12	VL	NO	H	VH	NO	L	VL	H	VH	VH	VH	0	NO	VL	H
C13	H	H	L	H	VL	NO	VH	H	L	NO	NO	VL	0	H	H
C14	H	H	H	L	L	VH	VH	VH	NO	L	L	VL	L	0	VH
C15	L	NO	L	H	VH	L	L	VL	VH	VH	H	H	NO	L	0

The fuzzy matrices collected from the different experts' judgments are aggregated as shown in Table 4.

Table 4: The aggregated fuzzy direct-relation matrix

	C1			C2			C3			…..	C13			C14			C15		
C1	0.00	0.00	0.00	0.13	0.31	0.56	0.25	0.50	0.75	…	0.25	0.44	0.69	0.13	0.38	0.63	0.06	0.13	0.25
C2	0.38	0.63	0.81	0.00	0.00	0.00	0.00	0.06	0.31	…	0.56	0.94	1.00	0.31	0.50	0.75	0.06	0.19	0.56
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮

	C1			C2			C3			.....	C13			C14			C15		
C3	0.31	0.44	0.63	0.25	0.38	0.63	0.00	0.00	0.00	⋮	0.56	0.81	0.88	0.50	0.69	0.81	0.50	0.75	0.56
C13	0.56	0.81	1.00	0.38	0.56	0.81	0.25	0.50	0.75	⋮	0.00	0.00	0.00	0.38	0.56	0.81	0.38	0.56	0.00
C14	0.56	0.81	1.00	0.38	0.56	0.81	0.50	0.75	1.00	⋮	0.44	0.69	0.88	0.00	0.00	0.00	0.56	0.81	0.44
C15	0.19	0.38	0.63	0.00	0.00	0.25	0.31	0.56	0.81	⋮	0.00	0.00	0.25	0.31	0.56	0.81	0.00	0.00	0.00

Step 5: Acquire the fuzzy normalized direct-relation matrix S. Normalization is performed using Eq.1:

$S = K \times T$ where (1)

Table 5: The fuzzy normalized direct-relation matrix S

	C1			C2			…	C13			C14			C15		
C1	0.000	0.000	0.000	0.011	0.028	0.051		0.023	0.040	0.062	0.011	0.034	0.056	0.006	0.011	0.034
C2	0.034	0.056	0.073	0.000	0.000	0.000		0.051	0.085	0.090	0.028	0.045	0.068	0.006	0.017	0.040
C13	0.051	0.073	0.090	0.034	0.051	0.073		0.000	0.000	0.000	0.034	0.051	0.073	0.034	0.051	0.073
…	⋮	⋮	⋮	⋮	⋮	⋮		⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
C14	0.051	0.073	0.090	0.034	0.051	0.073		0.040	0.062	0.079	0.000	0.000	0.000	0.051	0.073	0.085
C15	0.017	0.034	0.056	0.000	0.000	0.023		0.000	0.000	0.023	0.028	0.051	0.073	0.000	0.000	0.000

In order to defuzzify the normalized fuzzy direct-relation matrix, the Best Non-fuzzy Performance (BNP) method (Ross 1995) is used. The following formula calculates the BNP value of the fuzzy number. $BNP = l + \frac{(u-l)+(m-l)}{3}$. The resulted matrix is denoted M.

Step 6: Acquire the total-relation matrix. The total relation matrix X shown in table 7can be acquired by using Eq. (2), where I is denoted as the identity matrix. $X = M(I - M)^{-1}$ (2)

Table 6: The total relation matrix X

	C1	**C2**	**C3**	**…**	**C14**	**C15**
C1	0.079	0.081	0.101	…	0.102	0.076
C2	0.138	0.054	0.076	…	0.120	0.086
C3	0.135	0.098	0.074	…	0.142	0.135
…	…	…	…	…	…	…
C13	0.158	0.107	0.110	…	0.130	0.119
C14	0.173	0.117	0.145	…	0.095	0.149
C15	0.126	0.068	0.118	…	0.130	0.072

Step 7: Calculate the vectors D and R, the sum of rows and columns respectively within the total relation matrix X as in Eq. (3). Then the sum of rows and columns are separately denoted as D and R. Let X= (t_{ij}), i, j ∈{1,2,...,n), then $D = \left[\sum_{j=1}^{n} t_{ij}\right]_{n\times 1}$ and $R = \left[\sum_{i=1}^{n} t_{ij}\right]_{1\times n}$ (3)

At this stage and before determining the “Prominence” vector (i.e.; D+R), the FAHP is applied in order to determine the relative importance weight of each evaluation criteria.

Phase 2: The Fuzzy AHP

In this phase Decision makers are asked to compare the criteria via linguistic terms shown in Table 8.

Table 7*:* Linguistic terms and the corresponding triangular fuzzy numbers

Saaty scale	Definition	Fuzzy Triangular Scale
1	Equally important	(1, 1, 1)
2	Weakly important	(2, 3, 4)
3	Fairly important	(4, 5, 6)
4	Strongly important	(6, 7, 8)
5	Absolutely important	(9, 9, 9)
6	The intermediate values between two adjacent scales	(1, 2, 3)
7		(3, 4, 5)
8		(5, 6, 7)
9		(7, 8, 9)

In order to perform a pairwise comparison among the criteria, the fuzzified Saaty's scale is used in our proposed model to represent the correlation between the numerical values of TFN and linguistic variables. One such correlation is shown in Table 8, where the reciprocal of the triangular fuzzy number $M_i=(l_i, m_i, u_i)$, is denoted as $M_i^{-1}= (1/u_i , 1/m_i , 1/l_i)$. The steps followed in the proposed model based on the Chang's extent analysis (Chang, 1996) can be summarized as follows:

Step 8: The criteria that affect the selection of a LMS among several alternatives are defined, and a matrix of criterion C is constructed with TFNs assigned by the decision makers (experts).

Table 8: A pair wise comparison matrix

	C1			C2			C3			….			C13			C14			C15		
C1	1	1	1	4	5	6	4	5	6	…	…	…	1	2	3	4	5	6	5	6	7
C2	1/6	1/5	¼	1	1	1	1/9	1/9	1/9	…	….	…..	1/8	1/7	1/6	4	5	6	6	7	8
C3	1/6	1/5	¼	9	9	9	1	1	1	…	….	…..	4	5	6	1	2	3	3	4	5
C13	1/3	1/2	1	6	7	8	1/6	1/5	¼	…	….	…..	1	1	1	6	7	8	9	9	9
C14	1/6	1/5	¼	1/6	1/5	1/4	1/3	1/2	1	…	….	…..	1/8	1/7	1/6	1	1	1	9	9	9
C15	1/7	1/6	1/5	1/8	1/7	1/6	1/5	1/4	1/3	…	….	…..	1/8	1/7	1/6	1/9	1/9	1/9	1	1	1

Step 9: With the generated matrix, an extent analysis of all the criteria is conducted, resulting in m values of steps analysis for each element of the set C as follows:

M^1_{gi} , M^2_{gi}, M^3_{gi} , …, M^m_{gi}, where g_i (i = 1, 2, 3, … , n) is the goal set and all the M^j_{gi} (j = 1, 2, 3, … , m) are TFNs.

Then, taking into account the membership function of the TFNs, the fuzzy synthetic extent value S_i with respect to the i^{th} criteria is defined by equation (4) as:

$S_i = \sum_{j=1}^{m} t_{ij} \otimes \left[\sum_{i=1}^{n} t_{ij} \sum_{j=1}^{m} t_{ij}\right]^{-1}$ (4), table9 shows the synthetic extent value S_i of each criteria.

Table 9*:* The fuzzy synthetic extent value related to i^th criteria

	$S_i=(l_i, m_i, u_i)$						
C1	0.061878	0.090518	0.128933	C9	0.067414	0.095221	0.132352
C2	0.041165	0.053898	0.072312	C10	0.033549	0.058739	0.067959
C3	0.045207	0.067831	0.098281	C11	0.034485	0.045922	0.098751
C4	0.055038	0.081127	0.116781	C12	0.058455	0.076764	0.101218

	$S_i=(l_i, m_i, u_i)$						
C5	0.067519	0.082243	0.174436	C13	0.058881	0.079278	0.107424
C6	0.037213	0.055387	0.080032	C14	0.025748	0.034372	0.077383
C7	0.061377	0.088496	0.092582	C15	0.020293	0.026439	0.096717
C8	0.061153	0.081707	0.109758				

Step 10: Based on the fuzzy synthetic extent values, the degree of possibility (i.e.; $V(S_i \geq S_j)$) of each criteria is calculated using the Eqs (5) and (6). Let $S_1=(l_1, m_1, u_1)$ and $S_2=(l_2, m_2, u_2)$,

$$V(S_2 \geq S_1) = Sup(min(\mu_{S1}(x), \mu_{S2}(y))$$

When a pair (x, y) exists such that $x \geq y$ and $\mu_{S1}(x)=\mu_{S2}(y)=1$, then we have $V(S_1 \geq S_2)=1$. Since S_1 and S_2 are convex fuzzy numbers we have that

$V(S_1 \geq S_2)= 1$ Iff $m_1 \geq m_2$, (5) $\quad V(S_2 \geq S_1) = hgt(S_1 \cap S_2) = \mu_{S2}(d)$

$$(6)\mu_{S2}(d) = \begin{cases} 1 \; if \; m2 \geq m1 \\ 0 \; if \; l1 \geq u2 \\ \frac{l1-l2}{(m2-u2)-(m1-l1)} \end{cases}$$

The results of this step is shown in table 10.

Table 10: Degree of possibility of each criteria

S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15
-	0.2217	0.6	0.85	0.93	0.3	0.938	0.84	1	0.16	0.453	0.7	0.8	0.216	0.35
1	-	1	1	1	1	1	1	1	1	0.878	1	1	0.65	0.67
1	0.6605	-	1	1	0.7	1	1	1	0.71	0.71	1	1	0.49	0.55
1	0.3882	0.8	-	1	0.5	1	1	1	0.37	0.554	0.9	1	0.323	0.43
1	0.1446	0.7	0.98	-	0.3	1	0.99	1	0.02	0.462	0.9	0.9	0.171	0.34
1	0.9593	1	1	1	-	1	1	1	1	0.867	1	1	0.657	0.67
1	0.2401	0.6	0.88	0.95	0.4	-	0.88	1	0.18	0.467	0.8	0.8	0.228	0.36
1	0.2864	0.7	0.99	1	0.4	1	-	1	0.23	0.512	0.9	1	0.255	0.39
0.9	0.106	0.5	0.78	0.89	0.2	0.789	0.76	-	0.01	0.389	0.6	0.7	0.141	0.3
1	0.889	1	1	1	0.9	1	1	1	-	0.836	1	1	0.643	0.66
1	1	1	1	1	1	1	1	1	1	-	1	1	0.788	0.76
1	0.3773	0.8	1	1	0.5	1	1	1	0.35	0.566	-	1	0.309	0.43
1	0.346	0.8	1	1	0.5	1	1	1	0.31	0.544	0.9	-	0.292	0.42
1	1	1	1	1	1	1	1	1	1	1	1	1	-	0.9
1	1	1	1	1	1	1	1	1	1	1	1	1	1	-

Step 11: Calculate the weight vector and normalize the non-fuzzy weight vector as shown in table 11

Table 11: Normalized importance criteria weight

Criteria	Suitability	Scalability	Interoperability/Data	Compliance	Security	Traceability	Fault tolerance	Recoverability/ Error	Accessibility	Learnability	Operabilit	Attractiveness	Time behavior	Stability	Adaptabilit
Weight	0.929	0.415	0.530	0.778	0.892	0.341	0.789	0.758	1.000	0.389	0.015	0.647	0.715	0.141	0.299
Normalized weight	0.108	0.048	0.061	0.090	0.103	0.039	0.091	0.088	0.116	0.045	0.002	0.075	0.083	0.016	0.035

Step 12: Construct the causal effect diagram. The horizontal axis vector (D + R) of the diagram named ''Prominence'' is made by multiplying the criteria weight found in the previous step to (D +R), which reveals the relative importance of each criterion. Similarly, the vertical axis (D - R) named ''Relation'' is made by subtracting R from D, which may divide criteria into a cause and effect groups. Therefore, the causal diagram can be obtained by mapping the dataset of the (W(D + R), D - R), providing some insight for making decisions.

Table 12: "Prominence" and "Relation" vectors

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
W(D+R)	0.377	0.137	0.202	0.302	0.331	0.115	0.310	0.315	0.352	0.125	0.005	0.213	0.275	0.061	0.114
D-R	-0.565	0.262	0.260	0.207	-0.040	-0.223	-0.001	0.118	0.026	-0.141	-0.197	-0.060	0.019	0.164	0.171

According to Figure 2, the criteria having the lowest importance weight are C11, C14 and C15 (i.e.; operability, Maintainability and Adaptability) compared to a predefined threshold α=0.115.

Furthermore, these three criteria have no effect on the remaining criteria. So, they will be discarded in the selection of LMSs performed by Fuzzy VIKOR method in the next phase.

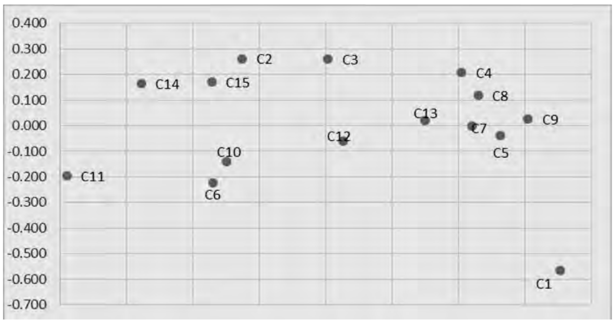


Figure2: Causal effect diagram

Phase3: Fuzzy VIKOR

Step 13: The three different LMSs are compared and ranked. LMS experts are asked to evaluate the alternatives A1, A2 and A3 (i.e.; Blackboard, Moodle, and Joomla LMS respectively) with respect to the 12 previously retained evaluation criteria. Table 13 shows an example of an expert evaluation.

Table 13: LMS expert's evaluation

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C12	C13
A1	VG (.6,.8,1)	VG (.6,.8,1)	G (.4,.6,.8)	VG (.6,.8,1)	VG (.6,.8,1)	G (.4,.6,.8)	G (.4,.6,.8)	G (.4,.6,.8)	F (.2,.4,.6)	F (.2,.4,.6)	F (.2,.4,.6)	G (.4,.6,.8)
A2	VG (.6,.8,1)	VG (.6,.8,1)	G (.4,.6,.8)	VG (.6,.8,1)	VG (.6,.8,1)	G (.4,.6,.8)	G (.4,.6,.8)	G (.4,.6,.8)	G (.4,.6,.8)	F (.2,.4,.6)	F (.2,.4,.6)	G (.4,.6,.8)
A3	G (.4,.6,.8)	F (.2,.4,.6)	P (0,.2,.4)	P (0,.2,.4)	P (0,.2,.4)	G (.4,.6,.8)	F (.2,.4,.6)	P (0,.2,.4)	G (.4,.6,.8)	G (.4,.6,.8)	F (.2,.4,.6)	F (.2,.4,.6)

Step14: Agregate LMS expert evaluations using Eq7. and represented in an aggreagted matrix (Table6).

The general term of the matrix is denoted by $\tilde{x}_{ij}^{k}$.

$\tilde{x}_{ij}^{k} = (a_{ij}^{k}, b_{ij}^{k}, c_{ij}^{k})$ (7) where k is the number of DMs and $a_{ij} = \min_k\{a_{ij}^{k}\}$; $b_{ij} = \frac{1}{k}\sum_{k=1}^{k} b_{ij}^{k}$; and $c_{ij} = max\{c_{ij}^{k}\}$. The aggregated matrix is shown in table 14.

Table 14: Aggregated fuzzy matrix

	A_1	A_2	A_3
C_1	(0.60,0.80,1.00)	(0.60,0.80,1.00)	(0.40,0.6,0.80)
C_2	(0.60,0.80,1.00)	(0.60,0.80,1.00)	(0.20,0.47,0.80)

	A_1	A_2	A_3
C_3	(0.20,0.60,1.00)	(0.40,0.60,0.80)	(0.00,0.20,0.40)
C_4	(0.40,0.73,1.00)	(0.60,0.80,1.00)	(0.00,0.33,0.60)
…..	…..	….	….
C_9	(0.20,0.53,0.80)	(0.40,0.67,1.00)	(0.40,0.73,1.00)
C_{10}	(0.20,0.60,1.00)	(0.20,0.60,1.00)	(0.00,0.47,0.80)
C_{12}	(0.20,0.60,1.00)	(0.20,0.67,1.00)	(0.20,0.53,1.00)
C_{13}	(0.40,0.60,0.80)	(0.40,0.60,0.80)	(0.20,0.53,0.80)

Step15: Defuzzify the aggregated fuzzy matrix. In this step, the CoG (centroid method or center of gravity) is used to defuzzify the values in Table14.

Table 15: Crisp values for criteria weight and alternatives preferences

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{12}	C_{13}
weights	0.377	0.137	0.202	0.302	0.331	0.115	0.310	0.315	0.352	0.125	0.213	0.275
A_1	0.8	0.8	0.60	0.71	0.8	0.6	0.6	0.6	0.51	0.6	0.6	0.6
A_2	0.8	0.8	0.6	0.8	0.8	0.6	0.69	0.69	0.69	0.6	0.62	0.6
A_3	0.6	0.49	0.2	0.31	0.42	0.38	0.4	0.38	0.71	0.42	0.58	0.51

Step16: Calculate fuzzy best and worst values. As LMS expert's objective is to maximize the benefits from the evaluation criteria, Vikor approach determines two important values: fuzzy best value f_j^+ and fuzzy worst value f_j^- using Eq8. The results are shown in Table16.

$f_j^+ = \max\{ x_{ij}\}$ and $f_j^- = min\, \{x_{ij}\}$, j= 1…m (number of criteria) (8)

Table 16: Best and worst crisp values for criteria

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{12}	C_{13}
f_j^+	0.8	0.8	0.60	0.8	0.8	0.6	0.69	0.69	0.71	0.6	0.62	0.6
f_j^-	0.6	0.49	0.2	0.31	0.42	0.38	0.4	0.38	0.51	0.42	0.58	0.51

Step17: Calculation of S, R and Q indexes. For each alternative, an index S_i is calculated, which refers to the separation measure of the i[th] alternative with the best value using Eq9. An index R_i, is also calculated which refers to the separation measure for the i[th] alternative to the worst value using Eq10. Then Eq11 uses S_i and R_i values to calculate the Q_i index. The results are collected in Table17.

$S_i = \sum_{j=1}^{n} w_j\, [(f_j^+ - x_{ij})/(f_j^+ - f_j^-)]$ (9) $R_i = max_j\, w_j\, [(f_j^+ - x_{ij})/(f_j^+ - f_j^-)]$ (10) and $Q_i = v\, \frac{S_i - S_{min}}{S_{max} - S_{min}} + (1 - v)\, \frac{R_i - R_{min}}{R_{max} - R_{min}}$ (11)

Where v is the strategy weight for the maximum group utility ($v = (n + 1)/2n$); n is the number of criteria.

Table 17: S, R and Q values

	A_1	A_2	A_3
S	0.702	0.035	2.7
R	0.352	0.035	0.377
Q	0.56	0.00	1.00

Step18: Rank the alternatives. Using S_i, R_i and Q_i values, the A_i are ranked in an ascending order as represented in Table18. The index Q_i reflects the separation of the alternative A_i from the best value. The best alternative is the one which has the smaller Q_i.

Table 18: Ranking of alternatives using S_i, R_i and Q_i.

$by\ S$	$A_2 > A_1 > A_3$
$by\ R$	$A_2 > A_1 = A_3$
$by\ Q$	$A_2 > A_1 > A_3$

Step19: Select a compromising solution. Let A^{**} , A^{*} respectively the LMS retained in step18 (with the minimum Q) and the LMS in the second position (Q ranking). A^{**} can be considered as a promising alternative if the two below conditions are satisfied (*Cond₁* and *Cond₂*).

(*Cond₁*) $Adv = Q(A^{*}) - Q(A^{**}) \geq (1/m - 1)$; (*Cond₂*) $S(A^{**}) \geq S(A^{*})$ and/ or $R(A^{**}) \geq R(A^{*})$

The obtained results are as follows: $A^{**} = A_2$ and $A^{*} = A_1$ (Q ranking)

$Adv = 0.59 > 0.09$ and A_2 is the best ranked according to S (ranking)

So *Cond₁* and *Cond₂* are satisfied. The alternative A_2, which is the web-based LMS (Moodle), is recommended for higher institutions according to the proposed ISO9126- based Framework.

5. Conclusion

In this paper, a novel Fuzzy MCDM based approach is proposed that integrtaes Fuzzy Decision Making Trial and Evaluation Laboratory Method (DEMATEL) the Fuzzy Analytic Hierarchy Process (AHP) and the Fuzzy VIKOR as efficient analyses and decision-making methods to (1) discover the interrelation between LMS evaluation criteria, (2) select the most important LMS evaluation criteria and (3) evaluate and rank a set of the most popular LMS (i.e.; Blackboard, Moodle and JoomlaLMS) on the market. The results are beneficial for guiding LMS stakeholders to identify and qualify pertinent features to be considered when selecting LMS. Also, this work helps LMS developers to improve and increase LMS' competitiveness.

Note: Vendor citations or descriptions in this paper are for illustrative purposes and do not constitute an endorsement by the authors.

References

Altbach, PG. Robert, OB & Patricia, JG. (2005) American higher education in the twenty-first century: Social, political, and economic challenges, Second Edition, The Johns Hopkins University Press, Baltimore and London.
Albarrak, A. I. (2010) Evaluating learning management systems for University Medical Education, International Conference on Education and Management Technology. Cairo Egypt, 672-677.
Almarashdeh, I. Sahari, N. Zin, N. & Alsmadi, M. (2011) Acceptance of learning management system: A comparison between distance learners and instructors. Advances in Information Sciences and Service Sciences, 3(5), 1-9.
Chang, D. Y. (1996) Applications of the Extent Analysis Method on Fuzzy AHP, European Journal of Operational Research, 95(3), 649–655.
Djouab, R. & Bari, M. (2016). An ISO 9126 Based Quality Model for the e-Learning Systems. International Journal of Information and Education Technology. 6. 370-375. 10.7763/IJIET.2016.V6.716.
Fardinpour, A. P. (2014) Intelligent Learning Management Systems: Definition, Features and Measurement of Intelligence. International Journal of Distance Education Technologies 12, 4, 19-31.
Gabus, A. & Fontela, E. (1972) World Problems, An Invitation to Further Thought within The Framework of DEMATEL, Battelle Geneva Research Centre, Geneva, Switzerland.
Işık, A.H., Ince, M. & Yigit, T. (2015) A Fuzzy AHP Approach to Select Learning Management System. International Journal of Computer Theory and Engineering 7, 6, 499.
Kroner, G. (2014) In collaboration with the Edutechnica team, "Does Your LMS Do This?," Edutechnica, January
Kurilovas, E. (2009) Methods of Multiple Criteria Evaluation of the Quality of Learning Management Systems for Personalised Learners Needs. Presented in Learning Management Systems meet Adaptive Learning Environments, EC-TEL 2009, Nice, France.
Lin, R.J., 2013. Using fuzzy DEMATEL to evaluate the green supply chain management practices. J. Cleaner Prod. 40, 32–39.
Liou, J.H. & Gwo-Hshiung Tzeng, L. (2008) Building an effective safety management system for airlines, Journal of Air Transport Management, Volume 14, Issue 1, Pages 20-26.
Malviya, R.K. & Kant, R. (2016) Hybrid decision making approach to predict and measure the success possibility of green supply chain management implementation, Journal of Cleaner Production, Volume 135, Pages 387-409,
Mehta, P. & Saroha, K. (2016) Analysis and evaluation of learning management system using data mining techniques, Fifth International Conference on Recent Trends in Information Technology. Chennai, India.
Muhammad, N. M & Nadir, C. (2017) Fuzzy DEMATEL method for identifying LMS evaluation criteria, Procedia Computer Science, Volume 120, Pages 742-749,
Naveh, G., Tubin, D. & Pliskin, N. (2010) Student LMS use and satisfaction in academic institutions: The organizational perspective. The Internet and Higher Education 13(3), 127-133.
Naveh, G., Tubin, D., & Pliskin, N. (2012) Student satisfaction with learning management systems: A lens of critical success factors. Technology, Pedagogy and Education, 21(3), 337-350.

Padayachee, I., Kotzé, P. ,Van, A. & Van der Merwe, A. (2010) ISO 9126 external systems quality characteristics, sub-characteristics and domain specific criteria for evaluating e-Learning systems.
Radwan, M. N., Senousy, M. B. & Riad, A. E. D. M. (2016) Neutrosophic Logic Approach for Evaluating Learning Management Systems. Neutrosophic Sets and Systems 11, 3-7.
Radwan, M. N., Senousy, M. B. & Riad, A. E. D. M. (2016) A New Expert System for Learning Management Systems Evaluation Based on Neutrosophic Sets. Expert Systems 33, 548-558.
Ramesh, V. M. & Ramanathan, C. (2013) A rubric to evaluate learning management systems, International Conference on Teaching, Assessment and Learning for Engineering. Bali, Indonesia, 73-77.
ROSS, T.J. (1995) fuzzy logic with engineering applications; MCGRAW-HILL, INC: New York, NY, USA.
Si, S. L., You, X. Y., Liu, H. C. & Zhang, P. (2018) DEMATEL Technique: A Systematic Review of the 2018, Article ID 3696457, 33 pages.
Wu, W. W. & Yu-Ting Lee, Y. T. (2007) Developing global managers' competencies using the fuzzy DEMATEL method, Expert Systems with Applications, Volume 32, Issue 2, Pages 499-507.
Zadeh, L. A. (1965) Fuzzy sets, Information and Control, vol. 8, no. 3, pp. 338–353.

Developing Creative Online Learning Communities: A Case Study of Student Perceptions

Wendy Barber
Faculty of Education, University of Ontario Institute of Technology, Canada
Wendy.barber@uoit.ca
DOI: 10.34190/EEL.19.016

Abstract: This paper is a qualitative case study measuring student perceptions of a pedagogical strategy for developing creative interactive online communities. The article reviews a teaching strategy for increasing student engagement through the use of creative and artistic expression. Using "Digital Moments" as a way to build inclusion in two synchronous graduate online courses, the author describes how the teaching strategy increased student participation, developed student ownership of learning, and encouraged collaborative processes between participants. This teaching strategy makes a significant contribution to digital pedagogy. Although the growth of online learning is quite substantial, our ability to develop online communities that inspire creative thinking has not kept pace. With online education becoming an integral part of academic institutions and corporations worldwide, support for such endeavors can be critical to the innovative and nimble approach required of organizations facing the fourth industrial revolution. This paper analyses and interprets the graduate students' perceptions of the value of using "Digital Moments". Specifically, the research methodology involved using a 12 question online survey, followed by semi-structured open-ended one on one interviews. Data were analysed using SPSS software and examined to reveal that overall student perceptions of the level of creativity in the online community were improved using this pedagogical approach. This also improved a sense of belonging and engagement in the class, and improved the learning environment by increasing connections between and among students and the instructor.

Keywords: creativity, online learning, communities

1. Introduction

This paper examines a simple yet powerful pedagogical strategy used in graduate online courses to create engaging learning communities. The author's goal was to replicate the relationship building moments which naturally occur as students enter a face to face class before the structured learning begins. In an effort to do this, each week students met synchronously in Adobe connect. Classes of 20-25 students entered the virtual room to find share pods in which they each uploaded a 'Digital Moment'. The content of the pod could include a variety of pictures, quotes, colours, links to describe in a single snapshot where the person was at that week. As weeks passed, students began to arrive earlier to class, in advance of start times, and began to look forward to connecting with classmates and sharing their own digital moments with others. As a unique pedagogical strategy, qualities which one might not normally associate with traditional online learning emerged: empathy, humour, risk-taking, compassion and a shared sense of community. From a group of individuals learning geographically all over the world evolved a close knit community of learners where the playing field was leveled and the traditional roles of teacher and learner become no longer visible.

2. Theoretical framework

The overall theoretical framework for this paper emerges from the integration and intersection of four major areas. First, Mishra and Koehler's (2006) work on technological pedagogical and content knowledge provides a pillar upon which we examine the use of Digital Moments as an online pedagogical tool. Mishra and Koehler's (2006) work states that there are three main components of teachers' knowledge including content, pedagogy and technology. In addition, they state that equally important to the model are the interactions between, and among these bodies of knowledge (p. 62). Digital moments provide an emotional window through these elements and they emerge both as a result of, and in spite of, the limitations of each element. Further, the theoretical framework used to analyze the use of Digital Moments and their role in creating engaging and productive learning communities is based on the role of creativity in an academic context Barone (2006), arts-based qualitative inquiry and pedagogy (Brearley, 2000), and critical reflective practice (Griffin, 2003). Davis (2012) argues that our pedagogy must change, that it isn't enough to simply add technology on to our already existing practices; we must infuse it throughout, just as it is fully integrated into the daily experiences of individual students and teachers. She reiterates that "teaching with technology is not just about how to use the hardware and the software, but is also very much about people, processes and a range of different interactions" (p. 149). One of the significant challenges for online educators is to maintain student engagement and build social presence amongst a community of learners from different geographical and cultural spaces, who may never have the chance to meet face to face. Keengwee and Kidd (2010) and Coppola, Hiltz and Rotter (2002) state that there are three faculty roles in online learning spaces, including cognitive, affective and managerial. The cognitive role is connected with the intellectual processes of learning, information storage, and thinking, while the affective role is influenced by the relationships between students, faculty, and the classroom environment. The managerial role relates to class and course management (Liu et al, 2004). Developing and teaching online courses requires specific sets of skills that faculty must acquire in order to be successful in this new paradigm of learning and teaching (Howell et al, 2004). Other authors (Garrison & Cleveland-Innes, 2005) refer to the challenges instructors face when designing online learning experiences that challenge learners to develop deep and meaningful learning experiences. Further, several authors speak to the role of building relationships through affective or social presence in online communities, and these "affective tasks comprise behavior related to influencing students' relationships with the instructor and with other students in the virtual classroom environment." (Liu et al, 2004, p. 537)

In relation to the theoretical background and purpose of investigating Digital Moments, this project aims to measure the affective impact that this strategy has on the social presence in the online learning community.

Thus, the primary research questions are:

- 1. What are student perceptions of the impact of the Digital Moments strategy on their learning experiences and
- 2. How does this practice of weekly sharing of Digital Moments create an engaging creative community.

3. Rationale for case study methodology

Merriam (1998) states that there are four major features that characterize a qualitative case study. First, the researcher is interested in understanding the meaning people have constructed. Individual cases in this study focused on the meaning that the subjects have placed on selecting and sharing their weekly Digital Moments. Second, the researcher was the major instrument of data collection and analysis. Third, this qualitative research involved field work, which in this study entailed class recordings and direct/indirect observation. Fourth, this qualitative research used inductive strategies. In this work, the research applied existing models of online learning using TPACK (Mishra & Koehler, 2006) to the subjects in order to broaden our understanding of how engaging online communities have an impact on learning. Finally, Merriam (1998) believes that the product of a qualitative research study is richly descriptive. This researcher used learners' stories to describe the process of developing meaningful learning and human relationships online.

3.1 Methodology

3.1.1 Phase 1 digital moments implementation

This was a pilot project to implement a new digital teaching strategy, and it occurred over two terms of teaching two graduate online courses entitled "Authentic Assessment" and "Critical and Reflective Practice in Education." The total number of individuals in both courses was 54, the total number surveyed was 47, and 25 students responded. Participants in the implementation phase were 54 graduate students, and the instructor was an Assistant Professor in the Faculty of Education. Classes met once a week for four hours over a twelve week period in the fall/winter terms. Anecdotal reflections from students recorded in Blackboard chat rooms, audio recordings of Adobe classes, and journal notes from the professor were used to provide additional qualitative data.

3.1.2 Phase 2 participants

The total number of students enrolled in the two graduate courses was 54. Of these, a population of 47 students were sent an online survey that asked 12 questions with responses based on a Likert- 7 point scale (where 1=Strongly Disagree, 2=Disagree, 3=Somewhat Disagree, 4=Neutral, 5=Somewhat Agree, 6=Agree, and 7=Strongly Agree). Of the 47 students sent the survey, 25 responses were received which indicated a 53% response rate. Gender of participants was noted with a 1 or 2 (Female/Male), with 21 participants identifying as female and 4 identifying as male. Student participants in the study gave informed consent and were given permission to withdraw from the project at any time. Their participation in the research was not related to their academic grades in the class, and the research survey was designed and data collected by a second researcher who was not the course instructor.

3.2 Data analysis

The Likert Scale survey, based on a Likert- 7 point scale where 1=Strongly Disagree, 2=Disagree, 3=Somewhat Disagree, 4=Neutral, 5=Somewhat Agree, 6=Agree, and 7=Strongly Agree. The 25 participants answered an online survey to provide responses for each of the 12 questions. Responses for each question were averaged numerically to result in an average score (1-7) for each of the twelve questions. The two open-ended questions relating to benefits and challenges of *Digital Moments* were coded qualitatively and analyzed along with instructor field notes from classes to determine themes, and a word search of the responses was also performed for keywords "community," "social presence" and "connections".

4. Data

The numerical average of responses to each of the 12 questions is indicated here, with 1 being correlated to a Strongly Disagree response and 7 being correlated with a Strongly Agree response. These average scores are reported in Table 1 below.

Table 1: Attitudes toward the use of digital moments (n=25)

Items	Mean (SD)	% Agree[1]	% Disagree[2]
I felt Digital Moments were conducted in a respectful way.	6.8 (0.4)	92%	0%
Digital Moments created a greater sense of community for me.	6.6 (0.7)	100%	0%
I felt safe when participating in Digital Moments.	6.6 (0.6)	96%	0%
The expectations of participating in Digital Moments were clear to me.	6.5 (0.8)	96%	0%
Digital Moments improved connections with my peers in class.	6.4 (0.9)	92%	0%
Using Digital Moments is an effective teaching strategy in online learning environments.	6.2 (1.3)	92%	4%
Digital Moments energized me at the start of the class.	5.9 (1.4)	88%	4%
Digital Moments made the class engaging for me.	5.8 (1.5)	84%	8%
Digital Moments supported my overall learning experience.	5.7 (1.4)	88%	8%
Digital Moments increased my motivation in class.	5.2 (1.7)	64%	12%
Digital Moments encouraged me to take risks in my learning.	5.0 (1.5)	72%	12%
Digital Moments improved connections with my peers outside of class.	4.8 (1.8)	52%	20%

[1]Includes Somewhat Agree, Agree and Strongly Agree responses

[2]Includes Somewhat Disagree, Disagree and Strongly Disagree responses

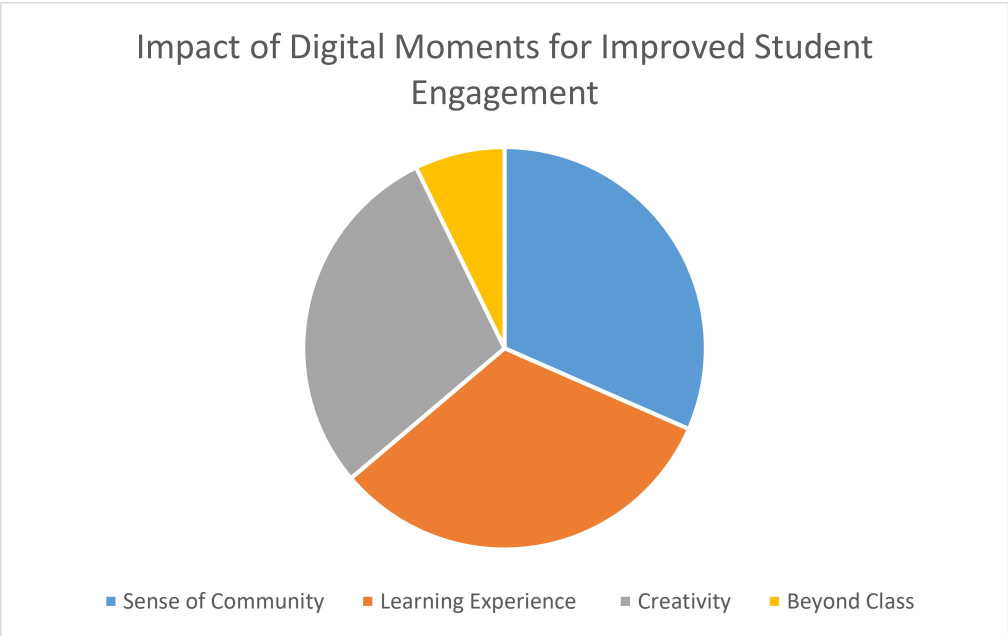


Table 2: Sample student reactions to digital moments (n=19)

It's so emotional
At the beginning I was so nervous and kind of cynical, so I thought "ok here we go" but now I really look forward to finding my own Digital Moment for the week and seeing everyone else's
I loved it!
I never thought I would get to know people online so easily
Doing this every week makes me actually ask myself how I am doing
I like guessing who puts what in their Digital Moment
I just started using this strategy with my own class and they loved it! Grades 5-6 students really opened up and I used it on the smart-board
This is a great way to get students to express how they feel without words
I think it helps to decrease the kind of stereotyping that you can get when you meet people face to face
It's really weird finally meeting classmates face to face and feeling like you already know them super well
When I used it with my own class it really helped me as a teacher to track where the kids were at
It's a safe way to express how you are feeling inside, sometimes I think technology is less personal but this was really personal
I actually shared with my peers, which I usually don't do in face to face settings
I found it interesting that you got to know people's sense of humour, without any real cues like you would get in a f2f environment, like body language
My friends reached out to me on weeks when I was struggling
It levelled the field for me as the teachers did it too, so we could see who they were as people, which made me want to contribute more
Really valuable! Best course I've taken in this degree
One week my Digital Moment was about a family member who had died, but she really had inspired me to go back to school so, it was really good to share it with the group
I am amazed at how well I got to know my colleagues in this class; I've had some awful online experiences and this was a refreshing change

5. Analysis: Overview

This survey data based on responses by 25 of 47 graduate students participating in 2 online courses reports on the results of 12 questions that were numerically rated on a 7-point Likert scale. The questions were each framed positively, and as a result, agreement of a positive impact of Digital Moments would result in a higher score. It is interesting to note that the average of all 12 questions was a score of 5.95/7, indicating that 85% of participants found a positive impact of Digital Moments on creating community.

An analysis of the answers to the additional anecdotal questions of 1. What were the benefits of using Digital Moments if any? and 2. What were the challenges of using Digital Moments if any? resulted in the following themes being coded and identified:
(a) the impact of developing social relationships in online classes, (b) the role of creativity as an element of an engaging online community, (c) teacher-learner role shifts in online spaces, (d) the de-valuing and re-valuing of types of knowledge representation using creative qualitative pedagogies, and (e) an overview of the benefits and challenges associated with this pedagogical strategy.

6. Major themes

6.1 Developing social relationships

The use of Digital Moments began to take on a life of its own beyond the scheduled class time. Some students created their own learning communities on Facebook and LinkedIn in order to stay in touch once the course had ended. In addition, Twitter feeds were used to follow each other and sustain friendships and learning experiences. These extended connections through technology became a web within which students connected on a personal level, a professional level, both emotionally and digitally. This is evidence that "learners are responding to the new technical and social opportunities with little help from the formal education system" and there is "evidence of deep networking and knowledge building in learners' informal practices" (Littlejohn, Beetham & McGill, 2012, p. 551). Learning that is situated in digital worlds must also have a social component to be effective. Kearney, Shuck, Burden and Aubusson (2012) concur that learning is a social endeavour. They identify three distinct features of mobile or virtual learning that include "authenticity, collaborations and personalisation" (p. 2). They refer to a socio-cultural model for virtual learning and the importance of "enhanced collaboration, access to information and deeper contextualisation of learning" (2012, p. 2).

6.2 Creativity

Kaufman (2013) reveals that "school is not simply about tests and 'checking boxes' of topics and assignments. Rather, schools today should have a mission of developing students as individuals and igniting their creativity" (p. 79). Students in this project began to unleash the bonds of traditional online courses they had taken, and began to flourish in the freedom of creative practice. At the same time, ironically, they began to take more responsibility for their own learning. Being allowed to choose empowered them to discover the intimate bond between real freedom, self-responsibility and creativity. While many stated they had been indoctrinated by a culture of marks and grades, many revelled in the return to a natural state of learning, one that allowed freedom, innovation and a deeper level of responsibility than many had taken in some time. In previous online courses, the keeper of knowledge had been the instructor. It took courage on the parts of both instructor and learners, but once out of their educational cage they embraced the wide open fields of knowledge the digital world provided. One student referred to his favourite quote that "wild elephants walk softly in open fields" as a metaphor for feeling free, calm and in his natural learning environment.

6.3 Teacher- learner-teacher role shifts

During the course, the roles in this professional learning community became almost indecipherable. While still within the university context, the instructor fulfilled the responsibility to assign grades to students. But in the learning environment, the power differential became almost invisible. The students with expertise in particular technologies took on the role of instructor, the teacher became the learner, thus empowering learners with the confidence to take risks, make mistakes, and ask for help. This supports the notion that 21C learners must be able to think critically, be problem-solvers and work collaboratively. In particular, for 21C learners in a virtual classroom, they must be able to go beyond the class and use their digital literacy within the context where they work and live. "It is obvious that not only learners, but also teachers need to acquire 21st century competencies as well as become competent in supporting 21st century learning" (Voogt, Erstad, Dede & Mishra, 2013, p.408). In order to create authentic learning and assessment tools, teachers need to learn how to design such tasks. McNeill, Gosper and Xu (2012) surveyed academics and found that many continued to target lower order learning outcomes. They state that

"universities increasingly value the skills such as problem-solving, critical thinking and creativity, yet the curriculum needs to be designed to support and scaffold development of these skills, and integrating them into assessment strategies has proven a challenge. While new technologies have sometimes been heralded as having the potential to address an apparent gap between the rhetoric of curriculum alignment and assessment practice in universities, academic practice is slow to change, and the uptake of new tools to support the development of higher order skills remains relatively low. (McNeill, Gosper & Xu, 2012, p. 283)"

This research argues that if Digital Moments can be used to create learning environments that support academics to learn new skills, then they may create more relevant 21C learning outcomes for their own students. In the digital world, it is imperative that teachers, regardless of academic standing, continually redefine themselves as life-long learners and model this for their students.

6.4 De-valuing and re-valuing

The implementation and acceptance of arts-based and creative assessment tools meant a significant 'unlearning' and 'revaluing' what it meant to demonstrate one's knowledge. It became important to unpack how each learner had developed their values about the importance or lack of importance of marks and grades versus the value of the learning process itself. Students began to see how the development of friendships and simple human qualities like trust, caring and compassion were the real foundation for creating meaningful learning experiences. It also helped them to begin to trust themselves; they began to believe there was an authentic self in each learner who could choose which direction to go, which tasks were personally and professionally relevant, and which were best left to others. The level of passion and interest became more important than the grade, and this represented a significant shift in values. As Kaufman states "development of these skills is purposefully integrated within core content areas in ways that help students find relevancy in their work, a characteristic central to motivation and learning" (2013, p. 79). Contrary to traditional educational frameworks, wherein the power is centered in the instructor or the institution, this model required a re-valuing of where the fundamental responsibility for learning resides - within the learner.

7. Conclusion

In conclusion, Atkinson and Claxton observe, “teaching is a highly specific process but one which nevertheless has similarities with others involving the performance of complex and diverse skills in real time and in contexts that are unpredictable and constantly evolving” (Atkinson & Claxton, 2000, p. 4). Online instructors are tasked with the challenge to develop digital communities with the kind of social capital and presence to engage students, decrease attrition and improve learning outcomes. While we may be aware of institutional barriers or traditional models of learning, the digital world demands that we adapt and evolve, using creative, socially constructivist and community-based approaches to learning. Although Vettraino attests that “education is tied up so tightly in its own web of red tape and bureaucracy that real learning, the rich and deep learning that needs to be there, often, struggles hard to escape” (2010, p. 77), it is imperative that digital educators begin to explore arts-based strategies to engage and challenge online students. While some educators may argue that fun and play do not have a place in academia, these authors argue that many of our greatest innovations have emerged from creative exploration and the numerous mistakes that often occur in positive, social and playful contexts. As such, using arts-based strategies such as Digital Moments can create a community of learners who take risks and support one another, thereby coming up with original thoughts and ideas that they may never have come to by taking a traditional “distance education” course where learners often feel isolated or alone. From a group of distinct individuals whose learning lenses were geographically and culturally diverse, evolved a close-knit community of learners where the playing field was levelled and the traditional roles of teacher and learner became imperceptible. This project provides one case study of a pedagogical tool that can be implemented to attain the goal of improved social presence in creative online learning communities.

References

Atkinson. T. & Claxton, G. (2000) (Eds.). “*The Intuitive Practitioner: On the Value of Not Always Knowing What One is Doing*.” Buckingham, PA: Open University Press.

Barone, T. (2006). “Arts-based Educational Research Then, Now, and Later,” *Studies in Art Education*, vol. 48, no. 4, pp. 4-8. 2006. doi: https://doi.org/10.1080/00393541.2006.11650495

Brearley, L. (2000). “Exploring the Creative Voice in an Academic Context,” *The Qualitative Report*, vol. 5, no. 3, pp. 1-23.

Coppola, N.W., Hiltz, S.R. & Rotter, N.G. (2002). "Becoming a Virtual Professor: Pedagogical Roles and Asynchronous Learning Networks," *Journal of Management Information Systems,* vol.18, no. 4, pp. 169-189.

Davis, S. (2012). “Liveness, Meditation and Immediacy – Innovative Technology Use in Process and Performance. Research in Drama Education,” *The Journal of Applied Theatre and Performance*, vol. 17, no. 4, pp. 501-516.

Garrison D.R. & Cleveland-Innes, M. (2005). "Facilitating Cognitive Presence in Online Learning: Interaction is Not Enough," *The American Journal of Distance Education,* vol.19, no. 3, pp.133-148.

Griffin, M.L. (2003) “Using Critical Incidents to Promote and Assess Reflective Thinking in Preservice Teachers,” *Reflective Practice: International and Multidisciplinary Perspectives*, vol. 4, no. 2, pp.207-220, 2003. doi: 10.1080/14623940308274

Howell, S.L., Saba, F., Lindsay, N.K. & Williams, P.B. (2004). "Seven Strategies for Enabling Faculty in Distance Education," *The Internet and Higher Education*, vol. 7, no. 1, pp. 33-49.

Kaufman, K. (2013). “21 Ways to 21st century skills: why students need them and ideas for practical implementation,” *Kappa Delta Pi Record,* vol. 49, no. 2, pp.78-83. doi: 10.1080/00228958.2013.786594

Kearney, M., Schuk, S., Burden, K. & Aubusson, P. (2012). “Viewing mobile learning from a pedagogical perspective,” *Research in Learning Technology,* vol. 20, no. 1, p. 1. doi: 10.3402/rlt.v2010.14406

Keengwe, J. & Kidd, T.T. (2010). "Towards Best Practices in Online Learning and Teaching in Higher Education," *MERLOT Journal of Online Learning and Teaching*, vol.6, no. 2, pp. 533-541.

Koehler, M.J. & Mishra, P. (2009). “What is technological pedagogical content knowledge,” *Contemporary Issues in Technology and Teacher Education,* vol. 9, no. 1, pp. 60-70.

Littlejohn, A., Beetham, H. & McGill, L. (2012). “Learning at the digital frontier: a review of digital literacies in theory and practice,” *Journal of Computer Assisted Learning,* vol. 28, pp. 547-556. doi: 10.1111/j.1365-2729.2011.00474.x

Liu, S., Kim, K.J., Bonk, C.J. & Magjuka, R. (2007)."What do Online MBA professors Have to Say about Online Teaching," *Online Journal of Distance Learning Administration,* vol.10, no. 2, p. 2.

McNeill, M., Gosper, M. & Xu, J. (2012). “Assessment choices to target higher order learning outcomes: the power of academic empowerment,” *Research and Learning Technology,* Vol. 20,(17595) doi: 10.3402/rlt.v2010.17595

Merriam, S. (1998). *Qualitative Research and Case Study Applications in Education*. San Francisco, CA: Jossey-Bass.

Mishra, P. & Koehler, M. (2006). Technological pedagogical content knowledge: a framework for teacher knowledge. *Teachers College Record,* Vol. 108, No. 6, pp. 1017-1054.

Vettraino, E. (2010). “Silent Screaming and the Power of Stillness: Theatre of the oppressed within mainstream elementary education,” In P. Duffy, & E.Vettraino (Eds.), *Youth and Theatre of the Oppressed,* New York: Palgrave MacMillan.

Voogt, J., Erstad, O., Dede, C. & Mishra,P. (2013). “Challenges to learning and schooling in the digital networked world of the 21st century,*” Journal of Computer Assisted Learning,* vol. 29, pp. 403-413. doi: 10.1111/jcal.12029

Situating Resilience, Grit and Growth Mindset as Constructs of Social Presence in the Fully Online Learning Community Model (FOLC)

Wendy Barber[1], Roland van Oostveen[1] and Elizabeth Childs[2]
[1]Ontario Tech University, Oshawa, Canada
[2]Royal Roads University, Victoria, Canada
Wendy.barber@uoit.ca
Roland.vanoostveen@uoit.ca
Elizabeth.childs@royalroads.ca
DOI: 10.34190/EEL.19.012

Abstract: Current research has indicated that resilience, grit and growth mindset are psychological characteristics beneficial to learning (Duckworth, Peterson, Matthews & Kelly, 2007; Kamtsios & Karagiannopoulou, 2012; Yeager & Dweck, 2012). This paper addresses a significant gap in the literature, that being that little research has connected the concepts of resilience, grit and growth mindset to online learners, and to elements specific to the online learning environment. Dweck (2008; 2015) discusses the difference between fixed and growth mindsets, and indicates how a growth mindset can help students persevere and develop grit in the face of challenge and adversity. She reveals that the difference between a fixed and growth perspective lies in whether the individual believes that his/her intellectual ability is static and fixed, or whether it can grow and change. The perspective held by the learner is a key factor and has "profound effects on their motivation, learning and school achievement" (Dweck, 2015, p. 49). The authors attest that this tenacity appears even more important for students in digital environments, and that the development of social presence, while allowing for self-directed and student-centred pedagogical approaches, can have a direct impact on academic success and attrition rates. Using a theoretical framework based on the Fully Online Learning Community Model (FOLC) (vanOostveen et al, 2016), the authors address how social presence, as evidenced by collaborative work in problem-based learning environments, can facilitate the development of resilience, grit and growth mindset in individuals and in communities. We argue that the factors contributing to the development of these learner characteristics emerge through social interaction, collaboration, and a strong social interactive presence amongst members of the community. As a result, the deliberate cultivation of an online learning space that allows for learners to fail within a socially supportive network, can begin to build resilience, grit and growth mindset, and also address issues of attrition in online learning situations. Hochanadel and Finamore (2015) indicate, "students must develop those psychological qualities of grit and tenacity and internalize a mindset that includes persevering, and universities are in a position to help" (p. 49). This paper provides an overview of the connections between, resilience, grit and growth mindset as they relate to online learning in the FOLC.

Keywords: resilience, grit, growth mindset, online learning

1. Introduction

The growth of online learning and the ensuing environmental shift in education to include digital learning platforms has caused educators to look closely at the way students best experience and create learning (Weegar & Pacis, 2012). The fourth industrial revolution, complete with its infusion of technology, is blurring the lines between the physical and digital realms of education and, as such, educational researchers have been compelled to examine the technological and human characteristics of online learning, which contribute to the pedagogical effectiveness of online learning environments (Weegar & Pacis, 2012).

While online learning is readily accessible in diverse digital platforms, allowing students to study at their own pace and on their own time (Blackmon & Major, 2012), pressures placed on adult online learners are compounding as students often juggle their education with commitments such as family, full-time employment and work deadlines (Blackmon & Major, 2012). Smart and Cappel (2006) found online learning brought with it time pressures for completing modules, and provided inadequate opportunity for human interaction, a factor deemed necessary for establishing peer support and developing in-depth group discussions on subject matter. Other pressures were identified including learner motivation, time management, comfort level with online technologies, as well as technical problems, a perceived lack of sense of community, time constraints, and difficulties understanding online course objectives (Hassenburg, 2009; Song, Singleton, Hill & Koh, 2004).

In order to address these issues, the authors argue that building resilience in online learners, and in online learning communities, can be a potent antidote to issues of attrition. Current research has indicated that hardiness, resilience, grit and growth mindset are psychological constructs beneficial to learning (Duckworth, Peterson, Matthews & Kelly, 2007; Kamtsios & Karagiannopoulou, 2012; Yeager & Dweck, 2012). Furthermore, success in online learning, which may involve a combination of factors such as attrition rate, development of online community and significant psychological constructs of individual learners, may be mediated by various concepts related to the characteristics of individual learners, how they approach the online learning experience, and how they deal with emerging problems and challenges in digital learning environments.

Beyond individual learning, this paper situates these concepts of resilience and grit within a Fully Online Learning Community (FOLC) model. The authors postulate that the support and challenge offered by acquiring a sense of belonging to an online community can begin to address issues of perceived isolation or attrition in online learners, and that the FOLC model can provide an environment that facilitates academic success for online learners.

2. Literature review: Definitions of resilience, grit and growth mindset

Numerous authors have described the concepts of resilience, grit, and hardiness, and distinctions among the terms are as follows. Yeager and Dweck (2012) refer to resilience as "any behavioural, attributional, or emotional response to an academic or social challenge that is positive and beneficial for development, such as seeking new strategies, putting forth greater effort, or solving conflicts peacefully" (p. 303). They refer to non-resilient behaviours as those that result in a negative response to a challenge, and not beneficial, such as quitting, cheating, or ineffective aggression or retaliation. Seligman (2013) refers to resilience as "optimism, appraising situations without distorting them, thinking about changes that are possible to make, and bouncing back from adversity, cognitive or otherwise" (Seligman, 2013, in Perkins-Gough, 2013, p. 1.) Grit can be defined as having the perseverance and passion for long term goals (Bashant, 2014; Duckworth, Quinn, & Seligman, 2009), and maintaining "a definite goal which will not be given up no matter how stressful things get" (Maddi, Matthews, Kelly, Villarreal, Gundersen, & Savino, 2017, p. 356).

Dweck (2008, 2015) discusses the difference between fixed and growth mindsets, and indicates how a growth mindset can help students persevere and develop grit in the face of challenge and adversity. She reveals that the difference between a fixed and growth perspective lies in whether the individual believes that his/her intellectual ability is static and fixed, or whether it can grow and change. The perspective held by the learner is a key factor and has "profound effects on their motivation, learning and school achievement" (Dweck, 2015, p. 49). Dweck believes that

> *"a growth mindset can be taught to faculty, students and parents. Growth mindset is changing a student's thinking that intelligence level is not a fixed number and can change. Grit in education is how one can achieve long-term goals by overcoming obstacles and challenges. Duckworth and Dweck collaborated, conducting studies to determine how a fixed belief that failure is permanent could prevent students from achieving academic success. (Hochanadel & Finamore, 2015, p. 49)"*

The challenge facing educators in online environments is this: how can we facilitate and create learning environments that address issues of learner resilience, grit, and a growth mindset, and what types of pedagogical strategies can facilitate the development of these psychological constructs online, in individuals and in communities. We argue that a FOLC model, based on concepts of Problem-Based Learning, is an ideal format within which learner resilience, grit and growth mindset can be cultivated.

A critical analysis of the literature indicates that while the constructs of grit, resilience and hardiness have been examined across a variety of settings, more work is needed to understand the impact that these psychological characteristics have in online learning environments. In addition, while there is a large variety of models for online learning (synchronous, asynchronous, MOOCs, distance education, hybrid), the modality and type of learning environment needs to be specified in order to assess the role that grit and resilience may play in online student success. Further, moving beyond individual grittiness in learning, the role of the online learning community must be addressed; in other words, collective grit and resilience for online learners can, and should be cultivated through the development of interdependent online learning environments. Through the development of relationships in a FOLC democratic setting, where roles of teacher and learner are non-traditional and intermingled, collective and community based tenacity and perseverance can improve academic outcomes for online students.

3. Overview of the FOLC model

In general, the FOLC Model integrates elements of more foundational theories guiding practice in distance and online education, including the Theory of Transactional Distance (TTD) (Moore, 1993) and the Community of Inquiry (CoI) framework (Garrison, Anderson, & Archer, 2000). The CoI framework, in particular, recognizes three presences essential to supporting distance education: Social Presence, Teaching Presence, and Cognitive Presence.

Figure 1: Fully Online Learning Community model (FOLC)

Lin and Lee (2006) state that "the online community can be defined as a social relationship aggregation, facilitated by internet-based technology, in which users communicate and build personal relationships"(p. 480). Wenger and Synder (2000) believe that "online communities facilitate virtual collaboration among community members with the potential of transforming the activities of off-line into an online context" (in Lin & Lee, 2000, p. 480). While this social element of online learning remains a predominant challenge to educators, effective online pedagogy relies on how skilled the instructor is at developing and sustaining a sense of belonging to the digital community. By combining problem-based learning and a strong sense of community, educators can become adept at helping students become independent autonomous learners who are capable of solving the complex problems facing 21C learners. Instead of taking the power role normally assumed by the teacher, instructors become equal members of the community, bringing unique strengths and learning needs themselves. In this way, instructors blend into the community, become one with the background. By being present on a level playing field with students, the teacher's role in the community disappears, and reappears as something completely different – as facilitator, lurker, guide and co-learner.

It is clear that the development of social capital can be a key element for creating a sense of belonging, a safe and challenging learning environment wherein feedback from a critical other enriches the learning experience. Students are challenged to select and collaboratively solve problems. Kearney et al (2012) attest that learning "is a situated social endeavor" (p. 1). In our work we find that within the FOLC model, students invest a great deal of time in developing social networks within their courses, many indicate that they also create a Linked In or Facebook group to supplement their contact with peers, following Twitter feeds on their mobile devices outside of scheduled class time. Kearney et al (2012) reiterate that "this socio-cultural view of learning takes into consideration both technical characteristics as well as social and personal learning processes" (p. 2). LittleJohn, Beetham and McGill (2012) agree that the social elements of learning are being embraced by students, and that "learners are responding to the new technical and social opportunities with little help from the formal education system" (p. 551).

The pedagogical strategies that underpin the implementation of the FOLC model provide insight into how this FOLC environment can facilitate the development of resilience, grit and growth mindset. By creating a strong social presence, cognitive presence and collaborative learning space, learners are encouraged to take risks, and thereby have opportunities to strengthen resilience. A Problem-Based Learning (PBL) environment, aligns closely with Dweck's (2015) ideals of growth mindset, and it allows for learners to question previously held notions about overcoming challenges and obstacles, to struggle collaboratively, produce diverse solutions, and create new ways to address learning challenges.

4. Role of PBL in developing resilience, grit and growth mindset

The pedagogical foundation upon which the FOLC model rest is that of Problem Based Learning. We believe that this orientation, towards a learner-centred and problem-centred approach, allows a social constructivist approach to learning, wherein resilience, grit and growth mindset are cultivated. Savin-Baden (2007) states that there are several key features of problem-based learning, including 1. A focus on complex real-world situations that have no one 'right' answer; 2. Students work in teams to confront the problem, to identify learning gaps, and to develop viable solutions; 3. Students gain new information through self-directed learning; 4. Instructors act as facilitators; 5. Problems lead to the development of clinical problem-solving capabilities.

As McNeill, Gosper and Xu (2012) state, "universities increasingly acknowledge the value of skills such as problem solving, critical thinking and creativity, yet the curriculum needs to be designed to support and scaffold development of these skills. (2012, p. 283). We argue that educators must move beyond the curriculum, and create environments within which students choose the curricula they need to solve the complex problems they select, as such, they need to be creative problem-solvers, be willing to readily accept failure, and develop a growth mindset and the resilience to persevere. McNeill, Gosper and Xu (2012) go on to state that "academics who were likely to introduce the development of student creativity in their curriculum found that confidence emerged as a key characteristic" (2012, p. 284). Students in these PBL / FOLC environments develop skills in collaboration, the ability to come to a variety of workable and diverse solutions, and they also acknowledge that each member of the community, while possessing different skills, has an important and valuable place in the group. These are critical skills for anyone working in the knowledge economy. LittleJohn, Beetham and McGill (2012) indicate that the nature of the workplace has changed, and digital forms of information are changing the meaning of what it means to work. They state that these changes are being exacerbated by three factors

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

5. Conclusions

It is clear that there is a significant gap in the literature involving grit, growth mindset, resilience and hardiness as they pertain to online learners and digital learning environments. Building resilience, grit and growth mindset are essential components of learning environments that promote the development of academic success in online communities. In fact, students need these qualities and characteristics to function and learn in a digital world. This is what Littlejohn, Beetham and McGill (2011) refer to as "the capabilities required to thrive, in and beyond education, in an age when digital forms of information and communication predominate" (p. 547). Kaufman concurs that "school is not simply about tests and 'checking boxes' of topics and assignments. Rather, schools today should have a mission of developing students as individuals and igniting their creativity" (2013, p. 79). Voogt et al (2013) also attest that it is generally agreed upon that "collaboration, communication, digital literacy, citizenship, problem-solving, critical thinking, creativity and productivity are essential for living in and contributing to our present societies" (p. 404).

While research on grit and resilience in online learning is in its infancy, this paper raises issues about how the development of resilience and grit in online learners, as situated within the FOLC model, can have a significant effect on attrition and academic success in digital environments.

References

Bashant, J. (2014). "Developing Grit in Students: Why Grit is Such a Desirable Trait, and Practical Strategies for Teachers and Schools", *Journal of Leadership and Instruction*, Fall, 2014, pp. 14-17.

Blackmon, S.J., & Major, C. (2012) "Student Experiences in Online Courses: A Qualitative Research Synthesis", *The Quarterly Review of Distance Education*, Vol. 13, Nol 2, pp. 77-85.

Duckworth, A.L., Peterson, C., Matthews, M. D. & Kelly, D. R. (2007). "Grit: Perseverance and Passion for Long-term Goals", *Journal of Personality and Social Psychology*, Vol. 92, No. 6, pp. 1087-1101.

Duckworth, A. L., Quinn, P. D. & Seligman, M. E. (2009). "Positive Predictors of Teacher Effectiveness", *The Journal of Positive Psychology*, Vol. 4, pp. 40-547.

Dweck, C. S. (2008). *Mindset: The New Psychology of Success*. Random House Publishing, Inc., New York: NY.

Dweck, C. S. (2015). "Growth", *British Journal of Educational Psychology*, Vol. 85, pp. 242-245. https://doi.org/10.1111/bjep.12072 Retrieved Dec 10, 2018

Dweck, C.S. (2016). “Managing Yourself: What Having a Growth Mindset Actually Means”, *Harvard Business Review*. Retrieved from https://hbr.org/2016/01/what-having-a-growth-mindset-actually-means

Garrison, R., Anderson, T., & Archer, (2000).” Critical Inquiry in Text Based Environments: Computer Conferencing in Higher Education”, *The Internet and Higher Education*, Vol. 2, No. 2-3, pp. 87–105.

Hochanadel, A. & Finamore, D. (2015). “Fixed and Growth Mindset in Education and How Grit Helps Students Persist in the Face of Adversity”, *Journal of International Education Research*, Vol. 11, pp. 47-50.

Kamtsios, S., & Karagiannopoulou, E. (2012). “Conceptualizing Students’ Academic Hardiness Dimensions: A Qualitative Study”, *European Journal of Psychology of Education*. doi:10.1007/s10212-012-0141-6

Kearney. M., Schuk, S., Burden, K. & Aubusson, P. (2012). “Viewing Mobile Learning from a Pedagogical Perspective”, *Research in Learning Technology*, Vol. 20(14406). doi: 10.3402rlt.v2010.14406

Lin, H. & Lee, G. (2006). “Determinants of Success for Online Communities: An Empirical Study”, *Behavior and Information Technology*, Vol. 25, No. 6, pp. 479-488.

Littlejohn, A., Beetham, H. & McGill, L. (2012). “Learning at the Digital Frontier: A Review of Digital Literacies in Theory and Practice”, *Journal of Computer Assisted Learning*, Vol. 28, 547-556. doi: 10.1111/j.1365-2729.2011.00474.x

Maddi, S. R., Matthews, M. D., Kelly. D. R., Villarreal, B. J. & White, M. (2012). “The Role of Hardiness and Grit in Predicting Performance and Retention of USMA cadets”, *Military Psychology*, Vol. 24, 19-28, DOI: 10.1080/089956)05.2012.639672.

McNeill, M., Gosper, M. & Xu, J. (2012). ‘Assessment Choices to Target Higher Order Learning Outcomes: The Power of Academic Empowerment”, *Research and Learning Technology*, Vol. 20(17595) doi: 10.3402/rlt.v2010.17595

Moore, M.G. (1993). *Theory of Transactional Distance*. In Keegan, D. (Ed.) Theoretical Principles of Distance Education. New York: Routledge.

Perkins-Gough, D. (2013). “The Significance of Grit: A conversation with Angela Lee Duckworth”, *Educational Leadership*, Vol. 71, 14-20.

Savin-Baden, Maggi. (2007). "Challenging models and perspectives of problem-based learning." Management of change: Implementation of problem-based and project-based learning in engineering (2007): pp. 9-30.

Smart, K.L., & Cappel, J.J. (2006). “Students’ Perceptions of Online Learning: A Comparative Study”, *Journal of Information Technology Education: Research*, Vol. 5, No. 1, pp. 201-219. Retrieved from https://www.learntechlib.org/p/111541/

Song, L., Singleton, E.S., Hill, J.R., & Koh, M.H. (2004). “Improving Online Learning: Student Perceptions of Useful and Challenging Characteristics”, *The Internet and Higher Education*, Vol. 7, No. 1, pp. 59-70.

Weegar, M.A. & Pacis, D. (2012). “A Comparison of Two Theories of Learning-Behaviorism and Constructivism as Applied to Face-to-Face and Online Learning”, In Proceedings e-leader conference, Manila.

Yeager, D.S., & Dweck, C. (2012) “Mindsets that Promote Resilience: When Students Believe that Personal Characteristics can be Developed,” *Educational Psychologist*, Vol. 47, pp. 302-314, DOI: 10.1080/00461520.2012.722805

Soft-Digital Skills in Higher Education Curricula

Susana Bastos, Helena De Oliveira, Moreira Manuel Silva and Liliana Azevedo
Polytechnic Institute of Porto (IPP) - School of Accounting and Administration of Porto, Portugal
(ISCAP) - Centre for Organizational and Social Studies of P. Porto (CEOS.PP), Porto, Portugal
Expandindústria, S.A., Portugal

susanass@iscapp.ipp.pt

hmoliveira@sapo.pt

mdasilva@iscap.ipp.pt

lilianabastosazevedo@gmail.com

DOI: 10.34190/EEL.19.037

Abstract: This article arises from the proposal of a new approach regarding the inclusion of soft-digital skills training in higher education. The study carried out on several curricular units in different higher education courses in Portugal led us to reflect on a different educational model, which combines the development of soft skills in digital environments. Digitalization and the use of technologies since early ages in the educational process are raising interesting questions. This article intends to go deeper on the use of digital technologies, namely through the virtual environments imposed by higher education institutions as a form of study. The main question is how pedagogies and the use of technologies have a meeting point where it is possible to continue humanization in education through the utilization of virtual environments to support the teaching/learning process. The methodology used in this study has its support on questionnaires made to students of higher education in different areas of knowledge, such as medicine, nursing, engineering, management, arts and literature. The main conclusions of this study are the importance of creating and using digital platforms that not only support the study but also contemplate the use of a virtual reality where students can interact with others in the discussion and resolution of real life situations.

Keywords: education, digital environments, skills, study support, humanization

1. Introduction

This article arises from the proposal of a new approach regarding the inclusion of soft-digital skills training in higher education. The study carried out on several curricular units in different higher education courses in Portugal led us to reflect on a different educational model, which combines the development of soft skills in digital environments. The way we work changed dramatically during the last years. The 21st century major changes have as main emphasis the digital transformation of the professions around the world.

From the digital global market are emerging opportunities to businesses and societies. However, the parties involved in the process, must have a different perspective in business strategies and be concerned with the impact on the society. Unemployment will rise, and the solution lies on lifelong training in the digital era, or, as we like to call it - 5.0 circumstances. Each company, school, university, teacher, student, should be aware of the current changes. Technology provides higher education with the tools that can or should engage learning sets to the student as an individual, in order to support him in his process of developing the core skills needed to embrace the labour market.

The path of education to success, provided by higher education institutions through the creation of technological environments, should include sets where students can find: information, tools – technological and others, and coaches (teachers) to help them cope with the real situations with which they are confronted while still at school.

The Artificial Intelligence (AI) used in the creation of digital environments for education is taken for granted success in all fields of education. The student 5.0 is the one that has a certain level of proficiency in core competences versus digital competences and human competences.

The main question is how pedagogies and the use of technologies have a meeting point where it is possible to continue humanization in education through the use of virtual environments to support the teaching/learning process. The main conclusion to be drawn of this study is that the use of digital environments combined with the traditional set of the process of teaching and learning "improves student performance and helps to be more effective".

2. Context: Common places

> *"The ITU - Telecommunication Development Sector - ICT Facts and Figures 2017 features end-2017 estimates for key telecommunication/ICT indicators, including data on mobile-cellular subscriptions, Internet use, fixed- and mobile-broadband services, household ICT access, and more. New data show that young people are at the forefront of today's information society: 830 million young people representing more than 80 per cent of the youth population in 104 countries are online."*

Universities must engage a new role in the preparation of their students to this new paradigm: their students are the ones that are in "the forefront of today's information society". In fact, the figures presented by the above-mentioned statistics, reveal a need to change the way we see and work at the higher education sector.

The curricula must undergo a huge transformation in order to promote the development in the students in the way they see information and how they treat that information. As well as the manner we use technology in higher education in order to prepare the future professionals to deal with the 4.0 revolution in the world of business.

The European Commission in the document entitled "The need to transform local populations into digital talent" supports that the growing transformation in economies and in societies must have a strong support in families, community and school. The "4.0 students", as we name them, grew up with smartphones, internet and technology, and they can´t even conceive a world without it.

This is the 4.0 generation, and schools have an important role to drive them in the correct path, so that they can learn how to live and grow with digital transformationThe urgent need to study this 4.0 generation emerges from a major concern on how this generation can still have an education of excellence with the so-called virtual environments or artificial intelligence (AI), and be simultaneously endowed with social and human values.

Therefore, it's our belief that this is the 5.0 generation: a combination between the core skills (hard and soft) and the digital skills. The 5.0 student is a person with the ability to deal with the real world. Therefore, educational institutions must start rethinking their methods of teaching and learning and how "to meet", reconcile, them with the digital world.

The students can't be forgotten in this changing process. The student is the centre of the educational process and the school is the place where the combination of the digital skills with the hard and transversal/soft skills must be organized and carried out.

The continuous progress of technology has had a significant impact on the manufacturing industry. Along with the transition to Industry 4.0, the huge increase of automation and data exchange will expose the industrial and project employees to never-seen cyber-physical systems, the Internet of things, cloud computing and cognitive computing. Therefore, industrial employees are living a transition from an industrial to a knowledge society in a time of just a few years (World Economic Forum, 2016).

On the level of human cognitive, behavioural and operational skills, the new context involves several challenges in industrial organizations and teams. The "new normality" can be described in the acronym VUCA: velocity, uncertainty, complexity and ambiguity. In the VUCA world, continuous, unpredictable and widespread changes are needed in order to develop new business models, new ways of thinking, and new individual and organizational skills (Caggiano, 2019).

Technical/hard skills such as: the use of ICT (information and communication technologies) tools; knowledge of languages; knowledge of professional software; knowledge of the Quality Management System (design, implementation and monitoring of the QMS); the ability to plan and organize; respect time and objectives; and guarantee the functioning of companies. However, for companies to strive in today's markets, unstable, constantly changing and thirsty for innovation, behavioural skills such as flexibility and adaptability, resistance to stress, work for goals, team working and problem solving, decision making and time management, must be "integrated" to make it possible to perform the gears of the organizational environment.

According to David J. Deming the demand for social skills has been growing over the last several decades. ''Human interaction in the workplace involves team production, with workers playing off of each other's strengths and adapting flexibly to changing circumstances. Such nonroutine interaction is at the heart of the human advantage over machines'' says Deming, when he explains that computers are still very poor at simulating human interaction, one of the reasons of the growing demand for social skills (Deming, 2017).

3. Drivers of change: the future for higher education institutions

> *"We've been doing a good job of redesigning physical learning spaces. The challenge is to genuinely understand that the virtual campus is just that! A learning space and one, moreover, that will need to be appropriately invested in to ensure curriculum and instructional design excellence." (Ashford-Rowe 2019, p. 11).*

The Educause Horizon Report: 2019 Higher Education Edition (2019) rises interesting perspectives about the way HEI (Higher Education Institutions) are implementing the digital environments in the teaching/learning process. In addition, this report brings up important remarks and statistics regarding the preparation for the future of HEI. The role of each participant in the process of teaching and learning must change to assure an education of quality towards the future. HEI must reinvent themselves in order to maintain their major role in society: to graduate students prepared to a profession. "This is one shift in the changing roles. I often think of the change to facilitator, coach, mentor, champion, assessment creator, and even curator!" (McCarty, 2019, p. 19).

The managers of HEI as leaders have a huge struggle to show a strong leadership in order to take to the future the intervenient parties in the process. The role of a leader must ensure that the staff involved in a changing process is going towards the goals defined. The communication of the strategy, implementation and its development, must have an "attentive eye" from the leaders. Teachers must be engaged in the process and have the needed skills to cope with the "future set of HEI".

The digital competences, the new/revised process of teaching and learning, the curricula, the contents of each course, are the scope of the required changes, so that we can have a school for the future (Bastos, Schleutker, Azevedo, 2018).

> *"Bringing personalized learning solutions to the higher education system will require major system changes from colleges and universities around the world. We have no time to waste in unlocking student success. Students deserve the environment and support that will help them reach their full potential and earn their higher education certificate." (Chang, 2019, p. 17).*

Table 1: Developments in educational technology, Adapted from Educause Horizon Report: 2019 Higher Education Edition, p. 20

Developments in Educational Technology	2012	2013	2014	2015	2016	2017	2018	2019
Analytics Technologies								
Adaptive Learning Technologies								
Games and Gamification								
The Internet of Things								
Mobile Learning								
Natural User Interfaces								
Bring Your Own Device								
Makerspaces								
Flipped Classroom								
Wearable Technology								
3D Printing								
Tablet Computing								
Artificial Intelligence								
Next-Generation LMS								
Affective Computing								
Mixed Reality								

Developments in Educational Technology	2012	2013	2014	2015	2016	2017	2018	2019
Robotics								
Quantified Self								
Virtual Assistants								
Massive Open Online Courses								
Block chain								

The developments in educational technology presented in the figure above, shows that from 2012 to 2015, the main technological tools used by HEI are analytic technologies, games and gamification, flipped classroom, 3D printing and tablet computing. From 2016 to 2019 the analytic technologies continue as an important tool, side by side with artificial intelligence (AI).

Analytic technologies are used across institutions, and they give emphasis to the study of statistics, descriptive analyses in the contents of the courses. The students, throughout this study can develop analytic competences that comprise "a dynamic, connected, predictive, and personalized systems and data" (Educause Horizon Report 2019, p. 23).

The Higher Education Institutions will need to develop analytic competences in a broader sense by implementing new computational systems and a trained staff equipped with the digital skills, to promote the effective use of complex data resources.

The use of new technologies at HEI requires a significant research and training along the years. In addition, the integration of the new technologies in methods of teaching/learning is essential to assure success in introducing technological solutions in educational sets. The creation of islands of "I-tech innovative approaches" at HEI, will not survive if the bridges constructed between them have flaws, such as the inexistent multidisciplinary among the contents of a course.

Artificial intelligence (AI) is starting to be used at digital environments at HEI in new areas of knowledge, where some years ago they were not meant to be or even feasible to be adopted (nursing, medicine, management, languages, literature, tourism, arts and music). The AI used in the creation of digital environments for education is taken as granted for a success in all fields of education. "As the programming, data, and networks driving AI mature, so does the potential that industries such as education see in its application. However, as AI develops more human-like capability, ethical questions surrounding data use, inclusivity, algorithmic bias, and surveillance become increasingly important to consider. Despite ethical concerns, the higher education sector of AI applications related to teaching and learning is projected to grow significantly" (Educause Horizon Report 2019, p. 39).

Table 2: Significant challenges, adapted from Educause Horizon Report: 2019 Higher Education Edition, p. 13

Significant Challenges	2012	2013	2014	2015	2016	2017	2018	2019
Competition from New Models of Education								
Blending Formal and Informal Learning								
Improving Digital Fluency								
Integrating Technology in Faculty Education								
Personalizing Learning								
Authentic Learning Experiences								
Rewarding Teaching								
Insufficient Metrics for Evaluation								
Embracing the Need for Radical Change								
Evolving Roles of Faculty and Ed Tech Strategies								
Achievement Gap								
Advancing Digital Equity								
Managing Knowledge Obsolescence								
Balancing Our Connected and unconnected Lives								
Teaching Complex Thinking								
Scaling Teaching Innovations								
Expanding Access								
Academic's Attitude about Technology								

Significant Challenges	2012	2013	2014	2015	2016	2017	2018	2019
Documenting and Supporting New Forms of Scholarship								
Adapting Organization Designs to the Future Work								
Economic and Political Pressures								
Increasing Demand for Digital Learning Experience and Instructional Design Expertise								
Rethinking the Practice of Teaching								

The future will bring new challenges for HEI. The essential key points to reflect about this "new future" are mentioned above. We defend that the improvement of digital literacy and fluency, the advance of digital equity and the rethinking of the practice of teaching and learning, are the major ones to be discussed at the HEI future set, otherwise "digital environment" combined with "real environment" can result in a huge failure.

4. Core skills for the "student 5.0"

The student 5.0 as we call it, is the student that has a certain level of proficiency in core competences versus digital competences and human competences.

It is important to make a description of the digital skills according to European Union and OECD.

According to the EU's Digital Competence Framework, a digital competence as "skills needed [which] include the ability to search, collect and process information and use it in a critical and systematic way, assessing relevance and distinguishing the real from the virtual while recognising the links."(European Union, 2019).

The 2017 report on Digital Skills in the EU labour market notes that "digital skills encompass a range of basic to highly advanced skills that enable the use of digital technologies (digital knowledge) on the one hand, and basic cognitive, emotional or social skills necessary for the use of digital technologies, on the other hand" (European Parliamentary Research Service, 2017).

The OECD has defined the following levels of digital skills: "generic skills: enable employees to use technologies in their daily work for accessing information online or using commonly available software; specific skills: enable the production of ICT products and services, including software, web pages, e-Commerce capabilities, cloud and Big Data and require knowledge of programming, application development and/or network management; complementary skills: enable complex information processing, problem solving, etc." (OECD, 2015).

These skills levels were drawn on foundational skills like digital literacy, social skills and creativity.

Skills may be broadly defined as "action in context" and they can be learned and developed.

Indeed, skills are strictly linked to behaviour and to its surrounding context that influences their potential of activation and their power of transference. More specifically, transversal skills are seen as a set of personal and interpersonal skills – generally called "soft skills" – but also as technical skills that can be used and that are important for workplace performance in multiple professions, regardless of the academic subject area (Vieira & Marques, 2014).

In a recent study in which employers were requested to rank a set of twenty-one workplace skills by importance, "Analysis and Problem-solving", "Creativity and innovation", "Adaptation and flexibility", "Planning and organization" and "Striving for excellence" were elected as the top five, while field-specific skills were in the sixth position (Vieira & Marques, 2014). These results are in line with previous research that acknowledge the increasingly value that soft skills have been receiving by the labour market (Andrews & Higson, 2008; Archer & Davidson, 2008),

Although Higher Educational Institutions are already aware of the importance of developing the soft skills among their students, a minority of institutions have formal practices such as curricular units integrated in the official curricula in order to reach this aim.

In a review of Higher Education Institutions, initiatives and projects aimed at promoting students' soft skills, only 9% were formal practices (Vieira & Marques, 2014). However, it may also be achieved by using pedagogical practices that may foster these skills and we believe that the curricular units where exists a combination between the reality and the digital environments is a path to take in consideration in order to achieve higher levels of success in the student's portfolio.

5. Study methodologies

The main question is how pedagogies and the use of technologies have a meeting point where it is possible to continue humanization in education through the utilization of virtual environments to support the teaching/learning process.

The methodology used in this study has its support on questionnaires made to students of higher education in different areas of knowledge, such as medicine, nursing, engineering, management, arts and literature.

The use of virtual technologies in higher education questionnaire is divided in two parts. In the first one, we intend to analyse the profile of the students, and in the second to get their opinion and experience about the use of virtual environments in the teaching and learning process.

The questionnaire was sent to specific universities/polytechnic schools of the city of Porto. The universities were selected by the courses and the level of practice involved in the curricula. The selected universities/polytechnic schools were Superior School of Health of Porto (ESSP), Superior School of Nursing of Porto (ESEP), Superior School of Engineering and Technology (ESET), Faculty of Economics of the University of Porto (FEP), Engineering Faculty of the University of Porto (FEUP), Faculty of Medicine of the University of Porto (FMUP), Superior Institute of Engineer of Porto (ISEP), Superior Institute of Accounting and Management (ISCAP) and Faculty of Pharmacy of the University of Porto (FFUP).

The questionnaire was sent to the director of the courses of medicine, nursery, pharmacy, economics, accounting and management and engineering to be answered by the students of the second and last years. In those years, the number of practical subjects is higher and the use of technologies is privileged.

The population has 220 students of the second year of the nursery, pharmacy, economics, management and engineering and the final year of medicine.

There were 132 answers, from those, 32 were not considered due to the lack of some answers of the questionnaires.

From the 100 valid questions, the educational institution with a higher number is the Superior School of Nursing of Porto (ESEP), the ages of the students are 19 and 20 years (second year), about 80% of the students and 20% have 22 years old or more, from the last year of the medicine course, is the fifth year and the only course in this study that has a five year duration. Regarding the gender, about 90% are feminine.

The second part of the questionnaire has 11 questions, covering the existence of e-platforms to study, what kind of support to study is provided by the e-platforms, the existent support of the teachers, the kind of information that is available in the e-platforms, the "tools" used are effective to the learning in a short and in a long life term and "which tools the students consider more effective and that should be provided by the schools".

The students' answers give us the knowledge that 100% of the HEI in study provides them a digital environment to support their studies. Namely, the most used digital environments are the e-platforms, such as Moodle, Sigarra and Colibri.

To the question "What support for the study is available to you?" about 50% of the students refers to "texts", "exercises and exams with resolution" had 20% of the answers, the "videos with the exposition of the given subject" gathered 10% of the result to this question.

"Do theoretical curricular units and practices resort to the use of technologies in the same proportion?" was a "test" question introduced in this study. The answers of 80% of the students refer that the theoretical curricular units do not use technologies, "all my classes are theoretical-practice" had 10% of the answers and the remaining 10% of the students referred that "theoretical curricular units" use technologies to provide the student the support study "texts".

"What kind of information is available on the Platform?" had 10% of the answers with "in addition to Moodle, we have access to a simulator online and physically we have access to training rooms with resources and necessary material" and 20% with "simulators/simulated practice", the important value lies on the "materials and diversified resources" with 70% of the answers.

To the question, "Do you consider that the means available are effective for your immediate learning?" 90% of the students agree. Nevertheless, this figure changes when the question is transformed in terms of a long life training, it decreases 10% the number of students that agree on the necessary means available to their learning.

To the question "From the following means indicate those you consider as fundamental to be made available at your school" 70% of the students answered that "combined platform with the previous situations", 20% agree that the "platform with study support material is sufficient and 10% give us the "platform with practical cases for virtual team resolution" answer. There was a fourth-possible answer "platform with study support material and with progression tests (stages of study)".

6. Results

All the HEI of the study have a digital platform to support the process of teaching/learning. The teachers and the students use the platform supplied.

Support texts, exercises and PowerPoints of the classes mainly compose the material available in the platforms. However, there is a significant number of HEI, which provide simulators and simulated practise for the resolution of real situations.

The majority of students consider:

"They are resources that can help in the future. It is easy to access to all. I think that some of the means available are more effective, for example, scheduling trainings turns out to be a more effective means of long-term learning, since it allows consolidating systematically, not only the practice and its details, but also the story that this involves. On the other hand, the simulator seems to me to be more effective in the short term, but not so in long term, because despite providing an interesting experience and good feedback, requires less reasoning and knowledge that support decision-making and does not allow so much attention to detail.

They give me access to numerous resources that I can use in the future, and allows easy access at any time.

The videos integrate theoretical knowledge with clinical cases and the flashcards help in the retention of the subject".

Besides what HEI already provide in their platforms, students considers that this should still contemplate:

> *"Study support material; study support material with progression tests (stages of study); practical case for virtual team resolution".*

7. Conclusions

The main conclusion to take out of this study is that the use of digital environments combined with the traditional set of the process of teaching and learning "improves student performance and helps him to be more effective".

Furthermore, in specific areas, such as "medicine and nursery there are emergency situations where you need to act quickly. The more we have had the opportunity to rehearse them before they are real, the less likely we are to make a mistake when we are in fact facing a real situation. Learning through simulation is much more effective and lasts longer in memory than learning with only reading / theory". The practice while at the school environment, such as simulation environments and internships along the course are seen as more effective than learning by reading and by solving theoretical exercises.

The choice or the settlement of the "best method to learn a profession" raises up different opinions in the literature and in the real world school situations "because they are resources that can help in the future. It is easy to access to all. I think that some of the means available are more effective than others, for example, scheduling trainings turns out to be a more effective mean of long-term learning, since it allows consolidating step by step, not only the practice and its details, but also the story that this involves. On the other hand, the simulator seems to me to be more effective in the short term, but not so in long term, because all the steps are described in the menu, and therefore, despite providing an interesting experience and good feedback, requires less reasoning and knowledge that support decision-making and does not allow so much attention to detail".

Is there a 5.0 student yet? No, for sure.

The future of higher education institutions is yet to come but its preparation and the way that the intervening parties involved in the process see the use of the digital environments at school set rises an urgent response from the leaders of HEI. The future lies on the hands of an artist … the artist must be innovative, communicative, leader, resilient, changeable, digital and human. "You can't read reality in an empty box" (Abel Paiva, in a class of the nursing course on the 5th June 2019).

References

Andrews, J., Higson, H. (2008) Graduate Employability, "Soft Skills" Versus "Hard" Business Knowledge: A European Study. Higher Education in Europe, ISSN: 0379-7724.

Bastos, S., Schleutker, K., Azevedo, L. (2018) How to facilitate development of soft skills in business studies? Description of a Portuguese and a Finnish pilot, https://uasjournal.fi/in-english/development-of-soft-skills-in-business-studies/.

Brian, A. et al. (2019) Educause Horizon Report: 2019 Higher Education Edition. Louisville, CO: EDUCAUSE, 2019. ISBN 978-1-933046-02-0, pp.11-39.

Caggiano, V. (2019) Hard Work on Soft Skills. Teaching and Learning Ways to be Happy, Anicia. Rome.

Deming, D. J. (2017). The Growing Importance of Social Skills in the Labor Market*. The Quarterly Journal of Economics, 132(4), 1593–1640. doi:10.1093/qje/qjx022.

European Commission, Directorate-General of Communications Networks, Content & Technology (2019). "Digital Skills - New Professions, New Educational Methods, New Jobs Final Report, ISBN 978-92-76--8 00668doi: 10.2759/36058. Luxembourg: Publications Office of the European Union.

European Parliamentary Research Service (2017) Digital skills in the EU labour market.

International Telecommunication Union (2017) ICT Facts and Figures 2017, The ITU - Telecommunication Development Sector, Geneve.

Mahmood, L., Slabu, L.G., Moura, G. R., Hopthrow, T. (2014) Employability in the first degree: The role of work placements on students' perceptions of graduate employability, Kent.

OECD. Working Party on Measurement and Analysis of the Digital Economy. Skills For A Digital World. Background Paper for Ministerial Panel 4.2DSTI/ICCP/IIS (2015) 10/FINAL

Probst, L., Pedersen, B., Wenger, J.; (2014) The need to transform local populations into digital talent. Unit F/3 KETs, Digital Manufacturing and Interoperability by the consortium composed of PwC, CARSA, IDATE and ESN, under the contract Digital Entrepreneurship Monitor (EASME/COSME/2014/004).

Vieira, D., Marques, A. (2014). Preparados para Trabalhar?, Lisboa: Consórcio Maior Empregabilidade/Fórum Estudante.

World Economic Forum (2016) The Future of Jobs Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution, Ref. 010116.

Traineeships in Jordan: Mutual Engagement, Joint Enterprise and Shared Repertoire Between Companies and Students

Naoual Benamar[1] and Rikke Magnussen[2]
[1]Department of Learning and Philosophy, Aalborg University, Copenhagen, Denmark
[2]Department of Communication and Psychology, Aalborg University, Copenhagen, Denmark
nbenam13@student.aau.dk
rikkem@hum.aau.dk
DOI: 10.34190/EEL.19.086

Abstract: The number of students in Jordanian higher education has seen a strong increase since 2001. Despite this, higher education in Jordan faces a range of challenges. Middle Eastern education has been criticised for traditional teaching methods, including passive consumption of knowledge, and for failing to engage students in applying their skills and knowledge to situations outside of the educational institutions. It is argued that traditional and didactic teaching methods still influence higher education in large parts of the Arabic-speaking countries. These methods are teacher-centred rather than student-centred, which presents certain problems and shows a need for improvement. Studies also show that students report that higher education does not equip them for a labour market that is in constant transition. These studies report that students are not in contact with 'real work life' and do not have the opportunity to apply theory in practice. This paper presents the results from a study conducted as part of a EU project called the Modernization of Teaching Methodologies in Higher Education: EU Experience for Jordan and Palestinian Territory (METHODS). The primary purpose of the overall three-year project was to modernise teaching methods at universities in Jordan and Palestine and to support the creation of independent learners. This project was conducted with a focus on investigating the potential of and barriers to collaboration between industry and students in higher education in Jordan. It was conducted with students, faculty members and representatives from industries in Jordan. The study specifically focused on compulsory traineeships at universities in Jordan that involve a student staying a short period of time in a relevant workplace. The results of the study showed that there is great potential for future collaboration between university students and industries and organisations. However, the study also uncovered barriers for collaboration between universities and industries due to a lack of mutual engagement and joint enterprise.

Keywords: higher education, Middle East, collaboration industry and universities, traineeships and learning

1. Introduction

One general realisation of our time is that the survival of any country depends on their population's ability to be innovative, flexible and creative in a world faced with global warming and foreign industries that exploit cheap labour (Drucker, 1993). To meet these challenges, the primary task of educators has been defined as preparing learners to creatively participate in the knowledge economies that most Western countries have evolved into (OECD, 2000). Despite this reality, the schools in many countries still teach students that knowledge is static, and as a result, students are being taught to become experts at consuming knowledge rather than producing knowledge (Sawyer, 2006).

Developing new educational approaches and practices to meet these goals has been a central focus at Middle Eastern universities in recent years. Middle Eastern education has been criticised for rewarding passive consumption of knowledge and for failing to engage students in the application of skills and knowledge to situations outside the educational institutions (Mahrous & Ahmed, 2010; Britz & Richard, 1992). In most Arabic-speaking countries, traditional instructive methods still influence higher education, and teaching is teacher-centred rather than student-centred (Saleh, Al-Tawil & Hadithi, 2012).

This paper presents results from the project, Modernization of Teaching Methodologies in Higher Education: EU Experience for Jordan and Palestinian Territory (METHODS). The main purpose of the overall three-year project was to modernise teaching forms at universities in Jordan and Palestine to support the development of independent learners. The study investigated the potential for and barriers to collaboration between students in higher education and industry in Jordan.

2. Background

The Middle Eastern education system has been criticised for being an examination-oriented system that is dependent on memorising facts rather than applying theoretical concepts to situations outside the classroom (Mahrous, 2010; Britz & Richard, 1992; Russell, 2004). However, educational approaches involving elements of authentic work situations have been perceived differently in the Middle Eastern context than in the West. In a cross-cultural study of business students' perceptions of the effectiveness of pedagogical tools, Mahrous and Ahmed (2010) found that methods stimulating authentic work 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 are a widely used tool in Western business studies and have been shown to provide students with more practical experience than other pedagogical tools (Burns, 1992). Mahrous and Ahmed suggested that the above results stem from students being accustomed to passive learning systems, which leads to students lacking the practical experience to analyse a problem with open-ended multiple answers and experiencing confusion regarding what is expected of them (Mahrous & Ahmed, 2010).

Previous studies conducted at higher education institutions in Jordan and Palestine showed that the students' educational experience lacks elements that bring them in contact with *real work life* and that they lack the opportunity to test theories in practice (Magnussen et al., 2018). Resultantly, the students' competences are often not in compliance with labour market demands. This is acknowledged by university professors who believe that collaboration between universities and the labour market should be an established practice (Suheir & Hilmy, 2017). Studies at Jordanian universities have generally shown that there is a need for educational systems to apply strategies that adapt to societal changes and meet employer needs (Khader, 2011).

The current study specifically focused on student traineeship at Jordanian universities, where a traineeship is a short period of time spent at a relevant workplace and is a compulsory part of all higher education. The study of traineeships in Jordanian higher education focused on understanding the potential for and the barriers to collaboration between students and industries in a Middle Eastern context. In this paper, concepts of 'communities of practice' (Wenger, 2004) are applied with the aim of understanding how the communities of university students and faculty members differ from those of commercial partners and measuring both the potential and barriers for collaboration that it creates. The concepts of mutual engagement, joint enterprise and shared repertoire will serve as an analysis frame for understanding challenges that exist in relation to traineeships in Jordanian universities. This paper will also suggest design principles for a digital platform to support collaboration between universities and industries in a Middle Eastern context.

3. Data collection in the METHODS project

METHODS is a three-year project that began in 2016 with the aim of modernising teaching methods in higher education at two Middle Eastern universities. The International Technology Learning Centre has been established in order to utilise information and communication technology (ICT)'s best practices at the higher education level. This project was created in collaboration with partners from the EU and the Middle East, including universities in Palestine and Jordan. The project's activities include pre-studies of the challenges of integrating new types of ICT learning forms at Middle Eastern universities, developing ICT learning centres and teaching forms to create a design course prototype and developing new ICT learning pilot courses. The current study specifically aims to uncover barriers to students' collaboration with industry as part of their education.

3.1 Data collection

This study was based on qualitative research involving six semi-structured interviews with companies, students and professors at Jordanian universities. The interviews were conducted with individuals and focus groups, which granted them the liberty to pursue interesting statements and points made throughout (Kvale, 1994). The collection of the qualitative research mainly took place at the universities; only one interview took place at the representative's workplace.

The interview guides were tailored to each group of participants and were aimed at discovering what type of cooperation existed between universities and companies, while uncovering their perceptions and definitions of the term *cooperation*. To achieve this, the main themes of the interview guide revolved around general questions, insights and visions, which aimed to provide insights into the present experiences of the participants as well as their future aspirations for cooperation (Kanstrup & Bertelsen, 2011). The tailoring of the interview guides allowed for an in-depth understanding of the aforementioned aims related to each participant group.

Table 1: Overview of the interviews conducted in the study

COMPANIES	
Interview 1	Participant 1, technical manager in an engineering company
Interview 2	Participant 2, key account manager in an IT company
Focus group interview	Participant 3, managing director in a factory Participant 4, coordinator at Jordan Chamber of Industry Participant 5, marketing manager in an engineering company.
STUDENTS	
Focus group interview 1	Participants 6, 7 and 8, engineering students
Focus group interview 2	Participants 9 and 10, IT students
PROFESSORS	
Interview 1	Participant 11, professor in IT

4. Findings

In this section, the findings of the interviews are presented under the three sub-themes related to the applied theoretical main concepts: mutual engagement, joint venture and shared repertoire (Wenger, 1998). Etienne Wenger's *Communities of Practice; Learning, Meaning and Identity* was applied as the main conceptual frame for the analysis of the gathered empirical data, specifically using the main characteristics of a community of practice, mutual engagement, joint enterprise and shared repertoire.

Table 2: Participant responses regarding mutual engagement, joint enterprise and shared repertoire

THEME	EXAMPLES OF CITATIONS
Mutual engagement	'Yes, I'm a private company. I need money, so I don't want to spend my time training students as a charity.' (P5)
	'…not all students find it easy to find companies that need trainees. Like right now, I know students who are still looking for companies to get them as a trainee; they haven't found it.' (P9)
Joint enterprise	'Yes, because at the first step, when the students want to go to search for a company to get the training, the students don't know where to go.' (P1)
	'…you have to have a training [course] that is related to your studies, that's basic and the most important thing.' (P2)
Shared repertoire	'…we have a huge gap for the students graduating from the university. We are suffering from this, we are hiring fresh graduates and we are waiting for a year for them to produce for you. So, we are suffering from this because we are working with the latest equipment.' (P1)

These dimensions were used as a framework for the analysis, aiming to discover what challenges exist between companies and students in relation to traineeships in Jordanian universities. The concept of digital habitats was used as a technological perspective on how elements from a potential trainee portal can support traineeships (Wenger, 1998).

4.1 Mutual engagement

In the interviews conducted with companies, the representatives expressed the belief that time is an important factor for them and that a traineeship therefore should create value for them in order for them to invest time into it. Participant 5, the owner of a private company, said,

> *'Yes, I'm a private company. I need money, so I don't want to spend my time training students as a charity.'*

In relation to his earlier experiences with students as trainees, Participant 5 has chosen to terminate the entry of trainees, since he experienced a lack of engagement from the students, who did not take the traineeships seriously. Participant 1, a technical manager in a company, recognises Participant 5's perception of the students regarding their lack of engagement, saying,

> *'…maybe if we each year have 100 graduates from the university, maybe two or three, let's say five, take it seriously.'*

The companies' perceptions of students can be regarded as a barrier for students in getting into traineeships, a consequence of which can be that companies stop hiring trainees. Regarding this trend, an IT student, Participant 9 said,

> *' …not all students find it easy to find companies that need trainees. Like right now, I know students who are still looking for companies to get them as a trainee; they haven't found it.'*

If this bias exists due to companies' negative experiences regarding previous trainees' lack of commitment, the previous trainees' disengagement can be considered an indirect barrier for current students entering traineeships. However, Participant 1 believes that the students' lack of commitment is, in fact, an expression of the actors' common understanding of traineeships as not being serious;

> *'It is a mutual relationship. The students know that we are not serious, and we know the students are not serious.'*

This indicates that none of the parties involved are truly engaged in the trainee course. The lack of engagement can therefore not be attributed to the students alone, but rather as a mutual feeling. According to Wenger (1998, p. 74), what defines a community of practice is the members sustaining close 'relations of mutual engagement organised around what they are there to do'. When this does not occur in a trainee course, the development of a community of practice is difficult, since the formation of a community of practice is, by definition, always a matter of mutual engagement (Wenger, 1998, p. 73). This creates an interesting question as to which factors underlie this lack of mutual engagement. The next section will therefore examine this matter.

4.2 Joint enterprise

One of the possible reasons for this lack of mutual engagement could be that the negotiation of a joint enterprise has not occurred between the actors. The content of the trainee course is not always related to the students' subjects. Participant 2, a key account manager in an IT company, describes what is most important for a traineeship:

> *'…you have to have a training [course] that is related to your studies, that's basic and the most important thing.'*

Participant 1 also highlights the issue from his point of view:

> *'…if there's real cooperation between the university and the companies here, there needs to be a list of all companies and a pre-request from each company on what courses the students have to finish before entering the training … But there's no such cooperation, maybe this will improve the outcome of the training.'*

Without cooperation, there is no joint enterprise, which is developed through collaboration and is the result of the collective negotiating process defined by the participants as they exercise it (Wenger, 1998). Such a negotiation process is usually a prerequisite for the practice to become meaningful to the actors involved and often deals with the conditions, resources and requirements of the practice (Wenger, 1998). If the trainee programmes do not match the students' programmes, a joint enterprise has not been negotiated in relation to traineeships. Joint enterprises help to create relationships of mutual responsibility that become an integral part of the practice (Wenger, 1998). When the content of traineeships does not match the students' fields of study, it can be assumed that the trainee course does not make sense to the students and that the sense of responsibility thus does not arise, affecting their engagement.

The data revealed another possible reason for the students' lack of engagement and inability to find traineeships related to their fields of study. Students apparently have trouble finding a company that matches their qualifications. When questioned about how the students get in contact with the companies, Participant 5 said:

> *'There is Google Search; they can search for factories online. A list of all the factories in Jordan, it's mentioned, but you don't know the level of the factory, the size there.'*

One apparent challenge is that students do not have adequate knowledge of the companies, as only limited information is available online. Regarding this, Participant 1 said:

> *'Yes, because at the first step, when the students want to go to search for a company to get the training, the students don't know where to go.'*

Participant 1 also confirmed that the students do not know where to find potential companies for traineeships. He said:

> *'…it is like a self-effort, he [the student] will go and search, and maybe he's a mechatronics engineer and he will go and train a more mechanical field or not in his field.'*

When the students lack access to sufficient information regarding companies that match their qualifications, they may end up in traineeships that are irrelevant to their fields of study, which can have negative consequences on their engagement.

4.3 Shared repertoire

In the interview study, the participants expressed their feelings that the students are not being adequately prepared for the labour market during their education, which means that companies must spend time and resources on preparing the new graduates for the work they are supposed to do. Participant 1 said:

> *'Yes, there should be intermediation between the students. You know, we have a huge gap for the students graduating from the university. We are suffering from this. We are hiring fresh graduates and we are waiting for a year for them to produce for you. So, we are suffering from this because we are working with the latest equipment.'*

Participant 1 explained how it is a challenge for businesses to invest up to one and a half years to develop the graduates to the point where they are ready to work independently. This may mean that repertoire between the programmes and the companies will not be developed. The empirical evidence showed that the university curriculum is not updated at the same pace as the labour market is evolving. Participant 8, who is an engineering student, said:

> *'…some courses need to be updated or even eliminated, because in the mechanical department, for example, they have some stuff about the training from before 100 years ago. Why do I have to study this? It's not even here anymore.'*

Participant 8 believed that part of the learning that takes place at university is irrelevant to the labour market. In line with Participant 8's comments on the courses at the university, Participant 1 said this about the technology used in the programmes:

> *'More general and old … So if time is going [forward], the gap will increase and the educational courses are not developed faster.'*

According to Participant 1, the gap between the programmes and the labour market has only deepened as the technology applied to the labour market continues to develop rapidly while the content of the teaching at universities stands still. A shared repertoire consists of a set of common resources, such as 'Routines, words, tools, ways to do things, stories, gestures, symbols, genres, actions or concepts that the community has produced or incorporated into during its existence and which have become part of its practice' (Wenger, 2004). If the curriculum of the programmes is not updated in relation to the development of the labour market, it can mean that the newly graduated students do not master the same repertoire that prevails in the workplace. This means that a shared repertoire must be established between the newly graduated students and the workplace, which requires time and resources (Wenger, 2004). There can often be a great distance between theory and practice, and updating the curricula of the programmes is not necessarily sufficient for the establishment of a shared repertoire between the students and the labour market. The students require the opportunity to apply theory in practice during the study period at the university. However, it seems from the empirical evidence that the teaching is not arranged so that the students are given the opportunity to apply this theory in practice. Participant 2, a key account manager said based on his previous experiences as a student on the same institution:

> *'…the actual trainings and applying what you study is missing, because when you train for something in a theoretical way, you have to apply it in order to remember it, always, and actually know the benefit of what you are learning at the university.'*

Participant 11, an IT professor, confirmed the lack of theoretical application in practice. When asked what she thought was one of the biggest challenges related to preparing students for the labour market, she responded:

> *'I think it's the practical part. We were in a meeting yesterday with the president, and he was basically recounting that you have to prepare students for the practical market, even in the most theoretical issues. We need to be more practical, give the students more lab issues, even in our courses … Like, let's present more case studies, get more people from the industry into our work, so I think this is a bit challenging and it needs a lot of work…'*

These quotes indicate that students lack sufficient opportunities to test the theories that they are taught, which can be a challenge to the development of a shared repertoire between the students and the companies. With such a starting point, it is essential to establish one singular community of practice that produces successful traineeship, since the students largely assume that they are receiving traineeships matching their fields of study. A digital solution that can support such a match is a relevant contribution towards the development of one singular community of practice.

5. Discussion and conclusion

The findings in this study concluded that under the present circumstances, there are numerous challenges that hinder the development of a community of practice based around existing traineeships between companies and students; these challenges are summarised in Table 3. These findings will be discussed in relation to perspectives regarding methods for developing digital tools to create a shared understanding and engagement between companies and universities.

Table 3: Barriers, potentials and future digital tools to support collaboration between companies and students

THEME	Barriers	Potentials	Digital tools
Mutual engagement	It is a challenge for students to find companies that match their qualifications and for companies to find students with the right qualifications.	Students are highly interested in finding companies that match their profile.	Digital platform where students and companies can study each other's profiles and contact each other before applying.
Joint enterprise	Collaboration lack between universities and industry in matching student competencies with needed competencies in companies.	Matching student competencies with needed competencies in companies will make traineeships more relevant and engaging.	A mediator who through digital platforms and contact to industry can map what courses students' needs to complete for the specific company to hire them as trainees.
Shared repertoire	Lack of courses and training in the newest technology. Lack of equipment.	Industry is interested in training students at university to avoid gab training gab in competences and costs of training graduated students.	Online and physical access to training in new technology and methods though e-learning platforms or centres established at universities in collaboration with industrial partners.

The analysis revealed that there is a lack of mutual commitment towards traineeships from both the students and the companies. The companies find that the students are not engaged in the traineeship or do not take it seriously when they are hired. However, they recognise that there is often a mutual approach and understanding towards traineeships that negatively affects the involvement of both parties. It can also be concluded that some of the problems relating to traineeships do not exist within the actual trainee course but rather outside of the course. This is found, among elsewhere, in the framework of a traineeship. It turns out that students frequently end up in a trainee course that is unrelated to their field of study. It is a challenge for students to find companies that match their qualifications, as students often use Google Search to find potential companies to hire them in traineeships. Apparently, the available information is often insufficient to know whether the companies match the students' qualifications or fields of study. There is no common negotiation for traineeships, which affects the students' engagement, since they see no meaning in the content of the trainee courses. Furthermore, empirical evidence shows that the curriculum at universities is obsolete in relation to labour market developments, causing a significant gap between the two parties. A shared repertoire is thus not developed between working life and academic life, resulting in the students and the companies speaking two different languages in a figurative sense.

One way to support the students' commitment and, thus, the development of a practice community is the creation of better opportunities for students and relevant companies to more easily find each other. One action could be to create a trainee portal containing a database where students could find the necessary information about companies and more easily search for applicable positions, while companies could also find the profiles of students. In the interviews, students stated that there is a need for a digital intermediary that can connect students with companies. According to Wenger et al. (2009), technology can contribute towards making a community visible. In this case, a trainee portal with an online database could make a company's practice visible to students who can apply for traineeships and add companies that are not already in the database. It could help the community grow larger if the students attain the outcome of ending up in the right traineeships. Wenger et al. (2009) said that technology provides tools for individuals by filtering information to meet one's needs; for example, to locate other networks and find relevant activities. A database could enable filtering, localisation and networking and thereby could promote mutual engagement. Furthermore, it would help simplify the search for relevant companies in relation to a student's field of study.

Wenger et al. (2009) said that technology introduces new opportunities and challenges for a community of practice, but it is worth mentioning that the trainee portal as a solution by itself to some of the challenges that emerge from the analysis could be problematic. Regarding this, there are several possible strategic considerations. An online community practice simultaneously requires an offline practice with mutual engagement (Wenger et al., 2009). If this mutual engagement does not exist among the players offline, it is difficult to predict whether the trainee portal could alleviate the lack of mutuality commitment or whether it is essential that the engagement regarding traineeships is first strengthened offline in the practice itself. Another relevant consideration is that the analysis emphasises how a trainee portal can act as a communication tool between universities and companies to enhance communication between the two actors. Therefore, the student's role does not remain that of a *communicator intermediary* between parties. This communication between universities and companies should ideally strengthen the responsibility of all three parties. This requires that students, university administration and faculty members as well as companies are involved in the communication and signing of contracts. Further studies and research-based development of educational approaches and tools are needed to address the barriers identified in this paper.

Acknowledgements

The research outlined in this paper was financially supported by the Erasmus+ project *METHODS*.

References

Alkoudman, R. M. and Elkalmi, M. (2015) 'Challenges to Web-Based Learning in Pharmacy Education in Arabic Language Speaking Countries', Arch. Pharma. Pract., Vol 6, No. 3, pp. 41–47.

Al-Salaymeh, A. and Ghanem, W. (2014) Modernization of Teaching Methodologies in Higher Education: EU Experience for Jordan and Palestinian Territory. METHODS, Erasmus+.

Baden, M. S. and Major, C. H. (2004) Foundations of Problem-based Learning, Open University Press.

Braun, V. and Clarke, V. (2006) 'Using Thematic Analysis in Psychology', Qualitative Research in Psychology, Vol 3, No. 2, pp 77–101.

Brinkmann, S. and Kvale, S. (2009) 'Interview- introduktion til et håndværk', Hans Reitzels forlag. (2.udg.).

Britz, J. and Richard, N. (1992) 'Problem Solving in the Early Childhood Classroom', National Education Association of the United States: Washington, D.C.

Burns, A. (1992) 'Teacher Beliefs and Their Influence on Classroom Practice', Prospect, 7, pp 56–66.

Chadraba, P. and O'Keefe, R. (2007) 'Developing Graduate Marketing Programs for Economies in Transition', Journal of Marketing Education, Vol 29, No. 3, pp 218–223.

Graff, E. D. and Kolmos, A. (2003) 'Characteristics of Problem-based Learning', TEMPUS Publications.

Garett, T. (2008) 'Student-Centered and Teacher-Centered Classroom Management: A Case Study of Three Elementary Teachers', Journal of Classroom Interaction, Vol 43, No. 1, pp 34–47.
Hmelo-Silver, C. E. and Barrows, H. S. (2006) 'Goals and Strategies of a Problem-based Learning Facilitator', Interdisciplinary Journal of Problem-Based Learning, Vol 1, No. 1.
Khader, F. (2011) Strategies and Roadmap for Effective Higher Education in Jordan. ICET Conference, Vol 1, No. 1.
Kvale, S. (1994) Interview. En introduktion til det kvalitative forskningsinterview. København K: Hans Reitzels Forlag.
Kvale, S. and Brinkmann, S. (2015) Interview - Det kvalitative forskningsinterview som håndværk. København K: Hans Reitzels Forlag.
Mahrous, A. A. and Ahmed, A. A. (2010) 'A Cross-Cultural Investigation of Students' Perceptions of the Effectiveness of Pedagogical Tools, The Middle East, the United Kingdom, and the United States', Journal of Studies in International Education. Vol 14, No. 3, pp 289–306.
Plush, S. E. and Kehrwald, B. A. (2014) 'Supporting New Academics' Use of Student Centred Strategies in Traditional University Teaching', Journal of University Teaching & Learning Practice, Vol 11, No. 1.
Russell, H. H. (2004) 'Connections among Factors in Education', Curriculum Inquiry, Vol 34, No. 3, pp 267–282.
Saleh, A. M., Al-Tawil, G. and Al-Hadithi. (2012) 'Teaching Methods in Hawler College of Medicine in Iraq: A Qualitative Assessment from Teachers' Perspectives', BMC Medical Education, Vol 12, No. 59.
Seidman, I., (2006) Interviewing as Qualitative Research: A Guide for Researchers in Education and the Social Sciences, (3rd ed.). New York: Teachers College Press.
Sungur, S. and Tekkaya C. (2006) 'Effects of Problem-Based Learning and Traditional Instruction on Self-Regulated Learning', The Journal of Educational Research, Vol 99, No. 5, pp 307–320.
Tubaishat, A., Bhatti, A. and El-Qawasmeh, E.E. (2006) 'ICT Experiences in Two Different Middle Eastern Universities', Issues in Informing Science & Information Technology, Vol 3, No. 12, p 667.
Wenger, E., (1998) Communities of Practice – Learning, Meaning and Identity, Cambridge University Press, New York.
Wenger, E. (2004) Praksisfællesskaber - Læring, Mening og Identitet, (1.udg.). København K: Hans Reitzels Forlag.
Wenger, E., White, D. and Smith, J. D. (2009) Digital Habitats: Stewarding Technology for Communities, CPsquare, Portland, OR.

Student Engagement, Mobile Technologies, and Changing Curriculum Delivery

Jeffrey Boehm and Neil Glen
Learning Technologists, Bath Spa University, UK
j.boehm@bathspa.ac.uk
n.glen@bathspa.ac.uk
DOI: 10.34190/EEL.19.079

Abstract: This paper is a case study describing the roles of students in research implementing mobile technologies in acting, dance, and visual arts classrooms at a creative arts university in Southwest England. Students and staff worked with the researchers implementing mobile technologies in a variety of classroom settings, including demonstration and performance studios. Using notions of community, consumption, exchange, and division of labour from Engstrom's Activity Theory as the basis for our approach, we worked alongside students and staff in active settings, developing and then adapting implementation in a fluid exchange between the members of each classroom community. Students were involved in at least three ways: as classroom participants providing verbal feedback, as classroom participants utilising the tools, and as Student Fellows (SF). The methods for obtaining student feedback ranged from semi-structured verbal feedback (which was recorded on video), feedback obtained while the tools were being used, and post-session observations from the Student Fellows. Class activities were also recorded using a static video camera. The tools included: iPhones, iPads, Android tablets, projection devices (projectors and large-screen TV's), and the virtual learning environment. In this paper we explain the three primary phases of our research, then we examine the various ways in which we engaged students to further develop the implementation of the technologies, and lastly, ways in which we saw development of the delivery of the curriculum.

Keywords: mobile technologies, student engagement, activity theory, visual arts, performing arts

1. Background

This paper discusses a project funded by a grant from the Higher Education Funding Council England (HEFCE) to implement mobile technologies in several classrooms in our School of Art & Design (AD), and the School of Music and Performance (MP). This project was driven by earlier research in which the authors engaged with a lecturer in AD who wished to project streaming video while also make recordings of a demonstration lecture (Boehm and Glen, 2017). The two primary aims & objectives for the project were:

- To further prior research by extending the use of mobile digital tools and co-creation to enhance student engagement in performance and demonstration-oriented learning environments.
- To assess the impact of the digital tools identified in our initial work, using action-based research methods, upon student engagement, understanding, and recall.

1.1 Mobile technology in Higher Education (HE):

Current research using mobile learning technologies covers a variety of approaches to mobile learning, also known as m-learning. This variety leads to difficulty in defining exactly what m-learning means (Rossing, et al. 2012). Vavuoula, et al (2009) explored the use of a mobile phone service that helped students gather information using inquiry-led learning during a museum visit. Ahmed and Parsons (2013) examined student use of an app in scientific abductive inquiry investigations. Huddy (2017) has been working with various platforms designed specifically to manage mobile device video of dance classes and performances. Use of the iPad in classrooms has been on the rise since its inception in 2010 (Rossing, et al, 2012), and has seen integration across 'multiple epistemological domains' in higher education (HE) because its uses align so well with the constructivist model of education. (Mavri, et al, 2018, Wheat, et al, 2018; Kong, S. C. & Song, Y, 2013). Indeed, Harvey & Smith (2014) report that the iPad is 'the most widely used devices on campus'. Most of the research on mobile technologies that we surveyed refers to the use of personal devices such as Apple's iPad or a mobile phone in the classroom or other educational setting in order to allow the student to engage more deeply with the content of a lesson or subject.

It is in this context, the notion that the use of mobile technologies could help to enhance the student experience in a wide range of classrooms by affording them different opportunities for reflection and engagement, that we constructed our implementation of mobile technologies for this project. As Leijen, et al (2009, p. 169) point out: 'Reflection stimulates students' awareness of their body and movement experiences, which is necessary for developing high-quality dance skills. . . reflection is essential for students to learn how the audience may perceive their performance or choreographic work.'

2. Activity theory and convergent technologies

2.1 Theoretical framework

Cultural Historical Activity Theory (CHAT) is a form of Activity Theory developed primarily by Yrjö Engeström (2015). It is built upon the works of Vygotsky and Leontév. CHAT is predicated on the notion that there are contradictions which arise in the functions of any given community, such as a workplace or school. A contradiction is something that becomes evident when there is stress in a community, often because it is encumbered by inefficient working methods. When the members of a community wish to improve upon those contradictions, then they must identify the cultural and historical reasons that they exist in order to improve the current conditions. The role of the researcher in CHAT is to work with the community to identify, and then to develop new tools in order to change the conditions created by the contradictions. A 'tool' is generally a method of working, which could include a literal tool such as a mobile device. CHAT is a flexible framework that adapts methods appropriate to the given study.

There were a few contradictions that led to this study:

- Students in demonstration settings had no access to the demonstrations outside of the classroom because there had been no recordings made of the demonstrations so they were relying solely on memory.
- Performance students were only able to self-assess their performances in real-time, thus inhibiting their ability to provide quality feedback for themselves and to peers.
- Students in making classes were often unable to see the details of a demonstration because there would be too many students crowded around a small workspace.

The overarching purpose of the study was to mediate these situations and to identify where students and staff would take advantage of the affordances offered by mobile technologies to increase their engagement with learning.

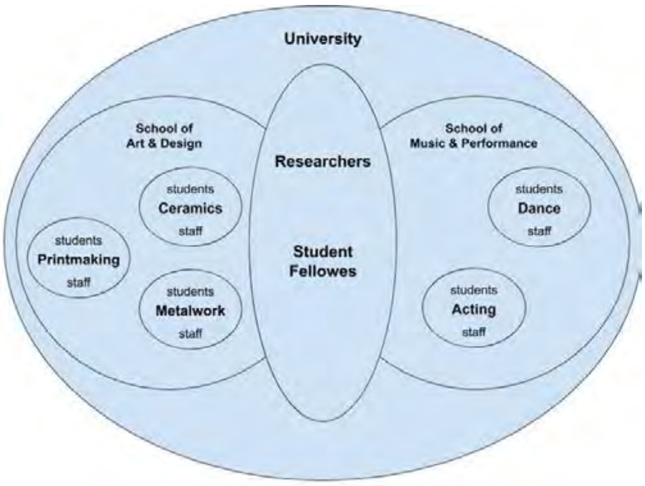


Figure 1: Illustration of the community

The notions of CHAT drawn upon in this paper are that of *community, subjects, tools, object, consumption, exchange, division of labour and outcomes.* In some ways the description of community in this instance is somewhat complex, but is probably best comprehended by the diagram in Figure 1. The members of the community include the university community. The students enrolled in the modules, student fellows, staff, and researchers are the subjects. The tools are the pieces of technology used in the project. Object is the use of mobile technology used to enhance student engagement. Consumption refers to the use of the technologies described above. Exchange will cover the interactions of the members of the community regarding the tools. Discussion of the division of labour will focus on who did what with the technologies. All of these elements draw together to form outcomes (see Figure 2). This case study will serve to illustrate both the explicit and implicit roles students played during the implementation of the mobile technologies in their classrooms.

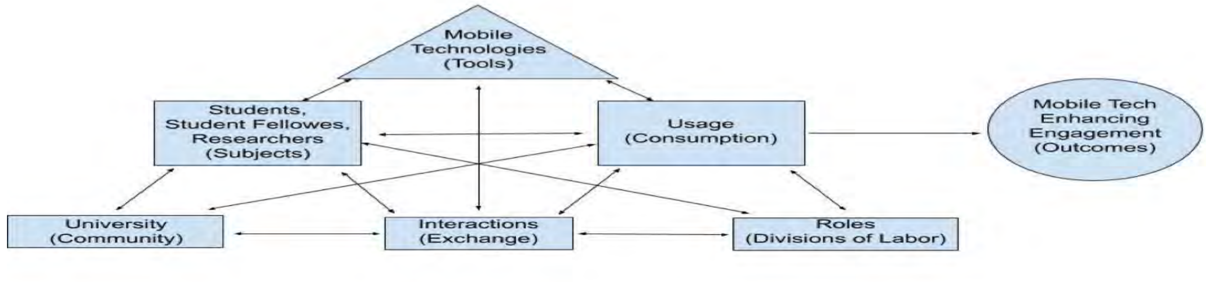


Figure 2: Interrelations of the elements of activity theory

3. Method

Selection of Subjects: The selection of the student subjects was a result of their enrolment in the chosen modules. The choice of modules was the result of a call for participation by university staff, including technical demonstrators. Staff had to agree to the use of mobile technologies in their classroom, and to work with the researchers, student fellows, and their own students in order to prove or disprove the viability of using those technologies. The student fellows were chosen through another call that specified 2nd-year students who: would serve as research assistants, actively engage with students and staff, and would be responsible for setting up the data collection camera. All participants signed an agreement verifying their willingness to be filmed for the purposes of data collection and possible conference presentations.

Technology: While differences in the types of classroom predicated the ways in which the technology was utilised, the fundamental setup was the same for each space: iPads, large screen TVs, and the virtual learning environment via Panopto. The technical demonstration settings used the standard Apple software to record and project classroom activities, while the performance modules used the Coach's Eye app as a means for recording and assessment.

Application of the Technology: Technical demonstrations consist of hand manipulation of materials and tools (such as etching plates, printing presses), hand built and slab constructed ceramics, and metalworking processes and tools that are difficult for everyone in a large group of students to see. In these spaces we projected the real-time images of the activity on a large screen on a mobile stand. The streaming projections were recorded simultaneously. These recordings were then uploaded to our VLE via the Panopto app for reference. The nature of performance necessitates students viewing their performances historically. The recordings, also projected on large screens, were used as a tool for peer and self-evaluation and discussion in class. These were also uploaded to our VLE via Panopto, but were used for further individual and small group evaluation.

Data Capture: The data was collected through video recordings, informal and formal interviews, and observation notes. We utilised two approaches to capturing video, a fixed camera and additional mobile devices which were used by the researchers and student fellows. The fixed camera was set to capture as much of each learning space and activity as possible, allowing us to view student activity that we may have not otherwise observed. This camera was purely for data collection and was not to be used as a tool by the classroom students or staff. The mobile devices were used to capture specific moments. This footage was randomly obtained by both the researchers and the student fellows, but was targeted to specific activities, such as students utilising the technologies away from a staff-led activity. At the end of each performance session, the lecturers and researchers would ask the class as a whole for feedback regarding that day's activities, the feedback sessions being captured on the fixed camera. After each session, the student fellows, staff, and researchers, compared notes about their own observations and then catalogued them in a Google doc. At the end of the project, students, staff, and student fellows were asked for their opinions and observations regarding the use of the technologies in their classrooms.

4. The performance students

This group consists of two subsets: actors and dancers. We used mobile technologies and projection to record their in-class performances and then used those recordings for formative assessment. The app used for these sessions is called Coach's Eye (TechSmith Corporation, 2018). It is designed to analyse athletic performance and features the ability to scrub through a video, to watch the recordings in slow motion, and to mark the video much as a sports analyst on television would do. The performers worked small groups of two to five students. At the end of term, students used the final recordings for a marked self-assessment. The two lecturers used the tool in different ways, however.

The dance lecturer recorded the small groups and then took each group over to the large-screen television to walk them through an assessment session, working to engage the students in the conversation. After the class, the video footage was then uploaded to our VLE and the students used that stored footage for further self-assessment which they did through journaling. The acting lecturer also recorded the small groups, but at the end of the class session he would choose one group to critique in front of the entire class. He also uploaded the footage for self-assessment to the VLE, but used it for formative assessment during individual tutorials later.

The dancers were uniformly positive about the implementation of mobile technologies in their classes. None of them had previously experienced seeing video of themselves dancing for anything other than a final performance. They said that they found the ability to view their actions in slow motion and to scrub back and forth to be very helpful. They did not find the drawing tools to be very helpful when they used the app without the lecturer, but thought that they were somewhat useful when the lecturer used them.

The actors, on the other hand, were of mixed minds on the usefulness of these tools. Most, like the dancers, expressed that the tools were very helpful and could see themselves using them more. A few did not find the exercise of watching the lecturer assess a group that was not their own to be very helpful. Some expressed ambivalence about the technology, but only after a couple of them voiced their dislike of watching a group that was not their own. Before that, the conversation started with mostly positive affirmations. Interestingly, the most vocal of the naysayers also admitted to having an extremely limited attention span that could not cope with something that she could not see as being directly relevant to her. However, the strength of her personality seemed to drive several people to slightly alter their opinions. That is an interesting insight into how the strength of one personality can affect the notion of effectiveness of an activity. However, in the end most agreed that it was worth pursuing the application of the technology, but perhaps by using it in a more targeted approach. This resolution from the students encouraged the lecturer to want to make adjustments to the implementation of the technology in his curriculum.

In both instances, the students readily embraced giving the technology a shot throughout the process. Neither was there any reticence to use it. When students were asked to use the mobile devices to film other students, there were always volunteers. The only caveat was one student in acting who did not wish to see himself on the large screen. He said that he had no problems viewing his performance on a computer screen, or on a mobile device, but it was seeing a large representation of himself that he could not handle.

Because mobile devices are commonly used by most students, when we put the devices in their own hands they had no problems putting them to use. Indeed, when we gave the devices to the actors to work with while they worked on their own, they got into a fair amount of silliness with them, taking goofy pictures and videos, which they mostly deleted before handing the devices back. “Our generation who have grown up, well throughout our teenage years, with the technology . . . I don’t think there’s boundaries. . . may have just seen the iPads as more for downtime”. Unfortunately, the acting students did not utilise the devices as we thought that they would, using them as tools to assess and refine their performance tasks for that day. As one observed, “I’m not sure it worked so well when they split into little groups with the iPads, they were laying on the floor, I’m not sure how much they engaged with the technology. But on the big screen they were quite engaged”. However, we observed the opposite with the dancers. The groups would take the devices to a corner, pull out their notebooks and pens and then write their observations. They were eager to get to the task at hand.

5. The visual art students

The use of mobile technologies in the visual arts was for very different purposes. Whereas the performers were using them as a tool for self-assessment, the point of the technologies in visual arts was twofold: 1) to aid in the presentation of technical demonstrations by enabling detailed instruction to be visible to a wider group of students and 2) to provide the opportunity for students to review the instructions when they were doing their own work outside of the class. The video footage of the demonstrations was uploaded to our VLE and the views were tracked to see if they were being accessed. The technical demonstrations took place in three different classrooms specific to the medium: metalworking, printmaking, and ceramics.

The students were positive about the potential of being able to have the sessions recorded, they thought being able to see the processes in detail on a large screen was exciting. They were positive about having the material available in the VLE. One of the demonstrators was also excited about being able to allow the students to get close up to the techniques and was open to exploring the technology, however they were conscious that the session was being filmed, and felt awkward about language or recognising that the demonstration contained mistakes commenting “ignore that bit” or “we can edit that later”. This uncertainty left the students unclear about the role of technology in their teaching. The hands-on nature of the work, and the opportunity for discussion and peer review within the cohort limited the engagement with recorded materials. Some people found it really useful. Some people, who might have been at the front anyway, so they could see what was going on would say, ‘Oh, I didn’t see the benefit of it’.” The student fellow encouraged some students who had missed some of the demonstrations to use a tablet and review material recorded earlier, they actively engaged with this, talking to each other and pausing, replaying the material as they worked through the task. “People that were, like, more involved in the demonstrations, helping out and things, didn’t feel the need for it because they could recollect things. They didn’t feel the need for it as much as the quieter students at the back.” Students who were less engaged found the recordings useful, “A couple of them (quieter students) were saying that it was helpful”.

The demonstrator was not used to using a live visual aid and, despite an having undertaken a familiarisation session in advance, defaulted to previous instruction techniques such as telling the students to take notes. This created tension for students between watching the demonstrator, viewing the demonstration on the screen, and taking notes. The students were reluctant to film anything, mainly because they had been instructed to take notes. The proximity of the demonstration to the screen changed the way the student viewed the screen, with a bias toward viewing the activity directly if possible. When students used the recording to substitute for missing the original demonstration they were somewhat confused by the recordings because they were missing the contextual information. In sessions designed for small groups of students, due to health and safety constraints of the workshop, the potential benefits of viewing processes via the screen was diminished. The instruction had been designed to enable students to complete the assigned tasks within the session, so the need to reflect and review was minimal. Since the workshops are only open to students when the technicians are present there was little need to review the online material as it was easier to ask the technician. For the later ceramics sessions, we switched from a tablet to an iPhone in a ruggedised case mounted on a GorillaPod. The demonstrator was comfortable grabbing this device with clay covered hands and putting it down close to the workpiece, adjusting the position until the key part of the work was on screen. This demonstrator felt more confident using the technology and directing the students to view the techniques being demonstrated on screen. The students who were in the back were then able to view the process on the screen. Examination of the analytics from our VLE showed very limited engagement with the videos outside of the class sessions.

6. The student fellows

In addition to setting up equipment and filming examples of student interaction with the technologies, the role of the SF was to help to break any possible conceived barriers between the students and the researchers. As one of them said in the post-interview, “I feel like . . . from my perspective. . . the other students would be more willing to speak to another student. . . a fellow student is more approachable.” The SF were quite willing to throw themselves into the processes of using the technology as well as helping the students to use the technology. There were more opportunities for the latter in the Visual Arts classes because student work was individual and they could immediately refer to the demonstration videos as they worked on their pieces. One of the SF assigned to the visual arts classes stated, “A couple of times in the session . . . where they were using playbacks of videos of demonstrations I was able to step in and show them how to use it, or just ask them their opinions if they thought it was useful and working in the space.” In the performance classes, the students were able to access the videos immediately because the iPads were assigned to specific groups and students worked with the footage immediately.

Some of the SF perceived that their participation was also useful for eliciting student feedback. “I think it was good to have someone to interact with the students, ask them questions and prompt them. It was better than having them respond to a questionnaire, you could get a better feel for how they were feeling about it.” We observed that not all of the SF were as willing to engage with the students as much as they were willing to do task-oriented assignments, such as filming specific groups and handling the equipment. Those who did interact with the students felt more a part of the project: “I felt more a part of the research team. I felt very much involved in the whole process.”

SF were helpful with some of the finer points of the filming of the assessment pieces, particularly in performance. For instance, in dance we made adjustments to the filming of the groups by filming into the mirror rather than directly at the groups from the front. This was necessary because if the group spread out too much, or moved out of the range of the iPads, we lost some of the performance. In acting, students filmed the performances using the iPads, but our SF would check on their positioning and suggest moving if they were not getting a good capture.

Insights from the SF will be helpful in the future, and also verified some of our own observations. One of the insights was about training on the kit, which is kind of alluded to in the above paragraph. Because the technology was primarily familiar in daily practice (iPads and iPhones), we elected to not have any training sessions so that we could see how the students would incorporate the technology based upon their own experiences. However, one SF observed, “It might have been helpful to set up getting the students to interact with the technology more (rather than just leaving them to it).” They had similar observations about some of the staff, “I think that it does take a lot of cooperation, willingness, from the staff to gain the most from it. They need to really think it through.” This observation made us think that perhaps we could have done a bit more to help the staff with that aspect.

7. Discussion

Our goal to enhance student engagement in performance and demonstration-oriented learning environments through co-creation met with mixed results. Students in AD were significantly less willing to take control of devices and utilise video artefacts than students in the performing community. Comments from the SF provided some insight into this phenomenon: ‘(Performers) are more used to analysing specific moments . . . that’s built into their [performer’s] teaching to begin with. . . where they finish a performance and then they all reflect on it together. Whereas with the Art & Design courses it was introducing something completely new.’ Unlike in our prior research (Boehm & Glen, 2017), the AD students would not even take the iPad to record demonstrations. However, some did engage with the iPad on a limited basis during work sessions in order to review techniques or procedures. Even fewer of them engaged with the footage outside of sessions. One of the SF in visual art thought the videos might be helpful in the 2nd and 3rd year: ‘It might be good to have the videos available in later years to refer back to, after not having been involved with the process. More long-term future use, than immediate.’

We were expecting to have more moments of exchange with students regarding the usage of the technologies, hoping that they would take more agency in the division of labor within the classroom curriculum. Although the actors, as discussed above, had some comments about the way the technology was used, on the whole they were pleased with it. The dancers had little to say about the way that it was employed in their module, although the dance lecturer had some ideas about restructuring the curriculum to better facilitate the student’s capabilities to discuss the videos on a deeper level. She decided that in the next iteration she would construct a more apparent ladder beginning with lecturer modelled discussion leading to student-led discussion. Regarding the app, Both actors and dancers found the basic functions of Coach’s Eye, (i.e., the playback and scrub features) to be quite useful, but did not see the usefulness of the drawing tools. We were surprised that nobody in either sub-communities reported downloading the app to use independently: ‘£5 for an app! That’s expensive!’ The one moment of true agency was when the dancers requested that Coach’s Eye be used in their technique module as well. The lecturer liked the idea, and mentioned that she have to give some thought as to how to incorporate it into that curriculum.

These issues appear to be a result, at least in part, of cultural-historical practices. The students were in the first term of Year 1 modules, so any reticence could be a reflection of a lack of a sense of agency in the processes of their own education. It is not out of the question that they are still thinking within a teacher-centred context and not yet comfortable with exercising their own agency, even when asked. Review of the timeline video did reveal key moments where AD and dance students used the technology independent of instruction. In these moments, the students made use of the captured material for self-directed review and reflection, which was not in the scheduled curricular activities of the class. In this way, they were beginning to reshape the delivery of content by taking agency when the class structure provided unscheduled opportunity.

The smaller number of students and space limitations in the metalworking shop, made the mobile technologies unnecessary. The staff member in printmaking did not grasp the possibilities of the technology, so the effectiveness there was limited. The ceramics demonstrator made good use of the technologies, adapting delivery methods to the affordances of the technology as he became more familiar with them. As with the acting and dance lecturers, this demonstrator expressed a desire to continue developing the curriculum to adapt the technologies in a meaningful manner because they felt that the students were benefiting from them.

Further exploration of the application of mobile technologies in some of these settings is clearly warranted. As stated above, three of the staff believe that its use is valid for improving the student experience and helping them to engage deeper into their own understanding. The use of CHAT as a framework for exploration enabled the researchers to gain further understanding of some barriers to creating whole community engagement in the adaptation and consumption of these tools.

References

Boehm, J.D. and Glen, N. (2017) 'Converging lines: Apple's iPad and active learning in higher education'. In Baab, B.F., et al (eds). *Proceedings of the 2nd International Conference on the Use of iPads in Higher Education*. Cambridge: Cambridge Scholars, pp. 63-77.

Engstrom, Yrjo. (2015) *Learning by Expanding: An Activity-Theoretical Approach to Developmental Research*. 2nd edn. Cambridge: Cambridge University Press.

Harvey, Fiona and Smith, Tamsyn (2014) *iPads coffee & cake: becoming experts together. Informal learning at the University of Southampton*. iPADs in Higher Education. 20 - 22 Mar 2014. 22 pp .

Huddy, A. (2017) *Digital technology in the tertiary dance technique studio: expanding student engagement through collaborative and co-creative experiences.* Research in Dance Education, 18:2, 174-189, DOI: 10.1080/14647893.2017.1330327

Leijen, Ä. (2009). 'Acknowledging practice: The applications of streaming audio and video for tertiary music and dance education'. In: *Proceedings of the 9th IEEE International Conference on Advanced Learning Technologies: The 9th IEEE International Conference on Advanced Learning Technologies*; Riga, Latvia. IEEE, 2009, 101 - 103.

Leijen, Ä., Lam, I.,Wildschut, L., Simons, P.R.J., Admiraal, W. (2009). *Streaming video to enhance students' reflection in dance education.* Computers and Education, 52(1), 169 - 176.

Kong, S. C. & Song, Y. (2013). *A principle-based pedagogical design framework for developing constructivist learning in a seamless learning environment: A teacher development model for learning and teaching in digital classrooms*. British Journal of Educational Technology. Nov 2013, Vol.44Issue6, pE209-E212.

Mavri A., Ioannou A., Loizides F., Souleles N. (2018) 'Social Learning and Social Design Using iPads and Groupware Technologies'. In: Zaphiris P., Ioannou A. (eds) *Learning and Collaboration Technologies. Design, Development and Technological Innovation.* LCT 2018. Lecture Notes in Computer Science, vol 10924. Springer, Cham

TechSmith Corporation. (2018) *Coach's Eye*. Mac edition. [Mobile app]. Available at: https://www.coachseye.com.

Rossing, J.P., et al. (2012) *'iLearning: The future of higher education? Student perceptions on learning with mobile tablets'.* Journal of the Scholarship of Teaching and Learning, Vol. 12, No.2, June 2012, pp. 1 – 26.

Wheat, C.A., et al. (2018). *Active University Teaching and Engaged Student Learning: A Mixed Methods Approach.* Journal of the Scholarship of Teaching and Learning, Vol. 18, No.4, December 2018, pp. 28-50. doi:10.14434/josotl.v18i4.22784

Supporting Blended Learning in ESP Courses: Switching Between "Online", "Offline" and "Onstage"

Pavel Brebera and Zuzana Bezdíčková
Language Centre, University of Pardubice, Pardubice, Czech Republic
pavel.brebera@upce.cz
zuzana.bezdickova@upce.cz
DOI: 10.34190/EEL.19.073

Abstract: The aim of the paper is to analyse the potential of the particular blended learning formats applied within the university courses of English for Specific Purposes (ESP) in the Czech educational context. The theoretical background is thus represented by some of the current global learning trends, such as personal learning environments, gamification or social learning, with relevant references to the area of foreign language teaching methodology, namely to the issues of task-based learning. From this perspective, blended approach is used as a conceptual framework for designing the particular integrated learning tasks, directed towards the development of students´ self-presentation skills in an online environment as well as in the classroom setting. Moreover, the task design options are considered in terms of their primary focus either on the area of general English or the field of ESP. The empirical part presents the results of our small-scale research, which was carried out in two specific areas of ESP, namely English for transport and English for health studies. The selected case study design draws on the potential of mixed methods approaches in social research. The quantitative data were collected via a structured questionnaire and analysed using the relevant statistical methods (chi-square, t-test, and correlational statistics). The qualitative part was focused on identifying the emerging categories through the content analysis of the students´ authentic language production within the particular integrated blended assignment. The research outcomes offer a complex evaluation of three different blended task formats with various degrees of involvement of their "online" components in the LMS Moodle. Besides, each of the aforementioned blended assignments included the task of an oral classroom presentation as its "offline" component. The analysis also focuses on the students´ perceptions of "onstage" aspects of those blended assignments which contained an online forum component. Our findings imply that performing an integrated blended assignment provides a very effective validation of the data previously collected in the category of the students´ proclaimed preferences of the particular educational content (ESP vs general English).

Keywords: blended learning, ESP, LMS Moodle, integrated task

1. Introduction

In the current educational practice, the area of blended learning can be viewed as a very useful approach which is broadly accepted throughout various communities of teaching professionals. Due to its combined nature, blended learning appeals not only to the advocates of purely online learning modes but also to the ones who openly prioritise classroom teaching. This phenomenon is definitely observable also in the field of foreign language course design which obviously manifests solid methodological principles in terms of the aims and objectives of language learning as well as the openness towards new ways of dealing with the educational content.

Over the past decades, the range of language learning contexts has been constantly extending (e.g. Brebera 2018) and therefore, new conceptual frameworks for developing particular language policies are being continuously searched for. One of the outcomes of the recent developments in the area of language teaching, learning and assessment is the introduction of the new category of the so-called "online interaction" in the revised Common European Framework of Reference for Languages (2018, hereinafter CEFR). In fact, this new conceptualisation presents another step in integrating the traditional four language skills, namely speaking, listening, reading and writing, within the subcategories of "online conversations & discussions" and "goal-oriented online transactions & collaboration" (CEFR 2018, p. 82). With regard to the aforementioned new categories of CEFR, our main intention is to address some of the most topical issues of contemporary language learning in their complexity, i.e. taking into consideration learning in "online" as well as "offline" environments. Besides, due to our deliberate focus on the particular formats of the language users´ interaction and production, represented by the tasks of giving an oral presentation and the participation in online forums, the aspects of the self-presentation both in the online and offline environments are covered under the label "onstage".

The core of this article is represented by the summary of empirical evidence related to the particular ways of dealing with integrated blended learning tasks in our teaching context, i.e. at a particular university in the Czech educational context. Nevertheless, the summary of outcomes of our empirical investigation logically needs to be preceded by a brief overview of the key concepts that our investigation draws on.

2. Overview of relevant concepts

Since our primary perspective is represented by foreign language teaching methodology, the basic conceptual framework for our efforts to design complex language learning experience should be searched for in the so-called task-based approach. It is evident that the focus on the concept of tasks in terms of prioritising real language use within the courses has been expressed by numerous authors of the literature on English language teaching methodology (Willis and Willis 2013; Long 2015; Ellis 2003; etc.). Besides, with regard to the specifics of contemporary language learners, also the perspective of "task-based language learning and teaching with technology", elaborated by Thomas and Reinders (2010), seems to be extremely useful. Nevertheless, a comprehensive summary of the so-called "critical features of a task" suggested by Ellis (2003, pp. 9-10), for example its "primary focus on meaning", "involvement of real-world processes of language use" or a "clearly defined communicative outcome" is still capable of providing the most essential points for a substantial understanding of the role of tasks in language teaching methodology.

Due to the enormous potential of modern technologies, the development of language learning tasks offers countless possibilities for contemporary teachers in any educational context. Therefore, the impact of various current global learning trends in the area of learning task design is omnipresent, depending on the particular type of integrated assignment. For example, since one of the online components of our blended learning scheme is represented by digital badges, the corresponding learning trend of gamification in terms of "the application of game elements to non-game contexts" (TechnologyAdvice 2014, p. 3) needs to be mentioned. Another part of our blended learning schemes is constituted by the use of online forums, mainly due to their potential of "sustaining collaborative dialogue" (Savignon and Roithmeier 2004, p. 284) for general communicative purposes. In connection to that, the communicative function of integrated tasks needs to be certainly reflected from the perspective of social learning, i.e. the type of learning which takes place "in a social environment, wherein learners can carefully examine and evaluate the actions of others" (Pappas 2015, no pagination).

However, perhaps the crucial framework for the understanding of the most relevant aspects of complex (not only language) learning experience through integrated blended tasks can be seen within the concept of personal learning environments (PLEs). This category has been in existence for more than a decade and its global impact has also been reflected in our Czech educational context in the research investigations carried out for example by Pospíšilová and Reimannová (2013), or recently mainly by Javorčík (2018).

A starting point of most of the analyses of PLEs is usually based on an influential conceptualisation of this category, formulated by Attwell (2007). For example, Dabbagh and Kitsantas refer to Attwell (2007) in order to characterise PLEs in the following way: "PLEs can be perceived as individuals organising their own learning in multiple contexts where informal learning can be used to supplement formal learning" (Dabbagh and Kitsantas 2012, p. 4). With regard to our long-term research interests, this particular definition seems to be extremely inspiring as it demonstrates a large degree of agreement with our previous efforts to map up the potential of various language learning contexts (Brebera 2018). Besides, the arousal of the concept of PLEs has been often interpreted as a response (or an alternative / alternative scenario) to formal learning management systems (e.g. Wilson et al. 2007; Martindale and Dowdy 2010; García-Peñalvo et al. 2011; van Harmelen 2006). Therefore, another reason why PLEs need to be reflected in this theoretical overview is our empirical experience with the use of LMS Moodle as the key online component of the particular blended schemes.

3. Empirical investigation: ESP preferences of university students

Our investigation was carried out at the University of Pardubice within the area of English language courses. Owing to a vast variety of the students´ English language competence at the entrance level of their university studies, the placement tests are used (for more see Brebera 2013), and consequently, the decisions about the proportion of ESP vs general English need to be taken. Although the English language courses are designed primarily in the area of ESP, the need for general, as well as academic English, often arises, which logically results in creating balanced courses in terms of focusing on the purely professionally-oriented command of a foreign language as well as on the acquisition of the generally applicable language means. Accordingly, it proves to be highly desirable to design such types of language learning tasks which would be appreciated by students as personally meaningful and thus enriching.

However, the analysis of the students´ preferences of ESP vs general English, which was based on the data accumulated from 1689 respondents during the years 2012-2019 at three different faculties, revealed some interesting facts. The responses were collected by means of a structured questionnaire. Table 1 presents the summary of differences in the students´ preferences, grouped according to their current language levels. The lower-level courses were represented by the categories of A2 and A2+, the intermediate ones by the levels B1 and B1+, and the higher-level ones by B2 and B2+ courses.

Table 1: Summary of the expressed preferences of ESP vs general English (GE) (N=1689)

	lower-level courses	intermediate courses	higher-level courses
strongly for GE	22	71	32
for GE	66	206	84
for a balanced course	159	366	275
for ESP	55	167	107
strongly for ESP	9	39	31

The chi-square statistics, which was performed in Microsoft Excel, was used to test the null hypothesis: "There are no differences among the ESP preferences expressed by the students in lower-level, intermediate and higher-level courses". Nevertheless, the result of the chi-square test made us deny the null hypothesis and claim that there is an association between the preferences of ESP and the particular language level of the students; $\chi 2(8)=24.237$, $p=0.002$. The related Table 2 shows the graphical summary of the differences between the observed and expected frequencies with reference to the particular level of significance, i.e "0" representing no significant difference, "+" or "-" a significant difference at the 0.05 level , and "++" or "-" a significant difference at the 0.01 level (according to Chráska 2003).

Table 2: Chi-square test results: Significant differences between the observed and the expected frequencies

	lower-level courses	intermediate courses	higher-level courses
strongly for GE	0	0	0
for GE	0	+	--
for a balanced course	0	-	0
for ESP	0	0	0
strongly for ESP	0	0	0

The outcomes of the chi-square test can be summarised in the following three statements:

- The students of intermediate courses show more preferences for general English than expected.
- The students of intermediate courses show fewer preferences for a balanced course than expected.
- The students of higher-level courses show considerably fewer preferences for general English than expected.

The following case studies demonstrate how these findings were reflected in the particular integrated blended learning task design. In summary, the task directed towards the development of the general language command was used in intermediate groups, whereas the tasks built on the ESP skills were used in higher-level courses.

4. Case study 1: Three types of blended tasks – a quantitative analysis

The first case study presents the quantitative analysis of three integrated blended assignments, which all comprised the student´s task of giving a classroom presentation. However, each of these blended assignments represents the specific type of involvement of its online component within the blended scheme, and besides, it deliberately focuses either on General English or ESP. The following Table 3 presents the description of each particular integrated assignment:

Table 3: The selected types of integrated blended learning assignments

	ASSIGNMENT A	**ASSIGNMENT B**	**ASSIGNMENT C**
Topic of classroom presentation	"New solutions for…"	"The Moodle forum follow-up presentation"	"My language learning story"
Type of integration with the online component	professionally-relevant topics previously studied in the e-learning course in the Moodle	the particular professionally-relevant post written into the Moodle forum and responses to the posts written by others	digital badges as microcredentials for the previous work, both in the Moodle and throughout the whole ESP course(s)

	ASSIGNMENT A	ASSIGNMENT B	ASSIGNMENT C
Degree of interconnection between “online” and “offline” components	low (recommendation to the student to use the language means previously studied in the Moodle course in his/her presentation)	high (obligation of presenting one´s own forum topic as well as the summary of responses of the others´ in the presentation)	medium (obligation of using the digital badges as the evidence of previous learning achievements in the presentation)
ESP vs general English (GE)	ESP	ESP	primarily GE, secondarily ESP
Language level	higher-level courses	higher-level courses	intermediate courses
Teaching context	Faculty of Transport	Faculty of Transport, Faculty of Economics and Administration	Faculty of Transport
Number of participating students	34	113	71

The overall evaluation of individual assignments was based on the quantification of students´ responses in structured questionnaires. The primary categorisation expressed at the level of descriptive statistical data was later complemented by the chi-square statistics in the case of quantification of nominal data, and using the t-test statistics and correlational statistics in the case of attitude measurement.

A general descriptive summary of the most relevant subjective perceptions related to the particular types of integrated tasks (i.e. Assignments A, B and C) is presented in Figures 1, 2 and 3. Figure 1 shows the particular aspects of individual assignments that the students were asked to rate when evaluating the respective assignments. The chi-square test did not reveal any statistically significant differences among the assignments ($\chi 2(10)=8.76$, $p=0.55$) although the participants of Assignment A seem to dominate especially in the categories “opportunity for creativity”, “opportunity for learning new language” and “opportunity for an active use of the acquired language” whereas the participants of Assignment B appear to prevail in the category “opportunity for interaction and feedback” and the representatives of Assignment C in the category “opportunity for language revision”.

Figure 2 presents the data related to the question to what extent the students found the individual assignments enjoyable. Similarly to the first graph, the seeming differences between the frequency of answers in the summative categories of “enjoyable” and “not enjoyable” were not confirmed by the chi-square test ($\chi 2(2)=3.74$, $p=0.15$) although there seems to exist a higher degree of appreciation especially of Assignment A and a lower level of enjoyment of Assignment C.

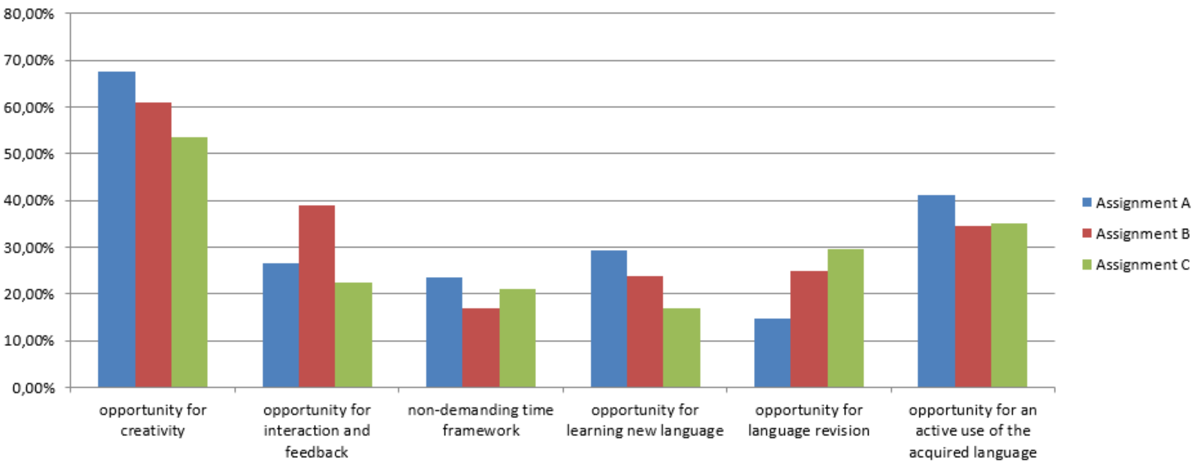


Figure 1: Students´ perceptions of the key aspects of the particular integrated blended assignments

On the other hand, the implications from Figure 3 in terms of a lower level of perceived language enrichment in the case of Assignment C were confirmed by identifying statistically significant differences between the observed and expected frequencies. This fact was identified via the chi-square test ($\chi 2(2)=9.9$, $p=0.007$), which was carried out within the summative categories “enriching” vs “not enriching”.

In addition to the summative categorisation (enjoyable vs not enjoyable; enriching vs not enriching) used in the case of chi-square tests, the complete scales were used for performing more precise t-tests focused on identifying the potential differences in the attitudes of 34 participants of Assignment A, 131 participants of Assignment B and 71 participants of Assignment C. As for the attitudinal scale aimed at the aspects of enjoyment, the mean values for each particular assignment did not manifest any statistically significant differences (Assignment A: $M=3.05$, $SD=0.73$; Assignment B: $M=2.8$, $SD=0.54$; Assignment C: $M=2.81$; $SD=0.76$). However, the mean values for the attitudinal scale focused on the perceived language enrichment of the particular assignments (Assignment A: $M=2.85$, $SD=0.55$; Assignment B: $M=2.82$, $N=0.51$; Assignment C: $M=2.63$, $SD=0.63$), revealed a statistically significant difference between the perceptions of Assignment B and Assignment C: $t(173)=-2.09$; $p=0.03$ ($F=0.1$, i.e. equal variance). Thus, with regard to the results presented in the previous Section 3, a conclusion may be drawn that although the intermediate students generally call for a higher proportion of general English, in our investigation the selected group of students demonstrated a tendency towards perceiving the particular "general English oriented assignment" as not really enriching.

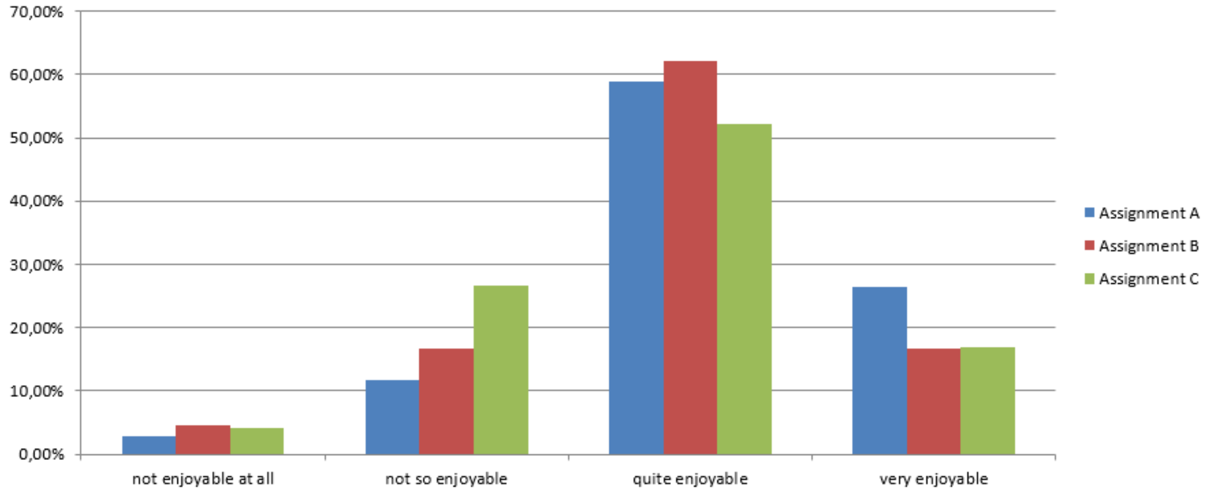


Figure 2: Students´ perceptions of the particular assignments: Enjoyment dimension

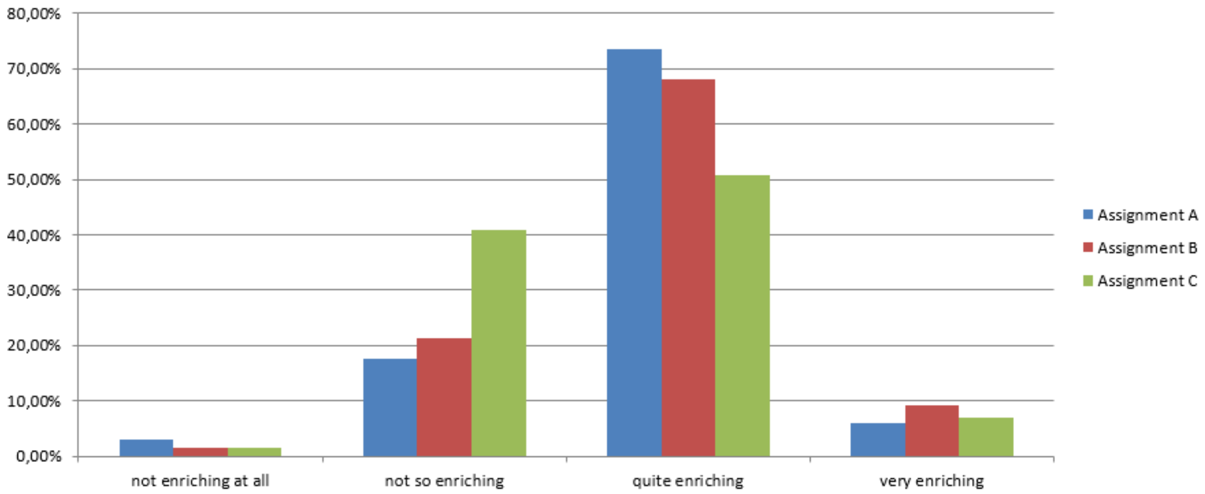


Figure 3: Students´ perceptions of the particular assignments: Enrichment dimension

In order to obtain a more complex picture of the researched phenomena within the particular groups of students, correlational statistics was used with the aim of finding out whether there exist any significant relationships between the students´ perceived enjoyment and enrichment of the individual assignments, their declared preference for ESP (in the case of Assignments A and B) or general English (in the case of Assignment C), and also their final grades. Due to the contextual specifics of the analysed assignments, it proved to be useful to perform the correlation tests for the whole groups of students only in the case of Assignment A and Assignment C (only the students of the Faculty of Transport), whereas in the case of Assignment B, a categorisation into 3 groups appeared to be more meaningful (full-time students of the Faculty of Economics and Administration, students of the Transport faculty: full-time, students of the Transport Faculty: part-time/distance). In the respective tables, the correlations significant at the level 0.05 are marked "*", and the ones significant at the level 0.01 are marked "**". According to Table 4, the specifics of strongly ESP oriented Assignment A are also demonstrated through significant positive correlations between the perceived enjoyment and enrichment with the declared preference for ESP.

Table 4: Assignment A: Correlations

Assignment A (N=34)	enjoyment	enrichment	preference for ESP	grade
enjoyment				
enrichment	0.54 **			
preference for ESP	0.43*	0.48**		
grade	0.31	0.05	0.20	

On the other hand, the correlations within Assignment C, which was carried out primarily in the area of general English, show a significant positive relationship only between the perceived enjoyment and enrichment (Table 5). In accordance with the previous findings which revealed some contradictions related to the proclaimed interest in general English by intermediate students, also the results of correlation tests show no association of the preferences for general English with other variables.

Table 5: Assignment C: Correlations

Assignment C (N=71)	enjoyment	enrichment	preference for GE	grade
enjoyment				
enrichment	0.39 *			
preference for ESP	0.16	-0.01		
grade	0.08	0.23	0.06	

The correlational analysis of Assignment 2, which was categorised according to the specific groups of students, resulted in the following findings:

- In the group of part-time/distance students of the Faculty of Transport, there appeared no significant correlations. This finding might be interpreted in terms of a considerable heterogeneity of this particular group (age, professional contexts, and level of English).
- In the group of full-time students of the Faculty of Transport, there appeared positive correlations in the same categories as in the case of Assignment A (0.44*: enjoyment/enrichment; 0.38*: enjoyment/preference for ESP; 0.42*: enrichment/preference for ESP). Similarly to Assignment 1, this finding might be interpreted in terms of a consistent interest of this particular group of students in professionally-related command of English.
- In the group of full-time students of the Faculty of Economics and Administration, there appeared a strong positive correlation only between enjoyment and enrichment (0.67**). This finding might be interpreted via the characteristics of the students´ chosen topics for forum entries and the follow-up presentations which were often rather general and did not manifest such a level of professional grounding as in the case of the full-time students of the Faculty of Transport.

Another interesting finding is represented by the fact that none of the groups demonstrated any significant correlation of the category "final grade" with other variables. This fact seems to imply that the perceptions or preferences related to the particular aspects of the language learning experience in formal learning contexts and the actual level of language competence need to be analysed as separate entities.

The overall design of Assignment B also provided a valuable opportunity for analysing potential correlations between the "online" component of the blended task, i.e. the forum participation, and the "offline" part, i.e. the classroom presentation. The data collected from the full-time students of both the Faculty of Transport and the Faculty of Economics and Administration are presented in the Tables 6 and 7 and reveal significant positive relationships between the forum and presentation in terms of the perceived enjoyment and enrichment.

Table 6: Transport faculty: Correlations between "online" and "offline" components of Assignment B

Transport (N=30)	forum enjoyment	presentation enjoyment	forum enrichment	presentation enrichment
forum enjoyment				
presentation enjoyment	0.16			
forum enrichment	0.45*	0.47**		
presentation enrichment	0.33	0.58**	0.69**	

Table 7: Faculty of Economics and Administration: Correlations between "online" and "offline" components of Assignment B

Economics (N=32)	forum enjoyment	presentation enjoyment	forum enrichment	presentation enrichment
forum enjoyment				
presentation enjoyment	0.39*			
forum enrichment	0.67**	0.17		
presentation enrichment	0.47**	0.15	0.62**	

On the whole, the outcomes of this quantitative analysis show some interesting areas where the integration of "online" and "offline" components within the particular blended learning assignments seems to work well as well as some problematic issues which could be addressed by means of future research investigations. The "onstage" part of the integrated assignments, which was carried out both in the format of classroom presentation and the exposure of one´s own language production on the online forum, proved to be a valuable language learning experience, which was generally appreciated by the participating students.

5. Case study 2: The blended task at the faculty of health studies – a qualitative view

The second case study presents some specific insights into the Assignment B, i.e. the Moodle forum task with the follow-up classroom presentation, which was used in the specific context of higher-level ESP courses taught at the Faculty of Health Studies. The students were part-time students with their own professional experience, and therefore, it was not easy to design the course which would match their very diverse needs. The active participation in the topics' choice was expected from the students to customise the course content. Hence, the up to date knowledge, the usefulness and the choice of the right ESP areas were achieved.

In this particular context, the effectiveness of integrated blended learning format in the area of ESP could be best manifested by the students´ choice of the particular professionally-relevant topics and by their genuine interest to present and discuss them both in an "online" as well as "offline" part of the integrated blended task

MSF midwife
Nurses and foreign humanitarian missions
Chronic pain
Oral Cavity Care of Intubated Patients
Surrogate mothers and homosexual couples
Burnout syndrome
Life threatening bleeding
The Head to Toe Assessment
Marijuana as a medical treatment
Scrub nurse's basic skill
Crohn's disease
Urinary Incontinence
The work of a surgical technologist
Epi-no, Aniball - vaginal dilatation balloon
CAESAREAN SECTION
The home birth in the Czech Republic

Figure 4: Students´ topics of the integrated blended task at the Faculty of Health Studies

The students choice could be divided into four main key categories:

- Lifestyle topics; where students were looking into the health problems connected with, for example, smoking or obesity.
- Topics dealing with specific illnesses; where the students' own experience was often reflected.
- Topics about treatments; where the newest approaches were presented.
- Topics dealing with medical or work ethics.

It also became evident that with higher language self-confidence, the choice of topics was more professionally related than with lower level students.

The atmosphere of openness and trust helped the students to feel free to discuss such controversial topics as surrogate motherhood and homosexual couples or usage of marihuana for the medical purposes which are still not legal in the Czech Republic. The online part gave them enough time and freedom to think and choose the topics they found exciting and valuable. The follow-up "offline" presentations served as an excellent source for discussion.

As the students became the co-authors and co-designers of the course, their willingness to learn and the level of involvement increased. The question of the most suitable study material choice was successfully dealt with by trusting the students' maturity and their professional expertise.

6. Conclusion

Currently, the ability to participate in online forums, as well as the competence in giving oral presentations (i.e. a combination of a sustained monologue and an interaction with the audience), belongs to the group of the core professionally-oriented competencies of a foreign language user. Therefore, in this article, we tried to illustrate how a meaningful interconnection between the e-learning courses in the LMS Moodle and the aforementioned particular types of follow-up tasks carried out in the "offline" environment might create really enriching and enjoyable language learning opportunities.

The findings of our small-scale research carry some interesting implications in the area of language curriculum design. Most importantly, the quantification of the participants´ subjective perceptions of integrated blended assignments proved to be a very effective way of validating the sum of the data previously collected in the category of the students´ proclaimed preferences of the particular educational content (ESP vs general language). At all language levels (i.e. lower, intermediate and higher), the researched population of our university students manifested mainly the appreciation of the focus on the professionally-related language within the integrated blended assignments. Besides, an observed high level of the students´ active engagement in the integrated blended assignments, which was manifested in both researched contexts (i.e. English for transport, English for health studies), emphasises the importance of the role of blended learning in the current language teaching curricula.

However, the study also displays some obvious limitations which are related mainly to the choice of its research methodology. Owing to the selected case study research design, the interpretations of our findings are valid primarily in our specific teaching context. Therefore, it needs to be pointed out that any potential generalisations of our research results beyond the scope of our case studies would be rather disputable.

Nevertheless, the results of our empirical investigation suggest that due to the complexity of language learning, the students can truly benefit to a large extent from various types of integrated tasks, designed with regard to the target situations of language use in real life contexts. We believe that our insights into the issues of language teaching and learning, supported by the specific empirical evidence, may serve as a starting point for further investigations in this field in other educational contexts.

References

Attwell, G. (2007) "The personal learning environments: The future of eLearning?", *eLearning Papers 2(1),* pp 1-8.

Brebera, P. (2013) "Standardisation of Foreign Language Teaching in Higher Education: Intentions and Reality", *ICERI 2013. 6th International Conference of Education, Research and Innovation. Conference Proceedings.* Sevilla: IATED, pp 39-46.

Brebera, P. (2018) "Formal, Informal and Non-Formal Language Learning Contexts for the University Students", *Proceedings of the 17th European Conference on e-Learning. ECEL 2018.* Reading: ACPI Limited, pp 54-59.

Chráska, M. (2003) *Úvod do výzkumu v pedagogice. Základy kvantitativně orientovaného výzkumu [Introduction to educational research. Basics of quantitatively oriented research],* Univerzita Palackého, Olomouc.

Council of Europe (2018) "Common European Framework of Reference for Languages: Learning, Teaching, Assessment. Companion Volume with New Descriptors." [online]. [cit. 2019-07-10] Available at: https://rm.coe.int/cefr-companion-volume-with-new-descriptors-2018/1680787989 .

Dabbagh, N. and Kitsantas, A. (2012). "Personal Learning Environments, social media and self-regulated learning: A natural formula for connecting formal and informal learning", *Internet and Higher Education 15 (2012),* pp 3-8.

Ellis, R. (2003) *Task-based Language Learning and Teaching.* Oxford University Press, Oxford.

García-Peñalvo et al. (2011) "Opening Learning Management Systems to Personal Learning Environments", *Journal of Universal Computer Science, vol. 17, no. 9,* pp 1222-1240.

Javorčík, T. (2018) "Assessing Students´ use of Personal Learning Environment", *Proceedings of the 17th European Conference on e-Learning. ECEL 2018.* Reading: ACPI Limited, pp 212-219.

Long, M. (2015) *Second Language Acquisition and Task-based Language Teaching*. Wiley Blackwell, Chichester.

Martindale, T. and Dowdy, M. (2010) "Personal Learning Environments", *Emerging technologies in distance education,* Edmonton: Athabasca University Press, pp. 177-193.

Pappas, C. (2015) "Social Learning Vs Informal Learning: Can You Tell The Difference?" *eLearning Industry* [online]. [cit. 2019-07-10] Available at: https://elearningindustry.com/social-learning-vs-informal-learning-can-you-tell-the-difference .

Pospíšilová L. and Reimannová, I. (2013) "Osobní učební prostředí českých a finských studentů" [Personal learning environments of Czech and Finnish students], *Sborník příspěvků z konference a soutěže eLearning 2013,* Hradec Králové: Gaudeamus, pp 125-129.

Savignon, S. and Roithmeier, W. (2004) "Computer-mediated communication: Texts and Strategies". *CALICO Journal, 21,* pp 265-290.

TechnologyAdvice (2014) "Gamification 101: Learn the Basics of Gamification Strategy." [online]. [cit. 2019-07-10] Available at: https://www.slideshare.net/technologyadvice/gamification-101-how-gami?related=1 .

Thomas, M. and Reinders, H. (2010). *Task-Based Language Learning and Teaching.* London, Continuum.

van Harmelen (2006) "Personal Learning Environments", *Proceedings of the Sixth International Conference on Advanced Learning Technologies,* Los Alamitos: IEEE Computer Society, pp 815-816.

Willis, D. and Willis, J. (2013) *Doing Task-based Teaching.* Oxford, Oxford University Press.

Wilson, S. et al. (2007) "Personal Learning Environments: Challenging the dominant design of educational systems", *Journal of e-Learning and Knowledge Society, Vol. 3, n. 2*, pp 27-38.

Computational Thinking Utilizing Visual Arts, or Maybe the Other way Around

Mie Buhl
Department of Communication, Aalborg University, Copenhagen, Denmark
mib@hum.aau.dk
DOI: 10.34190/EEL.19.138

Abstract: This paper is a theoretical discussion about the extent to which school subjects can contribute to teaching students computational thinking. Or is it the other way around and, perhaps surprisingly, how computational thinking might transform existing school subjects? The discussion takes as its point of departure the national experimental project Technology Understanding, which is the Danish response to a worldwide interest in bringing digitalization to students in primary and secondary schools and the Danish governmental initiative regarding implementation of digital literacy as a new school subject and as an integrated part of existing school subjects in primary school (Ministry of Education 2018). Visual arts education is one of the subjects chosen for the integration of technology, and this paper follows up on the ministry's intention by considering visual arts as the starting point for computational thinking. At issue is how visual art may be informed by computational thinking and how computational thinking may be informed by visual art. I argue that teaching students to understand algorithms and data processes can be inspired by practices from contemporary art and the ideas of new materialism (Barad 2008). Contemporary art may be characterized as conceptual, distributive, and interventional in life practices, and programming principles may illuminate how human activities and algorithms intertwine. I also argue that the teaching of contemporary art can be inspired by principles from programming and algorithms. These practices can illuminate how artistic concepts may be planned and designed for human interaction. However, programming for contemporary art requires openness regarding use, while programming for data processes requires the opposite. Thus, the integration of computational thinking into visual arts education is more than a means for understanding programming and algorithms; the dynamic also works in reverse. This paper will bring a wider societal perspective to bear on teaching computational thinking by bringing school subjects into the center of discussions and drawing on current discussions of STEAM education and contemporary art.

Keywords: visual arts education, technology understanding, computational thinking, STEAM

1. Introduction

In light of increasing digitalization worldwide and nationally, the Danish government decided to respond to its powerful influence on society by incorporating digital literacy into the school curricula (Ministry of Education 2018a). From 2018 to 2021, a national experimental project (tekforsøget.dk) is testing a newly-developed school subject called *Technological Understanding* as well as the integration of the subject's learning objectives into selected subjects in 46 schools across the country (Ministry of Education 2018b). Leaving aside the details of the new school subject for now, this paper will address one of the existing school subjects that has been chosen for integration of technological understanding in the national project: visual arts education in grades 1-3. Visual arts education in Danish schooling (K-12) started integrating information technology (IT) in the late 1980s when computer graphics became a part of visual arts education and programming activities became more commonplace in the work among a handful of visual arts education scholars, developers, teachers, and students (e.g. Nielsen 1987, Skov 1988) that led to inclusion of computer graphics inthe curriculum (Billedkunst 1991 p.12). Since 1991 IT has been considered as one of a range of media available for artistic expression (Rasmussen 2017). Danish art pedagogy is driven by learning through visual practice as well as developing skills within a broad field of art and visual culture, and it includes a critical perspective on visuality as a core learning objective (Buhl and Skov 2018). The role of technology in the school subject is double: it is the tool for artistic expression when students experiment with devices and applications, and it is the topic for artistic expression when students inquire and explore the societal implications of man-machine in a world of social media, algorithms and mobile technology.

As part of the initiative of technological understanding, visual arts education is at another inflection point in its relationship with technology. One aspect of this is the relation between computational thinking and art practices. In order to discuss this relation, I will investigate the term computational thinking and ask how it informs teaching visual arts education, and I will address current discussions of the arts in relation to the so-called STEM disciplines. Furthermore, I will discuss how practices in the school subject may inform computational thinking by drawing on conceptual currents in contemporary art, and I will explore how computational thinking may inform the school subject. My purpose is to determine whether and how technological understanding in visual arts education may add new dimensions to contemporary school education.

2. Perspectives on computational thinking

The term *technological understanding* is broader than *computational thinking*, and the two terms represent a division in the way scholars approach the issue. Caeli and Bundsgaard, for example, contrast teaching children "to think like computer scientists" with teaching them "to understand computers" (2018). They refer to two contrasting positions among computer scientists represented by Jeanette Wing and Peter Denning. Wing argues that "Computational thinking is a grand vision to guide computer science educators, researchers, and practitioners as we act to change society's image of the field" (2006 p. 35). She acknowledges the origin of computer science in math and takes it to another level of abstraction, emphasizing that computational thinking goes further than programming a computer. According to her, computational thinking is first and foremost a mode of problem solving that applies to real-life problems and is characterized by conceptualizing and abstraction on multiple levels, complementing and combining mathematical and engineering thinking. She regards it as a fundamental skill needed to live in modern society. Wing advocates for computational thinking in education as a formal skill in a particular language of the future, and asserts that a computer science major can do anything for a career, including work in the arts. From her perspective as a computer scientist, the skills involved in and the benefits of computational thinking are evident, but from other perspectives the picture may be more mixed.

According to Denning (2017) school teachers are not entirely comfortable with the idea of computational thinking. He claims that three questions repeated among teachers reveal the concerns that teachers have: 1. What is computational thinking? 2. How do we measure students' computational abilities? 3. Is computational thinking good for everyone? (2017 p. 34). To answer the first question, he takes an historical view, identifying scientist and educator Seymour Papert as the inventor of the term in his book *Mindstorms* (1960), in which he used it to refer to the skills children develop from programming. Denning also highlights computer scientist Al Aho's definition from 2011: "…computational thinking is the thought processes involved in formulating problems so their solutions can be represented as computational steps and algorithms," as well as Aho's explanation of the crucial importance of a computational model to formulating an operational definition of the term. In Aho's interpretation, designing an algorithm means designing a way to control any machine that implements the model so that the machine produces a desired effect in the world. Furthermore, Denning explains that Aho's term *computational model* applies to all fields in the humanities, law and medicine. Denning concludes by asserting the importance of making a distinction between the nature of algorithmic steps and human judgment. The nature of the first one is not arbitrary but a series of steps that control a computational model; human judgement is not a series of controlled steps. To the second question about how we measure students' computational abilities, Denning explores the difference between assessing students' knowledge about abstraction and their ability to perform it in design activities. Here Papert's ideas of "doing" are relevant. To the third question about the value of computational thinking for all students, Denning suggests that many "thinkings" are applied to education such as science thinking, economics thinking, systems thinking, logical thinking, rational thinking, network thinking, ethical thinking, design thinking, critical thinking, and, one could add, artistic and visual thinking. Denning's point is that computational thinking may be overrated, since each academic field claims its own way of thinking, and he concludes that "computational thinking primarily benefits people who design computations and that the claims of benefit to non-designers are not substantiated" (2017 p. 38). With this he casts doubt on the idea that computational thinking is generally applicble across the school curriculum a view that supports the new Danish school subject Technological Understanding but not the idea of its integration into existing school subjects.

While Wing emphasizes teaching children the logic and practices of programming and algorithms in order to solve problems, Denning suggests a more holistic approach that includes a user and designer perspective on how to judge whether there are "problems to set" (cf. the pragmatist Donald Schön's (1983) concept for identifying what the actual problem in a problem is) that computational thinking may solve or not as well as the understanding that computational thinking may not be the answer to everything. The two perspectives are applied to the Danish context by Caeli and Bundsgaard (2018) who join others' warnings about Wing's too narrow approach to computational thinking that neglects the history of computing in education. In line with Denning (2017), they revisit the history of technology education, but from a Danish perspective. They suggest that the perspectives represented by Wing and Denning can be traced to similar discussions about technology as a fixed or general orientation in previous educational initiatives. They encourage those engaged in current discussions about technology education to learn from history and advocate an approach that teaches a fundamental rather than an instrumental understanding of algorithms and data processes. Caeli and Bundsgaard, then, align with the Danish governmental initiative regarding the implementation of technology understanding as a new school subject and as an integrated part of existing school subjects in primary school (Ministry of Education 2018) because this initiative embraces an approach of fundamental understanding in which computational thinking, programming, and designing algorithms are contextualized, problematized and discussed. However, the question remains: how is this fundamental understanding reached? Is it through knowing skills or doing skills? Is it through abstraction or designing? The learning objectives of the new school subject and its integration into existing school subjects address computational thinking, programming, construction, and design, and the selected school subjects represent a broad swath of the curriculum, which makes it possible to foster an ongoing discussion of societal perspectives on technology. The implementation of technological understanding in schooling will show which perspectives dominate and whether the term *technological understanding* means thinking like computational scientists in order to solve problems or thinking about the implications of solving problems through computational modeling. As one of the selected school subjects, visual arts education can contribute significantly to this discussion because of its particular perspective on technological understanding and can, moreover, mediate the diverse interpretations of computational thinking by drawing on its creative approach to production.

3. Computational thinking: STEM or STEAM?

The role of visual arts in technological understanding is asserted by scholars who argue for an expansion of the four STEM disciplines Science, Technology Engineering, Math to include a fifth, Arts, thereby adding an 'A' to make STEM into STEAM. The choice to combine technology with a subject outside the obvious STEM disciplines indicates a governmental choice to address technology in ways that are both transdisciplinary and subject-specific. STEM education is the obvious response to teach the kind of computational thinking that originated from math and computer science. The STEM disciplines offer a contemporary response to real-life problems that must be addressed in an interdisciplinary fashion, but scholars argue that visual arts and STEAM approaches hold the potential to innovate science education in both K–12 and postsecondary education (e.g. Segarra et al. 2018) and suggest that the relationship between art and technology is a complementary one (Boy 2013). Discussing art and technology requires us to define what art means in relation to STEAM. Colucci-Gray et al. (2015) review the emergence of art in a UK discussion of STEM, arguing primarily that technological progression will never take place without involving the arts. The authors refer to three interlinked arguments from a Culture Learning Alliance (CLA) report: that studying the arts improves cognitive scores (including those in math and literacy), that it leads to innovation, and that it motivates young people to engage in STEM subjects and careers. They also report that participation in the arts can enhance high-performance teamwork, change management, intercultural communication, observational skills, and adaptability. Furthermore, the arts as a part of the humanities provide an intellectual framework for thriving in and understanding a changing world (CLA, 2015 p.11). Colucci-Gray et al. (2015) conclude that the three arguments provide weight to an economic imperative for STEAM as a necessary approach to improving the labor market.

However even arguments based on a single purpose like economic growth depend upon the twin approaches of viewing the arts as a means to reach that goal (an improved labor market) and as important in their own right (for understanding a changing world). From a Danish perspective, the twin approaches of viewing the arts can be traced back in time (Buhl, 2015) to the first law of schools in Denmark (1814) in which drawing was a significant activity that had a clear purpose: preparing boys for future craftsmanship and girls for crafts (Pedersen 2004).

Studies of the first law of schools show that drawing was a necessary skill for executing daily work, so the practical purpose of acquiring drawing skills was obvious. This early 'technology' was followed by an artistic approach to visual arts education, and the next significant trend was based on pedagogical reform ideas that developed in the late 1950s. Its focus was on the child's personal expression, explained by the need for general education, coined in the German term Bildung. The contours of a division in the way we think about the visual arts (in terms of utility or personal development) are drawn here and emerge repeatedly in various forms up to today's discussions of visual practices: either they are for utility or they are for appreciation. In late 1970s the communicative aspect of visual practice became part of the school subject. Visual activities came to be considered a particular language that comprises an important component of children's development and general education, and a critical approach to the images in mass media began to be applied along with the activities already performed. This development was only reinforced by the introduction of electronic media into the curriculum in 1991 and has been supported by research (e.g. Flensborg 2002). Digital technology has been a part of the Danish curriculum in visual arts education ever since, and technology projects in developing schooling include visual arts education (e.g. Buhl and Hemmingsen 2004, Flensborg 2004, Holm Sørensen and Levinsen 2010, Rasmussen 2017).

Later on, the twin approaches of viewing visual arts education as either utility or personal development became evident in matters of discussing learning objectives. An approach to visual arts education as social practice was added into the curriculum in 2009 through the term visual culture. Visual arts education took on a third path, towards visual practices drawing on contemporary arts to promote an understanding of a changing world. This addition was in line with international currents of developing a new and transdisciplinary approach to visuality that also included digital media (e.g. Mitchell 1994, 2002, Sturken and Cartwright 2009). Along with this development, the Danish school system encountered a new set of imperatives based on unsatisfactory scores in international reports of school children in reading and math skills. These measures grew out of developments in international school systems and the Program for International Student Assessment **(**PISA**)** 2000-2012, which did not include visual arts skills. The result is that visual arts education has been all but excluded from the Danish discourse in educational science, where evidence has entered the discourse and resulted in a paradigm shift. The paradigm shift has consequences for visual arts education that are revealed in the learning objectives of the new school reform (Danish Ministry of Education 2013, 2014) which added the subject, but only in the service of other school subjects. Thus, the 'utility' approach of the subject was revitalized in an instrumental manner and based on political rather than pedagogical arguments. IT and media, already part of the visual arts curriculum, now take a new form as a cross-disciplinary topic.

The new Danish school subject called technological understanding, then, is only the latest addition to technology in visual arts education, in which computational thinking appears as one among other learning objectives for the subject. The question that presents itself is whether the utility, or the personal development or the social practice approach to visual arts will be dominant, or they will find a way to co-exist? Colucci-Gray et al. (2015) note that there is a lack of clarity in the very meaning of the 'A' in STEAM education. They suggest that "three uses of the term [STEAM] are evident: as supporting creative pedagogies; reflecting diversification of what counts as 'science'; and a resistance to technicist [sic] and economically focussed accounts of education" (2015 p.30). Their suggestions align with the idea of including art in STEM learning practices but outside art as a school subject. In the current economic and cultural climate, it is unlikely that visual arts will be acknowledged to have a function in its own right, and the endeavor of advocating for STEAM education exemplifies that. The question is whether that goes for the Danish technology understanding project too or an integration of technology understanding into visual arts' curriculum will be successful?

In this paper, art is discussed only as the visual arts, but the discussion draws on the history of the Danish school subject's pedagogy in which the instrumental function and the general education function are intertwined and in which technology is a tool, a thinking mode, and a topic for critical thinking. Visual arts education in Denmark has cognition, cultural and critical dimensions and is influenced by currents of contemporary art. Contemporary art includes the idea of concept development as a mode of "programming" social art practice and enacting a relation between concept and viewer. This way of thinking draws upon design as well as inquiry and critical approach to art activities, and the artist's or the art student's design concepts invite the audience to be participants in realizing an art work. In order to develop and conduct an artistic concept, a pedagogy for imagination, innovation, planning and experimentation are required. Inquiry and critical pedagogy suggest that the purpose of artistic activity is to develop towards citizenship and democracy. These are contemporary interpretations of instrumental functions and general education in visual arts education. It is suggested that art has the potential to be a model for computational activities based on the fact that creating an algorithm can be compared to conceptualizing a contemporary work of art. Likewise, the view of art works as social projects that try to solve real-life problems may also shed light on teaching technological.

4. Signifiers of contemporary arts

This paper follows up on the ministry's intention by taking visual arts education as a starting point for computational thinking. It is argued that teaching the understanding of algorithms and data processes can be inspired by practices and ideas from contemporary art. Contemporary art can be seen as participatory, networked, social, self-organized, conceptual, distributive, and relevant to life practices. Computers challenge how we understand art, because the technology as a 'materiality' constitutes meaning (Andersen and Pold n.d.). Andersen and Pold assert that digital technology is more than a topic for interpretation in the arts; rather, digital technology changes the ways of making art, for instance, by following the logics of algorithms and data processing. The digital interface is both technical and cultural and represents the result of a historical development that gradually led to its current use, but it is still under the influence of human decisions. In a contemporary art perspective technology and programming principles illuminate how human activities and algorithms intertwine and offer insight into the conditions under which artists work. Ideas of new materialism (e.g. Barad 2003) take this idea of intertwinement one step further by suggesting a post-human and performative approach to computation as material practice in order to go beyond human and nonhuman dichotomies. Sociologist Karen Barad questions the givenness of differential categories of "human" and "nonhuman" and examines practices to identify how boundaries are stabilized and destabilized in order to argue for a levelling of human and nonhuman agency (Barad 2003 p. 808). By this she suggests a new approach to a relation where human intention and actions do not control the material. New materialism offers a framework for understanding how contemporary art concepts are the result of actions and agency similar to those at play in the design of algorithms for data processing. However, the idea of programming for contemporary art participation involves an openness towards use, while programming for data processes requires the opposite. Thus, the integration of computational thinking into visual arts is more than a means for understanding programming and algorithms. Contemporary art promotes understanding of the human and nonhuman 'agencies' based on artistic 'algorithms' for meaning-making with and without the involvement of digital technology. This opens a wider societal perspective on teaching computational thinking and artistic practice because the asymmetry between man-machine where man has the control of the machine is levelled.

5. Visual art education instrumental, human judgement or social material practice?

When we engage computational thinking in visual arts education, we develop new perspectives to understand and practice art as a social and material enactment of human and nonhuman actions that constitute meaning. Producing a clay figure is neither an act of artistic inspiration nor a matter of transforming hidden meaning into material expression; it is instead a *negotiation* of meaning making. By applying a socio-material perspective to activities in the school subject, the learning objectives in art education will change from traditional and modernist ideas like the following: when children make art they are creating original works, the production process consists of individualized and personalized expressions, development of technical skills means manipulation of a medium, such as canvas, clay, or paint, or works of art are finished and fixed pieces that are produced in school (Buhl 2017). Furthermore, technology used for art production will go beyond digital applications that re-mediate analog practices like painting and facilitate development of new art processes by which students design concepts for visual social practices of meaning making. Art practices offer the possibility to design open-ended algorithms that invite participation. But what happens to the human judgement in a new material understanding of computational thinking and art practice? What happens to Denning's claim of the societal perspective? Technology as integrated into the school subject may take on a new role and transform visual arts education to a point at which technological understanding is neither a tool for artistic expression with which students experiment using devices and applications nor a topic for artistic expression through which students inquire and explore the societal implications of man-machine in a world of social media, algorithms and mobile technology. Contemporary art currents and new materialism theories suggest a third path on which technological logics and social inquiry are integrated learning modes. This may be the rationale behind the Danish initiative of technological understanding in visual arts education.

6. Conclusion

The merger of technology and the subject of visual arts raises some concerns with regard to learning and new thinking patterns. Technology educators Mayes and De Freitas (2013) discuss three interconnected learning paradigms that sum up how technological education is approached: the associative learning paradigm referring to programmatic learning and training programs, the cognitive learning paradigm referring to individual and constructive learning activities and the situated learning paradigm referring to social and practice activities. Lessons learned from previous initiatives (c.f. Caeli and Bundsgaard 2018) call for serious consideration of which learning paradigms to draw on. For one thing, pedagogical traditions from different disciplines will challenge both transdisciplinarity and collaboration because they are rooted in different ideas about what constitutes knowledge. This paper's discussion suggests that technological understanding may hold potential to bridge computational thinking and visual arts education following a so-called third path in schooling. But the realization of the third path is influenced by professionals from other domains of knowledge and stakeholders following other agendas in and outside school than what emerge from developing art pedagogy. Thus, the conclusion of this paper is formed by unanswered questions: What will be the role of technological understanding in visual arts education? Will visual artscontinue to be marginalized from STEM education and if; is that good or bad for the students' ability to cope as future professionals and citizens? Will we witness a regression to old behavioristic learning practices from computer science, or will we succeed in formulating problems, solving problems and contextualizing problem solutions based on critical, social and democratic negotiation? Will technological understanding become an addition to a modernist art paradigm or will new theoretical developments of levelling human and non-human 'agency' transform art pedagogy into socio-material art pedagogy and provide new art - and new technology practice? Only time will show.

References

Andersen, C.U. and Pold, S. (n.d.) *Manifest for kunstmuseet i en digital tidsalder. [Manifest for the art museum in a digital age]* Aarhus: Aarhus University. Retrieved from: https://pure.au.dk/ws/files/84856820/Pold_Andersen_pre_print.pdf

Boy, G. A. (2013) From STEM to STEAM: toward a human-centered education. In *European Conference on Cognitive Ergonomics Aug. 2013*, 26-28. Toulouse, France: NASA Kennedy Space Centre.

Barad, K. (2008) Posthumanist performativity: toward an understanding of how matter comes to matter. In Alaimo, S. and Hekman, S. (Eds.), *Material Feminisms,* 120–154. Bloomington: Indiana University Press.

Buhl, M. and Skov, K. (2018) Billeder på tværs af fag og projekter [images a cross school subjects and projects] In Christensen, K.E. and Marxen, H. *Visualitet i undervisningen [Visuality in teaching].* Odense: Meloni

Buhl, M. (2017) "Students and teachers as developers of visual learning designs with augmented reality for visual arts education". in A Mesquita & P Peres (Eds.), Proceedings of the 16th European Conference on e-Learning*,* 94-101. Academic Conferences and Publishing International, 16th European Conference on eLearning, Porto, Portugal, 26/10/2017.

Buhl, M. (2015) "Evidence or advocacy? visual arts education in Denmark." In T Torres de Eca, C Trigo & M Agra Pardinas (Eds.), *Risks and Opportunities for Visual Arts Education in Europe / Riscos e Oportunidades para a Educação das Artes Visuais na Europa]. Porto: APECV. ISBN: 978-989-99073-2-4.* APVC, Porto, s. 105-113, Risks and Opportunities for Visual Arts Education in Europe / Riscos e Oportunidades para a Educação das Artes Visuais na Europa], Lisbon, Portugal, 07/07/2015.

Buhl, M. and Hemmingsen, K. (2004) *Unges fritidsrelaterede æstetiske medieressourcer i en pædagogisk kontekst. [Young people's leisure time related aesthetic media resources in a pedagogical context]* Research report. København: Danmarks Pædagogiske Universitetsforlag.

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

CLA: Cultural Learning Alliance (2015) *STEAM Hack October 2015 blog*. Retrieved from http://www.culturallearningalliance.org.uk/news/steam-hack-october-2015/ (accessed 8/6/2019).

Connor, A.M., Karmokar, S., and Whittington, C. (2015) "From STEM to STEAM: strategies for enhancing engineering & technology education." iJEP 5, 37-47.

Colucci-Gray, L., Burnard, P., Humphreys, B., Davies, R.C., Gray, D.M., and Trowsdale, J. (2017) *Reviewing the potential and challenges of developing STEAM education through creative pedagogies for 21st century learning: how can school curricula be broadened towards a more responsive, dynamic and inclusive form of educatio*n? BREA, file://id.aau.dk/Users/mib/Documents/artikler%202012/2019/Ecel/report%20on%20steam.pdf

Denning, P. J. (2017) "Viewpoint. Remaining trouble spots with computational thinking." Communications of the ACM, 60(6), 33-39.

Flensborg, I. (2004) *Visuel kultur i læremidler i netværk.* [Visual cultures in means for learning in network] Research report. Copenhagen: Danish University of Education Press.

Flensborg, I. (2002) "Aesthetic perception in graphic user interfaces." in Illeris, H. (Ed*.) Studies in Visual Arts Education.* Copenhagen: The Danish University of Education.

Ministry of Education (2018a) Undervisningsministeren vil gøre teknologiforståelse obligatorisk i folkeskolen [The minister of education wants technological understanding to be compulsory in school] https://www.uvm.dk/aktuelt/nyheder/uvm/2018/jan/180126-undervisningsministeren-vil-goere-teknologiforstaaelse-obligatorisk-i-folkeskolen

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

Ministry of Education (2013) *Agreement between the Danish government (the Social Democrats, the Social Liberal Party and the Socialist People's Party), the Liberal Party of Denmark and the Danish People's Party*. Retrieved from:http://eng.uvm.dk/~/media/UVM/Filer/English/PDF/131007%20folkeskolereformaftale_EG_RED.pdf

Ministry of Education (2014) *Nye fælles mål. [New common objectives] Act for reform of the Danish School system*. Retrieved from: http://www.emu.dk/modul/billedkunstm%C3%A5l-l%C3%A6seplan-og-vejledning

Ministry of Education (1991) Billedkunst [Visual arts education) 1991/4. Undervisningsvejledning for Folkeskolen [Guidance for teaching visual arts in the Folke School) file://id.aau.dk/Users/mib/Downloads/1991-billedkunst.pdf
Ministry of Science, Innovation and Higher Education (2012) *Denmark – a nation of solutions*. Retrieved from http://ufm.dk/en/publications/2012/files-2012/innovationstrategy.pdf
Nielsen, J. (1987). *Datamater og erkendelsesprocesser [Computers and cognition processes]* (Docotral dissertation) The Royal Danish School of Educational Studies, Copenhagen
Pedersen, K. (2004) *Rekonstruktion af billedpædagogikken.* [Reconstruction of visual arts pedagogy] Copenhagen: Danish University of Education Press.
Mitchell, W.J.T. (1994) *Picture Theory: Essays on Verbal and Visual Representation.* Chicago: University of Chicago Press.
Mitchell, W.J.T. (2002) Showing seeing. *Journal of Visual Culture 1*(2), 165-181.
Pedersen, K. (2004) *Rekonstruktion af billedpædagogikken. [Reconstruction of art pedagogy]* Copenhagen: Danish University of Education Press.
Rasmussen, H. (2017) *Kompleks betydningsfremstilling i digitalt billedarbejde og billedæstetisk kompetenceudvikling i skolen - En Design-Based-Research-inspireret undersøgelse af, hvordan it-didaktisk design kan fremme læringsudbyttet af digitalt billedarbejde på iPad på 5. klassetrin [Complex meaning-making in digital visual production and visual aesthetic competence development. A Design-Base Research study of how ICT-didactic design can promote digital visual production suing iPads in fifth grade*. (Doctoral dissertation) Aalborg Universitetsforlag, Aalborg.
Schön, D. (1983) *The Reflective Practitioner: How Professionals Think in Action*. New York: Basic Books
Segarra, V. A., Natalizio, B., Falkenberg, C. V., Pulford, S., and Holmes, R. M. (2018) "STEAM: using the arts to train well-rounded and creative scientists." Journal of Microbiology & Biology Education, 19(1), doi:10.1128/jmbe.v19i1.1360
Skov, K. (1988). Computeren som velkommen deltager i en proces. [the computer as a welcome participant in a process] Billedpædagogisk Tidsskrift 4
Sturken, M., and Cartwright, L. (2009) *Practices of Looking: An Introduction to Visual Culture*. New York: Oxford University Press. 2nd ed.
Sørensen, B.H. and Levinsen, K. (2010) *Skole 2.0. [Schooling 2.0]* Aarhus: KLIM.
Wing, J. M. (2006) "Computational thinking." Communications of the ACM, 49(3), 33-35. https://doi.org/10.1145/1118178.1118215

Plagiarism Tendencies and Contributing Factors in e-Learning Environments: Rwandan Higher Education Context

Jean Claude Byungura[1], Henrik Hansson[2], Kamuzinzi Masengesho[3] and Thashmee Karunaratne[2]
[1]University of Rwanda, College of Business and Economics, Kigali, Rwanda
[2]Stockholm University, Department of Computer and Systems Sciences, Stockholm, Sweden
[3]University of Rwanda, College of Arts and Social Sciences, Huye, Rwanda
jcbyungura@ur.ac.rw, byungura@dsv.su.se
hhansson@dsv.su.se
k.masengesho@ur.ac.rw
thasmee@dsv.su.se
DOI: 10.34190/EEL.19.087

Abstract: Plagiarism has been a critical concern to consider by universities and research institutes worldwide for ensuring academic integrity. Even with the internet revolution, this academic dishonesty became increasingly overwhelming more especially due to easy access and use of online resources without acknowledging the original authors. Prior research explored several perspectives of plagiarism such as culture, language, internet technology, and policies from different institutional settings. However, little is known about plagiarism in the online Rwandan higher education context. The aim of this study is twofold. First it attempts to understand the tendencies of plagiarism through internet-based resources and then secondly to identify the contextual factors that contribute to plagiarism by students at University of Rwanda. Both undergraduate and master's dissertations were randomly collected and analysed to ascertain the frequency of plagiarism tendencies from the text-based similarity indexes. In addition, open-ended interviews were conducted to 15 teachers and 15 students from UR colleges. Similarity indexes from Turnitin's originality reports were used to determine the frequency of similarity indexes through computer-based text-matching process. Results indicated a highly critical rate of tendencies to plagiarism each referred type of plagiarism. Likewise, findings portrayed that for the sample of analysed documents, no thesis document is deemed genuine to fulfil the academic integrity. In addition, the frequency of similarity indexes of the texts matched from the analysed thesis documents and online databases is closely similar for both undergraduate and graduate students. Moreover, this study identified 17 factors contributing mostly to plagiarising through easy access to internet resources at this university. Among them, six reasons are related to social-cultural context, five to institutional context and the last six are attributed to individual factors. A holistic approach encompassing innovative, detective and preventive strategies is recommended in association with computer-supported tools to eradicate plagiarism at this institution. Further research can explore the adoption and use of computer-based text matching tools as an additional strategy for combating plagiarism in both public and private universities at national or regional level by comparing several institutions.

Keywords: plagiarism control, digital learning environment, tertiary education, online text-matching, academic integrity

1. Introduction

Academic integrity is considered as a fundamental part of teaching and learning which benefit both students and educational institutions. The global perception is that plagiarism has become one of the prevalent issues that threaten educational integrity and quality of education (Vamplew and Dermoudy, 2005). Immensely accelerated by easy access to the internet in tertiary education particularly (Austin and Brown, 1999; Brown and Howell, 2001; DeVoss and Rosati, 2002; Wood, 2004; Howard, 2007), the extent of plagiarising has increased substantially worldwide. Thus, there are several assumptions positing that plagiarism is much greater in digital learning environments than in traditional classes (Heberling, 2002). Scholars have revealed that plagiarism cases, in the online learning process, can be both intentional and accidental (Franklyn-Stokes and Newstead, 1995; McGowan, 2005).

Different factors inclining students to plagiarise have been evidenced by a number of empirical studies in different contexts (Franklyn-Stokes and Newstead, 1995; Sutton and Huba, 1995; Bennett, 2005; Devlin and Gray, 2007). Some of these reasons include the lack of ethical education and knowledge about plagiarism itself, lack of academic writing skills, and lack of adequate policies on academic integrity. Adding to these factors, inadequate disciplinary measures, high desire to get high grades, easy access to digital academic archives, fear of failure and high time pressure for completing learning tasks are the other reasons inciting students to plagiarise (Devlin and Gray, 2007; Eret and Ok, 2014).

While technology has made it much easier for students to plagiarise, from digitally available resources, tools for online text-matching have also been developed. Several computer-based tools are implemented by universities with the purpose of controlling the illegal use of online materials in academic writing (Foster, 2002; Park, 2004; Scaife, 2007; Hill and Page, 2009; Shen *et al.*, 2009; Buckley and Cowap, 2013). However, several universities in the developing world are still using the manual process to control and detect plagiarism. This is anxious and time-consuming for teachers assigned to a big number of students for research supervision (Batane, 2010; Coughlin, 2011). This study aims to investigate how and why students plagiarise in academic writing. It relied not only on students and teachers' perceptions about plagiarism but also on the analysis of dissertations using an online text-matching tool. Considering that developing countries' higher learning institutions suffer from limitations of using technology in supporting plagiarism control, this research is carried out at the University of Rwanda (UR) as the case study.

2. Study background

2.1 Plagiarism in the digital age

Plagiarism in terms of academic misconduct has been there before the internet age. Subsequently, the latter came with easy access to web-based scientific databases, which made plagiarism a more severe problem in educational institutions. Consequently, as the learning process takes place in a ubiquitous computing environment, this encourages information sharing and makes plagiarism simpler to commit. Most students' assignments and final dissertations are prepared in an online environment using a huge amount of e-resources. Hence if these soft copies are not used reliably and ethically by students, this results definitely in hampering academic integrity.

Despite cultural differences and other variations between countries and higher learning institutions, plagiarism has become apparently a serious problem in the world's academic sphere (Teixeira and Rocha, 2006; Batane, 2010; Coughlin, 2011; Turnitin, 2012). Universities, especially in the western world, America and Asian-Pacific region have developed strong anti-plagiarism policies and disseminated them to create a strong awareness to ensure a strong academic integrity and institutional reputation (Brown and Howell, 2001; Jude and Zetterling, 2009; The University of Adelaide, 2011; Stockholm University, 2016). In Africa and especially in Rwanda, there are persistent claims from departments, schools and the university management that academic integrity and quality of education are strongly hindered by students' plagiarism (Wiehler, 2013), mainly facilitated by easy access to e-resources.

Students may plagiarise in both traditional and digital learning environments. Be it in later or the former environment, previous studies suggested some factors of plagiarism as classified into three categories: Societal-cultural, Institutional-contextual and Individual factors (McCabe and Trevino, 1997; Teixeira and Rocha, 2010; Eret and Ok, 2014). Social-cultural factors may include perceptions on peer behaviours, ethical values, the language of instruction, social membership and financial constraints (McCabe and Trevino, 1997; Teixeira and Rocha, 2010). Institutional factors include reasons such as teachers attitudes, heavy teaching workload, inadequate resources, lack of policies and guidelines on anti-plagiarism, lack of commitment to eradicate academic dishonesty and lack of strict penalties and limited time period for research (Haines, Diekhoff, LaBeff, & Clark, 1986; Hughes & Mccabe, 2006). The last category of individual factors involves students' laziness, poor time management, fear of failure, poor academic skills, poor understanding of plagiarism and lack of ethical skills and low level of previous educational background (McCabe and Trevino, 1993; McCabe, Trevino and Butterfield, 1999; Ledesma, 2011).

They are several plagiarism types as reported in the literature (Howard, 1995; Robert, 2001; Cabe, 2003; Collberg and Kobourov, 2005; McCabe, 2005; Bretag and Carapiet, 2007; Wright and Armstrong, 2008; Bretag and Mahmud, 2009; Pereira, Moreira and Galante., 2010; Coughlin, 2011; Turnitin, 2012; Harris, 2015). The list of plagiarism types provided in table 1 is mainly based on the classification from Turnitin. Although this list is not exhaustive, it can serve as a frame of reference to undertake a situational analysis of this phenomenon for this study. In whatever situation, among the above types of plagiarism, there is still no computer-based tool that can replace a teacher in evaluating students' papers. What the computer and internet can help a teacher is just to provide an originality report which makes easier to review and recommend further corrections in the dissertation before its final submission for grading.

Table 1: Types of plagiarism in the digital learning environment

Type of plagiarism	*Short Description*
Clone	Verbatim copying without any addition or subtraction (word-for-word).
CTRL-C	A written piece that contains significant portions of text from a single source without alterations.
Find-replace	Altering keywords and phrases with the essential content of the source unchanged.
Remix	Paraphrasing from other sources and making the content fit together seamlessly.
Unauthorised-collaboration	Using unknown someone else in academic writing.
Recycle	Self-plagiarism or borrowing one's own previous work without sourcing and citing
Hybrid	Combining correctly cited material with a non-cited material in the same passage.
Mashup	Improper citation of the mixed material copied from several sources.
404 Error	Including citations to falsified, fake or inaccurate sources.
Aggregator	Citing properly the material but the paper contains almost no original work.
Re-tweet	Properly cited but closely relied on wording and structure of other's original materials.
Translation	Submit a translated paper from one language to another.

Despite the high number of studies and reports that explored the issues of plagiarism in the digital age, the ones focusing on case studies in the global south, most especially in Africa are still scarce. Hence, this study intends to contribute to this field by evaluating the plagiarism phenomenon at the University of Rwanda. Prior studies explored this phenomenon focusing only on documents such as assignment papers (Walker, 2010) or journal articles and theses (Bretag and Carapiet, 2007; Coughlin, 2011). Others emphasised only on teacher perceptions (Batane, 2010; Stoltenkamp and Kabaka, 2014; Walker and White, 2014) and some others with a focus on the students' perspective (Bennett, 2005). This particular study identifies the types of plagiarism tendencies, and both teachers and students' views are taken into consideration for further understanding of the reasons inciting students to plagiarise. Therefore, this study was guided by the following two research questions: (1) What levels and types of plagiarism tendencies are the most frequent at the University of Rwanda? and (2) What reasons drive students to plagiarise at this university?

3. Materials and methods

In this study, a qualitative approach was adopted for data collection and it was designed in the form of a case study (Yin, 2009; Creswell, 2013). The University of Rwanda was selected as a single bounded system case for the inquiry. The analysis of data was performed qualitatively to understand the reasons for plagiarism, and quantitatively to determine the frequency of plagiarism. Qualitative inquiry is a type of methodology that allows a researcher to explore a phenomenon in a real-life setting over time by collecting in-depth data from multiple sources of information (Yin, 2009). Techniques for collecting data included interviews and documents survey. The latter include the university policies related to quality education and plagiarism prevention and the theses manuscripts that have been earlier submitted by students and already graded. Some dissertations documents were collected from the archives in the university library and others from different teachers/supervisors in their offices.

3.1 Participants

This study was carried out at the University of Rwanda (UR), a recent merger of all former public higher learning institutions. This university is composed of 6 colleges and several campuses across the country. A purposive sampling technique (Denscombe, 2014) was used and participants were chosen on the basis of their experience and previous usage of UR eLearning system. This is a non-probability sample that is particularly selected based on the study objective and population characteristics. Hence, participants included 15 teachers who were selected from all UR colleges and 15 students who were selected in undergraduate and postgraduate programs. While teachers have, experience ranging from 4 to 18 years, 10 undergraduate students have spent 4 to 5 years at university and the remaining five postgraduate students were in their final year program.

This sample participated in in-depth interviews that were conducted between July 2015 and June 2016 across all UR campuses. The interview arrangements, including time, date, purpose and the process of the research were previously communicated to the participants to allow them to express their willingness and convenience for participation. The main investigator has also assured the anonymity of participants by clearly informing that the interviews are only for the research purpose and that the provided information will be kept confidential. To ensure confidentiality, respondents names are excluded and codes are created for identifying them for this research. Associated

3.2 Data collection procedure

The interview guide was designed with reference to the conceptual framework of the most recurrent types and factors of plagiarism (See table 1) in the digital learning environment. The questions were designed to collect views from teachers and students on reasons (Devlin and Gray, 2007; Eret and Ok, 2014) for plagiarising at this institution and the extent to which they know about this academic fraud. They were also asked whether there exist any related preventive strategies at the University of Rwanda. Participants were also asked to provide their reflections on how plagiarism could be eradicated and to what extent the introduction of computer-based tools can be a sustainable support. To ensure the validity of research, especially on students' perspective, questions on plagiarism were not targeting individuals but rather the general view of the learning environment. This was to avoid students' private concerns about plagiarism phenomenon to be reported in the interviews, which is socially undesirable. Responses were recorded using a digital recorder and field notes were taken to allow further analysis after data transcription.

In addition to interviews, an authorisation to access the earlier submitted students' theses was sought and granted by the University Library. The policy at UR is that the copies of the defended dissertations remain the property of the university and hence the reason for getting a permission from the library to use them for this study. In total, using a stratified random sampling technique, 154 dissertation documents (bachelor and master's theses) were collected for analysis. These include thesis manuscripts contextually known as "Research Project Papers" or "Memoirs", that were submitted before and graded. As there were no systematic database or repository of submitted memoirs at UR libraries, some have been copied from compact Discs (CDs) and others from hard disk drives in each visited library office. As some files were corrupted and couldn't be opened for analysis, more other dissertation documents were collected from individual supervisors at their respective offices in order to increase the sample size. In total, a sample of 112 documents, spanned from 2012 to 2016 academic year, were successfully opened and hence selected for analysis. Of these documents, 40 are postgraduates while 72 are undergraduates. These documents range from many fields including Agriculture, Education, Health Sciences, Business, Economics, Social Sciences and Information technology.

3.3 Data analysis

The interview data were analysed using a thematic analysis approach of qualitative data (Braun and Clarke, 2006). This analysis was conducted in accordance with the types of plagiarism and the reasons why students plagiarise as mostly identified in the literature. Interviews were transcribed and later analysed to find out the main themes related to the reasons of plagiarism as the main core phenomenon under investigation. Identified reasons of plagiarism from respondents' perspective were categorised into three main factors of plagiarism namely institutional contextual, cultural context and student's cultural factors (Eret & Ok, 2014; Teixeira & Rocha, 2009). Suggestions on deterring plagiarism misconduct at UR were also identified and used in the formulation of recommendations and conclusion. Adding to that, relevant excerpts from interviews were used to illustrate identified themes. Where necessary, further contacts with individual respondents were made to get an agreement on a concise description of the results and ensure accuracy after the analysis.

For the corrected theses copies at UR, Turnitin, a computer-based anti-plagiarism system was used for analysis to produce similarity indexes as indicated by originality reports. The latter served as a reference to determine the frequency of each type of plagiarism detected. Turnitin is one of the existing online text-matching tools that is used to produce automatically the originality reports (Bretag and Mahmud, 2009; Turnitin, 2012). Using both the instructor and administrator's rights to Turnitin software, a sample class was created in the system and all the collected documents were submitted for plagiarism evaluation. Although there is a number of online systems for detecting plagiarism, Turnitin has been used for this study because it is currently in its early stages of implementation at the University of Rwanda. Thus, it was easy to have both student and instructor licenses which enabled us to submit the collected sample documents for text-matching process. Figure 1 below is one example of text-matching process to determine the similarity indexes which are processed and reported using the above-mentioned computer-based text-matching tool.

Figure 1: An example of the text-matching process using Turnitin as a computer-supported tool

For each thesis document, an originality report was generated and stored in the local computer disk before further analysis in line with the conceptual framework used in this study. The aim was to confirm whether or not a particular document contains any type of plagiarism. The analysis excluded the bibliography section while determining the percentage of plagiarised texts.

4. Results and discussion

4.1 Revels and frequency of plagiarism tendencies

The data analysed using Turnitin tool assisted in answering the first research question. By referring to the work of Batane (2010), the similarity indexes with bibliography section excluded, were categorised into five main levels and expressed in percentages. These levels are namely: Genuine Paper, Tolerable research, Low-scale, Medium-Scale and High-scale plagiarism. The table below shows these levels of plagiarism as expressed in percentage, where for example a student's Originality Report with 35% similarity match is classified as Low-Scale plagiarism.

Table 2: Scales for classifying the similarity indexes in this study

No	Level	Range of Similarity Index (%)
1	Genuine Paper	0-5
2	Tolerable Paper	6-19
3	Low-Scale plagiarism tendency	20-39
4	Medium-Scale plagiarism tendency	40-69
5	High-Scale plagiarism tendency	70-100

The levels and text-matching similarity indexes presented in the above table 2, served as the reference for data analysis to determine the extent to which the theses manuscripts are plagiarised and to which category (scale) of plagiarism each thesis document belongs to. Figure 2 below shows the percentage scale of each thesis manuscript and the level of plagiarism taking into consideration both undergraduate and postgraduate students' dissertations.

As it can be realised from the figure 2, of the total 112 documents analysed, 93,06 % (34.72, 44.44 and 13.89) are classified as plagiarised on Low, Medium and Highly scale for undergraduate program, while for postgraduate students, the trend looks similar at 97.50 % (52.50, 42.50 and 2.50) respectively as calculated from each similarity index from the originality reports. This occurrence indicates clearly that the extent of plagiarising at the University of Rwanda is highly critical. On the other hand, the same data indicate that for all the analysed papers, there is no genuine paper found and that only 9.44 % (6.94 % and 2.50 %) are regarded as tolerable dissertations.

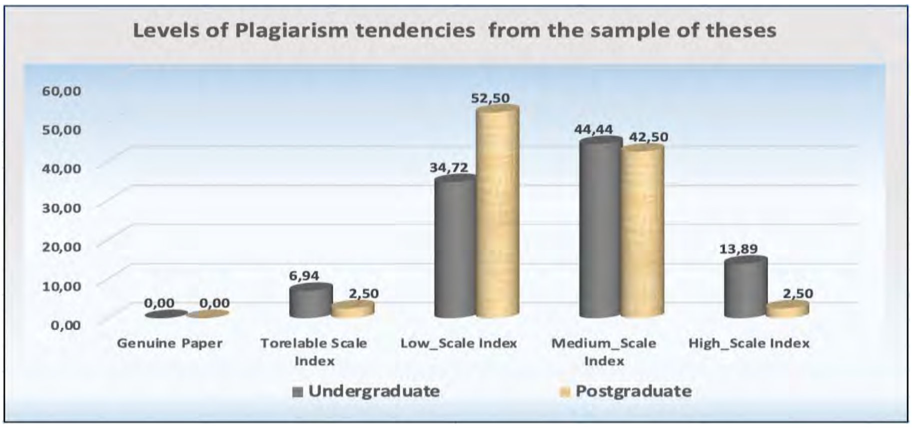


Figure 2: Levels of plagiarism from corrected sample of theses

The important note to make is that there is no universal agreement on what plagiarism rate to be accepted in the global scientific community. While Turnitin company suggests 25% text-matching as legitimate, other similar software for plagiarism control may have different rates. Therefore, most studies suggested that each university policy on plagiarism should be clear on what can be considered as an acceptable rate to guide the faculty in deterring this academic misconduct and guide students on how to write with integrity.

4.2 Frequency of plagiarism by category

With reference to the classification of Turnitin, which earlier identified 10 main types of plagiarism, it was also important to determine the frequency of plagiarism by each category using the same sample of documents corrected from teachers and the libraries across all the colleges of the University of Rwanda. Figure 3 below highlights these findings.

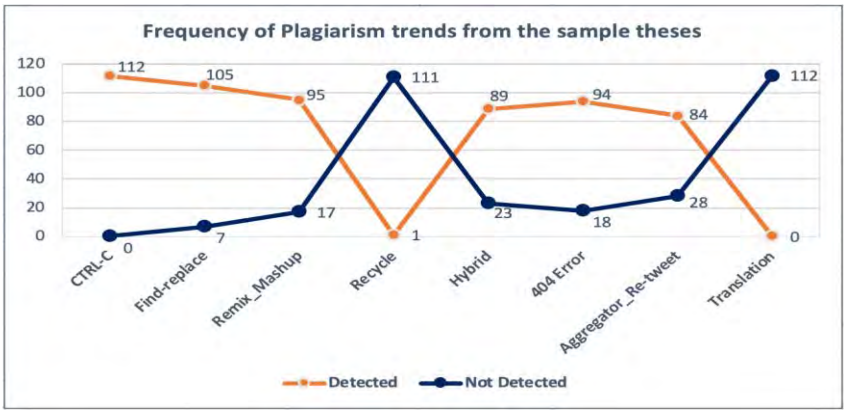


Figure 3: Frequency of plagiarism trends by type

The information from the above figure reveals that the total sample of documents contains significant portions of texts from other sources without changes. This means that all the sample documents (100 %) used in this study contains the “CTRL-C” type of plagiarism. This is followed by “Find-Replace”, “Remix-Mashup”, “404 Error” and “Clone-Verbatim” as they have been detected at the level of 93.75 %, 84.82 %, 83.93 % and 81.25 % out of the total analysed documents. In addition, all the remaining types of plagiarism have also been noticed in more than 75% of documents apart for “Recycle” category which is only apparent in one document (0.89 %). Hence, only in one thesis manuscript, there has been noticed a case of recycled blocks of texts copied from one of the author’s previous study without citation. This shows that the plagiarism frequency in most documents of final year students is highly critical and thus there is a high need to find out both preventive and detective measures by the University of Rwanda for this prevalent internet related plagiarism.

This study was also interested in examining the plagiarism phenomenon from each study program as the sample included both undergraduate and postgraduate thesis documents. In figure 4, the frequency of plagiarism is scattered into bachelor and master’s theses as per the sample used for the analysis. It can be observed that there is a slight difference in plagiarism between undergraduate and postgraduate students.

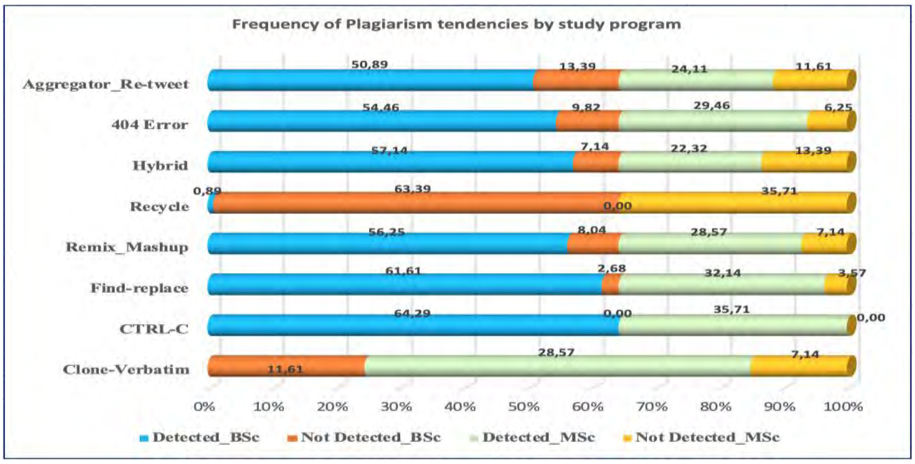


Figure 4: Frequency of plagiarism tendencies by study program

4.3 Factors of plagiarism from respondents' perceptions

This study was also interested in exploring the potential factors that contribute to plagiarism tendencies by students. To answer this question, a sample of teachers and learners were interviewed and related views were extracted from the interview transcriptions to form the base of analysis from respondents' perspectives. Identified reasons for plagiarism were categorised into three main factors namely, Societal-cultural, Institutional-contextual and Individual factors according to the explored literature.

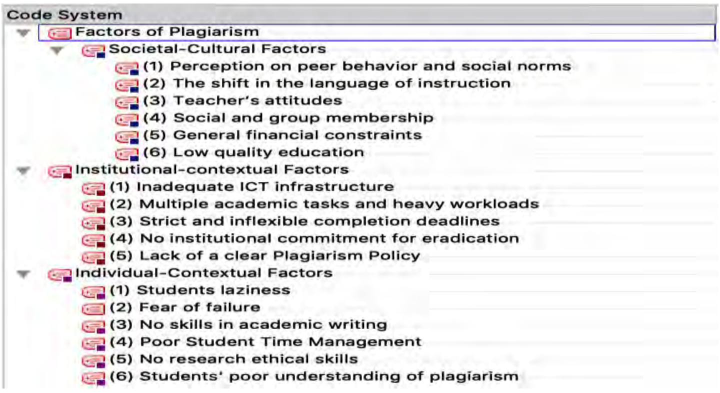


Figure 5: Identified factors of plagiarism from interviews

As reported in figure 5, six reasons related to societal-cultural factors were identified from the respondents' views as the contributing influences to plagiarism by students at University of Rwanda. Similarly, this study identified also six factors related to individual context and then five factors categorised under institutional context. All these reasons were expressed by both teachers and students in their interviews. They articulated them as incitements that lead students to involve themselves in academic misconduct, especially for the thesis course.

Overall, the mostly reported factors with high occurrences were the shift in the language of instruction in Rwandan tertiary education system, high degree of teachers who turn a blind eye in case of suspected plagiarism, perceptions on peer behaviours, social norms and group membership of the students. Some respondents for example revealed that plagiarism is an inherited factor as several cheating cases were reported but no disciplinary measures were taken to students neither at college or university levels.

Moreover, inadequate ICT infrastructure that can assist faculty members in controlling plagiarism was also highly reported as a strong factor. Several respondents maintained that the lack of an adequate text-matching tool is hindering the control of plagiarism even if teachers might be committed to doing so. Additionally, lack of institutional commitment and academic integrity policies, which are contextual to the University of Rwanda were also hugely accentuated by respondents. It was also noticed that some plagiarism cases are inadvertent when they are related to reasons such as lack of skills in ethics and academic writing, and students' poor understanding of what is plagiarism. Respondents interviewed in the present study emphasised that the current students at the University of Rwanda do not have adequate research ethical skills and this factor is seemingly related to poor understanding of plagiarism. The poor time management for students and their laziness are also interlinked. This was amplified by some teachers who said that today's students are interested in easy going life and do not see any value for their research. For that reason, they allocate a little time on thesis writing and get to concentrate on it when they are close to the deadline. Due to poor understanding of plagiarism, some interviewed teachers did not hesitate to mention that some plagiarism cases by students are even not intentional due to lack of knowledge on this academic misconduct.

5. Conclusion and future work

The purpose of this study was to understand the frequency of plagiarism tendencies and the perceivable contributing factors for this academic misconduct by students at the University of Rwanda. Results indicated that, with today's internet opportunities offered in the online learning environment, plagiarism at this institution is at high scale. The most critical types of plagiarism that were found to be at the highest level include, the "Copy-Paste", "Find-replace", Remix-Mashup", "404 Error" and "Clone-Verbatim" respectively. Although the frequency is not highly significant for other types of plagiarism explored in this study (Figure 3), they have been also observed in all the analysed documents, which impact negatively as well on the institutional academic integrity. In addition, for the total sample of the analysed documents, none is deemed as a genuine dissertation, while the majority of them recorded the extreme text-matching similarity indexes (39% to 100 %) with the online sources. Thus, in the same sample of documents, only 6,45% of undergraduates and 2,50 % of graduate memoirs are considered as tolerable. The analysis of similarity indexes did not consider bibliographies and small blocks of quotes in the sample of documents used for this study.

From the interviews conducted with teachers and students, the study revealed 17 key factors that drive students of University of Rwanda to plagiarise in their research projects. These factors have been clustered into three the main factors namely societal-cultural, institutional-cultural and individual related factors as it can be indicated in table 3,4 and 5 respectively. If we make a reference to the types of plagiarism identified and the reasons for plagiarism as discussed by respondents, this study proposed both preventive and detective measures to eradicate this academic misconduct at this university. It is highly urgent to develop different capacities in terms of human, infrastructure and sustainable strategies for cultivating academic integrity. Suggestions for addressing the above individual factors have been proposed by respondents. The design and integration of a course on academic writing and reference management systems on both teachers and incoming students in their first year were also proposed. This course should cover the issues of academic integrity rules, policies; and codes of conduct in higher education. They also mentioned that this course should cover the topics of academic honesty and types of plagiarism in the digital age. Likewise, this study proposes some plagiarism preventive actions. These include the creation of anti-plagiarism policy and its awareness, development of students' ethical and academic skills, enforcement of appropriate penalties in a transparent way for identified cases of plagiarism, revision of the teaching workloads, reduction of the teacher-student ratio in thesis supervision and the allocation of enough time for the final research projects. As detective measures, the implementation of a computer-based text-matching tool and related training for the teachers and researchers are also recommended.

Furthermore, easy access to ICT resources including but not limited to internet, online libraries and databases for students, is needed to be improved at this university. The establishment of a holistic and transparent system to deter plagiarism at UR is a key strategic component to allow the faculty, students and administrators appreciate the meaning and danger of this prevalent academic dishonest in thesis, course assignments and other research activities at UR. Teacher training on the new tools for determining and analysing pedagogically the originality reports from plagiarism detection software is also highly recommended. Last but not the least, some respondents revealed that some teachers do not have skills in online reference management systems, as part of the scientific academic writing skills. Thus, special training is advocated for them as prerequisites in order to equip them with what they should similarly transfer to students. As a further research, this study suggests a deeper action research on the adoption and application of a specific plagiarism detection software at this university or any similar context as a further research. The latter should go into detail to explore the experiences of a system integration process and to measure the degree of use by teachers and students. The validity of generalising this study results is, indeed, limited and impossible due to the sample size, the data used, and the case study which is only a public university. Therefore, a further nation or regional-wide research to be undertaken in both private and public universities to provide a general bigger picture of plagiarism in the digital environment is hereby recommended. The results of such an extended study could serve as the baseline for establishing a common and holistic framework with appropriate contextual measures to combat plagiarism at a holistic higher level.

Acknowledgements

This study has been conducted under the support from the Swedish International Development Cooperation Agency (SIDA), Stockholm University, and the University of Rwanda within the UR-Sweden Program for research, higher education, and institutional advancement. Hence, the above support is highly acknowledged. Our special thanks go to the teachers and students from the University of Rwanda who voluntarily participated in this research. We wish also to acknowledge the efforts of the directors of the libraries at the college level for their collaboration in this research data collection.

References

Austin, M. J. and Brown, L. D. (1999) 'Internet Plagiarism: Developing Strategies to Curb Student Academic Dishonesty', *The Internet and Higher Education*, 2(1), pp. 21–33.

Batane, T. (2010) 'Turning to Turnitin to Fight Plagiarism among University Students', *Journal of Educational Technology & Society*, 13(2), pp. 1–12.

Bennett, R. (2005) 'Factors associated with student plagiarism in a post-1992 university', *Assessment & Evaluation in Higher Education*. 2005, 30(2), pp. 137–162.

Braun, V. and Clarke, V. (2006) 'Qualitative Research in Psychology Using thematic analysis in psychology Using thematic analysis in psychology', *Qualitative Research in Psychology*, 3(2), pp. 77–101.

Bretag, T. and Carapiet, S. (2007) 'A Preliminary Study to Identify the Extent of Self-Plagiarism in Australian Academic Research', *Plagiary: Cross-Disciplinary Studies in Plagiarism, Fabrication, and Falsification*, 2(5), pp. 92–103.

Bretag, T. and Mahmud, S. (2009) 'A model for determining student plagiarism: Electronic detection and academic judgement', *Journal of University Teaching and Learning Practice*, 6(1), pp. 49–60.

Brown, V. J. and Howell, M. E. (2001) 'The Efficacy of Policy Statements on Plagiarism: Do They Change Students' Views?', *Research in Higher Education*, 42(1), pp. 103–118.

Buckley, E. and Cowap, L. (2013) 'An evaluation of the use of Turnitin for electronic submission and marking and as a formative feedback tool from an educator's perspective', *British Journal of Educational Technology*, 44(4), pp. 562–570.

Cabe, P. A. (2003) *Examples of plagiarism--A taxonomy, in 'TIPS on Plagiarism'*, *University of North Carolina at Pembroke*. Available at: https://www.skidmore.edu/psychology/resources/student/tips.php (Accessed: 24 November 2015).

Collberg, C. and Kobourov, S. (2005) 'Self-plagiarism in computer science', *Communications of the ACM*, 48(4), pp. 88–94.

Coughlin, P. E. (2011) 'Plagiarism in five universities in Mozambique: Magnitude, detection techniques, and control measures', *International Journal of Educational Integrity*, 11(2), pp. 1–19.

Creswell, J. W. (2013) *Qualitative Inquiry and Research Design: Chosing Among Five Approaches*. 3rd edn. Los Angeles: Tousand Oaks, CA: Sage.

Denscombe, M. (2014) *The good research guide: for small-scale social research projects*. McGraw-Hill Education, (UK).

Devlin, M. and Gray, K. (2007) 'In their own words: a qualitative study of the reasons Australian university students plagiarize', *Higher Education Research & Development*, 26(2), pp. 181–198.

DeVoss, D. and Rosati, A. C. (2002) '"It wasn't me, was it?" Plagiarism and the Web', *Computers and Composition*, 19(2), pp. 191–203.

Eret, E. and Ok, A. (2014) 'Internet plagiarism in higher education: tendencies, triggering factors and reasons among teacher candidates', *Assessment & Evaluation in Higher Education*, 39(8), pp. 1002–1016. doi: 10.1080/02602938.2014.880776.

Foster, A. L. (2002) 'Plagiarism-Detection Tool Creates Legal Quandary When professors send students' papers to a database, are copyrights violated?', *The chronicle of higher education*, 48(36), pp. A37–A38.

Franklyn-Stokes, A. and Newstead, S. E. (1995) 'Undergraduate cheating: Who does what and why?', *Studies in Higher Education*, 20(2), pp. 159–172. doi: 10.1080/03075079512331381673.

Haines, V. J. *et al.* (1986) 'College cheating: Immaturity, lack of commitment, and the neutralizing attitude', *Research in Higher Education*, 25(4), pp. 342–354. doi: 10.1007/BF00992130.

Harris, R. (2015) *Anti-Plagiarism Strategies for Research Papers*, *VirtualSalt*. Available at: http://www.virtualsalt.com/antiplag.htm (Accessed: 28 May 2016).

Heberling, M. (2002) 'Maintaining Academic Integrity in On-Line Education.', *Online Journal of Distance Learning Administration*, 5(1), pp. 1556–3847.

Hill, J. D. and Page, E. F. (2009) 'An Empirical Research Study of the Efficacy of Two Plagiarism-Detection Applications', *Journal of Web Librarianship*, 3(3), pp. 169–181.

Howard, R. M. (1995) 'Plagiarisms, Authorships, and the Academic Death Penalty', *College English*, 57(7), pp. 788–806. doi: 10.2307/378403.

Howard, R. M. (2007) 'Understanding "Internet plagiarism"', *Computers and Composition*, 24(1), pp. 3–15.

Hughes, J. M. C. and Mccabe, D. L. (2006) 'Understanding Academic Misconduct', *Canadian Journal of Higher Education Revue canadienne*, 36(1), pp. 49–63.

Jude, C. and Zetterling, C.-M. (2009) *Guiding students away from plagiarism*. 1st edn. Stockholm: KTH Learning Lab.
Ledesma, R. G. (2011) 'Academic Dishonesty among Undergraduate Students in a Korean University', *Research in World Economy*, 2(2), pp. 25–35. doi: 10.5430/rwe.v2n2p25.
McCabe, D. L. (2005) 'Cheating among college and university students: A North American perspective', *International Journal for Educational Integrity*, 1(1), pp. 1–11.
McCabe, D. L. and Trevino, L. K. (1993) 'Academic Dishonesty: Honor Codes and Other Contextual Influences', *The Journal of Higher Education*, 64(5), pp. 522–538. doi: 10.2307/2959991.
McCabe, D. L. and Trevino, L. K. (1997) 'Individual and Contextual Influences on Academic Dishonesty: A Multicampus Investigation', *Research in Higher Education*, 38(3), pp. 379–396. doi: 10.1023/A:1024954224675.
McCabe, D. L., Trevino, L. K. and Butterfield, K. D. (1999) 'Academic Integrity in Honor Code and Non-Honor Code Environments: A Qualitative Investigation', *The Journal of Higher Education*, 70(2), pp. 211–234. doi: 10.2307/2649128.
McGowan, U. (2005) 'Educational integrity: a strategic approach to anti-plagiarism', in *2nd Asia-Pacific Educational Integrity Conference*. Australia: University of Newcastle.
Park, C. (2004) 'Rebels without a clause: towards an institutional framework for dealing with plagiarism by students.', *Journal of Further and Higher Education*, 28(3), pp. 291–306.
Pereira, R. C., Moreira, V. P. and Galante., R. (2010) 'A new approach for cross-language plagiarism analysis.', in *International Conference of the Cross-Language Evaluation Forum for European Languages*. Berlin Heidelberg: Springer, pp. 15–26.
Robert, A. H. (2001) *The plagiarism handbook: Strategies for preventing, detecting, and dealing with plagiarism*. 1st edn. California: Eyrczak Publishing.
Scaife, B. (2007) *IT Consultancy Plagiarism Detection Software Report for JISC Advisory Service*. Manchester: NCC Group plc.
Shen, Y. *et al.* (2009) 'Research on Anti-Plagiarism System and the Law of Plagiarism', in *2009 First International Workshop on Education Technology and Computer Science*. IEEE, pp. 296–300. doi: 10.1109/ETCS.2009.327.
Stockholm University (2016) *Regulations for Disciplinary Matters at Stockholm University*. Available at: http://www.su.se/english/about/rule-book/regulations-for-disciplinary-matters-at-stockholm-university-1.181 (Accessed: 16 June 2016).
Stoltenkamp, J. and Kabaka, M. (2014) 'Turnitin Adoption and Application at a HEI : A Developmental Approach', *Creative Education*, 5, pp. 1043–1052.
Sutton, E. M. and Huba, M. E. (1995) 'Undergraduate Student Perceptions of Academic Dishonesty as a Function of Ethnicity and Religious Participation', *NASPA Journal*, 33(1), pp. 19–34.
Teixeira, A. A. C. and Rocha, M. F. (2006) 'Academic Cheating in Austria, Portugal, Romania and Spain: a comparative analysis', *Research in Comparative and International Education*, 1(3), pp. 198–209. doi: 10.2304/rcie.2006.1.3.198.
Teixeira, A. A. C. and Rocha, M. F. (2010) 'Cheating by economics and business undergraduate students: an exploratory international assessment', *Higher Education*, 59(6), pp. 663–701.
The University of Adelaide (2011) *Academic Honesty Policy*, *The University of Adelaide*. The University of Adelaide. Available at: http://www.adelaide.edu.au/policies/230 (Accessed: 24 July 2016).
Turnitin (2012) *The Plagiarism Spectrum; Instructor Insights into the 10 Types of Plagiarism.* Available at: http://pages.turnitin.com/rs/iparadigms/images/Turnitin_WhitePaper_PlagiarismSpectrum.pdf.
Vamplew, P. and Dermoudy, J. (2005) 'An Anti-Plagiarism Editor for Software Development Courses BT', in *Proceedings of the 7th Australasian conference on Computing education*. Australian Computer Society, Inc., pp. 83–90.
Walker, C. and White, M. (2014) 'Police, design, plan and manage: developing a framework for integrating staff roles and institutional policies into a plagiarism prevention strategy', *Journal of Higher Education Policy and Management*, 36(6), pp. 674–687.
Walker, J. (2010) 'Measuring plagiarism: researching what students do, not what they say they do', *Studies in Higher Education*, 35(1), pp. 41–59.
Wiehler, S. (2013) 'Analysing Memoir Topic Trends in the Social and Political Sciences in the Faculty of Arts, Media and Social Sciences at NUR', *Rwanda Journal*, 1(1), pp. 36–48.
Wood, G. (2004) 'Academic Original Sin: Plagiarism, the Internet, and Librarians', *The Journal of Academic Librarianship*, 30(3), pp. 237–242.
Wright, M. and Armstrong, J. S. (2008) 'The Ombudsman: Verification of Citations: Fawlty Towers of Knowledge?', *Interfaces*, 38(2), pp. 125–139.
Yin, R. K. (2009) *Case study research:Design and method*. 4th edn. Tousand Oaks, CA: Sage.

Current Challenges in Gamification Identified in Empirical Studies

Daniel Cermak-Sassenrath
IT-University, Copenhagen, Denmark
dace@itu.dk
DOI: 10.34190/EEL.19.065

Abstract: For about ten years gamification has been a buzzword in business, and for about 20 years a topic of research in academia. Despite much commercial interest in and a potentially huge market for successful products, for instance, in the areas of education and health, much excitement is still based on speculation, reception in parts of the academic community remains sceptical, and a pervasive application in many areas of everyday life is arguably yet to happen. It might be time to take stock: By collating observations from multiple empirical studies and meta-studies, this survey identifies, briefly presents and discusses definitions, aims, applications, strategies and specifically challenges of gamification. While gamification is far from being the first or the only notion to describe attempts to connect play with purposes beyond itself, this study is based on research that identifies itself as being focused on gamification. This study does not aim to exhaustively list experiences or results of gamification, or to carry out a systematic review of the field, but to collect and highlight issues that need to be resolved or mitigated for gamification to progress. It finds problematic definitions, unclear strategies, a low number of empirical studies, methodological problems, mixed and partial results, non-uniform user behaviours, a predominant focus of studies on low-level behavioural effects and short-term effects, as well as undesirable side-effects of gamification.

Keywords: challenge, education, empirical survey, gamification, health

1. Introduction

The idea to fit play with purposes beyond itself, to 'leverage aspects of games to achieve something beyond playfulness' (Richter, Raban, Rafaeli, 2015), has been proposed and implemented many times, before and after the 'digitalisation of society or the massive economic success of computer games' (Fuchs, 2014)[1], under a plethora of monikers. This study is based on research that identifies itself as being focused on gamification.

Regardless of when and by whom the notion of gamification was first proposed (Tulloch, 2014; Hägglund, 2012), 'only around the beginning' of the 2010s (Fuchs, 2014) it 'gained widespread usage' (Tulloch, 2014), and 'has become a favoured buzzword of marketers, online strategists, start-up gurus, venture capitalists and digital consultants' (ibid.). But despite much commercial interest in and a potentially huge market for successful gamification products (critically discussed by Fuchs, 2014), for instance, in the areas of education and health, much excitement is still based on speculation, reception by 'many games studies academics and game designers' remains sceptical (Tulloch, 2014; see e.g. Fizek, 2014; Raczkowski, 2014), and a pervasive application in many areas of everyday life is arguably yet to happen. It might be time to take stock: By collating observations from multiple empirical studies and meta-studies, this study identifies, briefly presents and discusses definitions, aims, applications, strategies and specifically challenges of gamification. This study does not aim to exhaustively list experiences or results of gamification, but to collect and highlight issues that need to be resolved or mitigated for gamification to progress. The survey is not systematic, but includes empirical gamification studies and meta-studies that are identified through online searches using various search engines such as *Google Scholar* (in April and May 2018), and surveys of empirical studies this author is aware of such as Hamari et al. (2014), Seaborn and Fels (2015), and Johnson et al. (2016).

2. Definitions of gamification

Gamification is often defined as the process of transforming a non-play and usually purposeful activity in some way and to some degree into a play activity, that is, usually, a game (Deterding, 2015)[2], while keeping the purpose intact; the resulting artefact is said to have been *gamified*. Full-fledged so-called serious games that incorporate some e.g. educational elements are thus not addressed by this notion (Seaborn, Fels, 2015).

Gamification is taken here to be a *motivational method*; 'an attempt to afford for the emergence of intrinsic motivations' (Hamari, Koivisto, Sarsa, 2014) by harnessing the intrinsic motivation that drives play, 'by getting

[1] Fuchs (2014) 'present[s] examples' of 'predigital gamification' from the areas of 'religious practice, music, magic, education, lifestyle, and styles for killing'.
[2] For a critical account of which qualities are usually recognized by gamification attempts in games and thus reproduced outside and independent of them see Raczkowski (2014).

close as much as possible to the enjoyable and fun experience found in games' (Rapp, 2017; see Deterding, 2015). In the area of education, 'applying game mechanics to the classroom should increase students' *intrinsic motivation* to learn' (Hanus, Fox, 2015, emph. added). Gamification can thus be seen as a turn away from a reliance on traditional methods of extrinsic motivation such as 'rewards or punishments' (Johnson et al., 2016). The findings of Seaborn and Fels' (2015) meta-study 'suggest an emerging consensus' in gamification to focus on 'intrinsic, or internally-driven, motivation above and beyond a reliance on extrinsic, or externally mandated, motivators'.

One early and still prominent (Rapp, 2017) definition of gamification in the academic discourse is Deterding et al.'s (2011) definition, which focuses on the use of game design elements and game mechanics (Seaborn, Fels, 2015) in non-game contexts. It assumes that 'single design elements, such as points, badges and leaderboards' can be extracted 'from their original gaming context' and implanted 'in other environments', with 'their effects on players' intact (Rapp, 2017). Kapp (2012 qtd. in Seaborn, Fels, 2015) similarly names 'game-based mechanics, esthetics and game thinking' as elements to employ in gamification.

An alternative perspective for gamification is offered by Huotari and Hamari (2012) who propose to focuses on 'invoking the same psychological experiences as games (generally) do' (Hamari, Koivisto, Sarsa, 2014). Very similarly, Werbach defines gamification as 'the process of making activities more game-like' (2014 qtd. in Sailer et al., 2017) and aims to 'elicit user experiences typical of games' (Sailer et al., 2017). Werbach and Hunter’s (2012) definition of gamification appears to aim to combine the approaches of Huotari and Hamari (2012) and Hamari et al. (2014); they posit to use game elements such as 'dynamics, mechanics, [and] components' (Seaborn, Fels, 2015) but not to create game-like systems (ibid.), but to 'take advantage of human psychology in the same way that games do' (ibid.). Sailer et al. (2017) appear to employ a very similar notion; they propose a 'definition that combines both views', that is, Deterdings et al. (2011) and Werbach's (2014), to 'define gamification as the process of making activities in non-game contexts more game-like by using game design elements'.

These definitions are not unproblematic. For instance, it is often unclear what a game design element is, which psychological effect it has on players/users (Seaborn, Fels, 2015) and how it interacts with other elements, and that many game elements are actually not unique to games (Hamari, Koivisto, Sarsa, 2014). A majority of 'reviewed methods' (Deterding, 2015) of gamification appear to centre around the same, relatively small set of popular 'design elements' (ibid.). These 'largely consist [of] [...] points, achievements, leader boards, levels, virtual items, quests/missions, avatars, collections, unlocking, engagement loops, onboarding, competition, cooperation, or feedback' (ibid.). Mekler et al. (2017) observe that typical gamification implementations most often use '[p]oints, levels and leaderboards, [...] the poster children of gamification [...], due to their apparent connection to digital games [...] and due to them being readily applicable to various non-game contexts'.[3] While Deterding et al. (2011) 'propose to define game design elements as those elements that are characteristic of games, i.e. that can be found in many games, and that are significant to the meaning of the game' (Sailer et al., 2017), Sailer et al. note that it 'is often somewhat arbitrary and subjective' (ibid.), 'which building blocks should be identified as characteristic game design elements' (ibid.); they also point out that the use of 'many different game design elements [...] can result in very diverse applications' (ibid.). It is also often unclear which particular experiences are facilitated by games, and how these can be brought about.

Attempts to mitigate the issues are undertaken. Deterding (2015) addresses the gap between game design elements and player experience by proposing a design framework. Sailer et al. (2017) investigate how a set of game design elements correlates with the satisfaction of psychological needs of players; they find 'that specific game design elements have specific psychological effects' (ibid.). Mekler et al. set out to 'experimentally investigate the effects of individual game elements' on 'both behavioral outcomes and users' intrinsic motivation' to address the problem that 'most empirical gamification studies investigate the impact of multiple game elements [at the same time], making it difficult to pinpoint how and to what extent these game elements contribute to user motivation and behavior' (2017). Their study examines 'specifically [...] how points, leaderboards, and levels, – three of the most commonly employed game elements [...], – affect need satisfaction, intrinsic motivation and performance' (ibid.). They find that 'in this particular study context, points, levels and

[3] Sailer et al. posit that '[g]ame design elements', that is, 'the basic building blocks of gamification applications [...] are largely equivalent with game design patterns' (2017) – a position that appears not to be pervasively represented in the discourse; certainly it is absent from Deterding et al.'s 2011 definition.

leaderboards may have functioned as (effective) extrinsic incentives' (ibid.), leading to neither 'more feelings of competence' nor to increased 'intrinsic motivation compared to the plain condition' (ibid.).

Depending on notion and method or framework, 'the specific designs and realizations of gamification environments can be quite diverse' (Sailer et al., 2017). Examples of gamification include applications as different as *FourSquare*, *Stack Overflow*, *CAPTCHAs* and *Duolingo* (Richter, Raban, Rafaeli, 2015; Figure 1), the *Khan Academy* and *Codecademy* (Hägglund, 2012), an in-house currency at Google, a carpooling game at SAP, the *Foldit* campaign for participants to playfully solve scientific problems, recycling initiatives by Recycle Bank, Opowerl and the Halton Borough Council, a response-time leaderboard at Engine Yard, and gamified annual reviews at Spotify and Living Social (Dale, 2014).

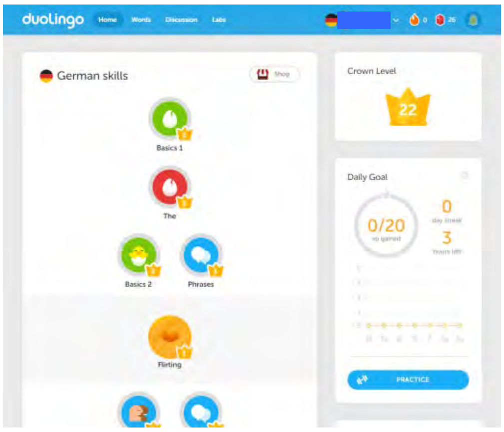


Figure 1: Example – *Duolingo* user home page interface with gamification elements

3. Aims of gamification

Gamification may aim to facilitate engagement and motivation (Raczkowski, 2014) e.g. in educational situations (Seaborn, Fels, 2015; Hanus, Fox, 2015; Sailer et al., 2017; Mekler et al., 2017), to sweeten or 'to inject a little fun into mundane activities' (Sardi, Idri, Fernández-Alemán, 2017) or into otherwise tedious or boring tasks (Seaborn, Fels, 2015; Hanus, Fox, 2015; Sardi, Idri, Fernández-Alemán, 2017); 'to promote participation, persistence and achievements' (Richter, Raban, Rafaeli, 2015); to change behaviour (Aparicio et al., 2012; Nicholson, 2012; Blohm, Leimeister, 2013; Sakamoto, Nakajima, Alexandrova, 2012 in Seaborn, Fels, 2015; Rapp, 2017) which might include 'increased participation, improved performance, or greater compliance' (Seaborn, Fels, 2015; Rapp, 2017); to function 'as an analytical strategy to capture and track data in a system' (Seaborn, Fels, 2015); 'to create engaging workplaces [...]; facilitate mass-collaboration [...] or encourage knowledge contribution' (Richter, Raban, Rafaeli, 2015); 'to incentivize repeat usage, increase contributions, and establish user reputations' (ibid.); and to 'solve problems' (Kapp, 2012 qtd. in Seaborn, Fels, 2015).

4. Applications of gamification

Popular application contexts for gamification include commerce, education/learning, self-optimisation (health/exercise/wellness and 'healthy food habits' (Raczkowski, 2014; Rapp, 2017)), 'control on patients' diseases' (ibid.), intra-organizational systems and sharing, environmentally sustainable consumption and 'environmental protection' (Sailer et al., 2017), work/workplace, innovation/ideation, data gathering (Hamari, Koivisto, Sarsa, 2014; Richter, Raban, Rafaeli, 2015; Hanus, Fox, 2015); consulting (Raczkowski, 2014); marketing/customer loyalty, politics, interactive systems (Richter, Raban, Rafaeli, 2015; Herzig, Ameling, Schill, 2012 in Sardi, Idri, Fernández-Alemán, 2017); online communities and social networks, as well as crowdsourcing (Seaborn, Fels, 2015).

In their 'review of applied gamification research' Seaborn and Fels (ibid.) observe 'a wide range of interest but a largely limited playing field'. The focus appears to lie 'largely' within 'the domain of education, and to a lesser extent [within] health and wellness, online communities, crowdsourcing, and sustainability'; Sardi et al. (2017) see 'considerable interest in applying gamification to the digital healthcare industry'.

5. Strategies for gamification

While one could plausibly assume that to introduce external incentives generally increases participants' motivations for an activity, this is not necessarily the case. On the contrary, they might even compromise participants' intrinsic motivations. According to Cognitive Determination Theory (CET), intrinsic motivation is sustained by 'the innate psychological needs for competence and self-determination' (Deci et al. 2001). People's 'perceptions of competence and self-determination' are impacted by 'external events such as the offering of rewards, the delivery of evaluations, the setting of deadlines, and other motivational inputs' (ibid.). Events 'that lead to a more external perceived locus of causality' decrease people's perceived self-determination and 'undermine [their] intrinsic motivation'; whereas events 'that increase [people's] perceived self-determination (i.e., that lead to a more internal perceived locus of causality) will enhance [their] intrinsic motivation' (ibid.). Similarly, 'events that increase perceived competence will enhance intrinsic motivation so long as they are accompanied by perceived self-determination [...], and those that decrease perceived competence will diminish intrinsic motivation' (ibid.).

Deci et al. posit that incentives such as rewards 'have two aspects' (2001), that can lead to people to feel either 'feel competent and in control' or to 'feel powerless and incompetent' (Hanus, Fox, 2015). CET explains that '[t]he *informational* aspect conveys self-determined competence and thus enhances intrinsic motivation', while 'the *controlling* aspect prompts an external perceived locus of causality (i.e., low perceived self-determination) and thus undermines intrinsic motivation' (Deci, Koestner, Ryan, 2001). The use of desirable, 'tangible rewards (including material rewards, such as money and prizes, and symbolic rewards, such as trophies and good player awards)' decreases intrinsic motivation, 'because tangible rewards are frequently used to persuade people to do things they would not otherwise do, that is, to control their behavior' (ibid.).

Several gamification strategies can be identified that thus aim to facilitate the emergence of intrinsic motivations. Nicholson (2012) subscribes to the idea for gamification 'to buil[d] upon intrinsic, or internal, motivation rather than [on] extrinsic, or external, motivation' (Seaborn, Fels, 2015). He 'outlines a number of core theories that could inform a more intrinsic gamified strategy for meaningful engagement' (ibid.). Based on '*[o]rganismic integration theory* [Ryan, Kuhl, Deci, 1997], a sub-theory of self-determination theory' (Seaborn, Fels, 2015), he 'proposes a user-centred framework for *meaningful gamification*' (ibid.), which 'articulates useful design values (user centricity, transparency, personalization)' (Deterding, 2015). The main mechanic appears to be to move the external motivators for the desired outcomes of the intervention along the 'continuum of motivation intentionality mediated by internal and external methods of control' from 'extrinsic motivation' towards 'internally-controlled or autonomous intrinsic motivation' (Seaborn, Fels, 2015; Figure 2).[4] Sakamoto et al. (2012) develop a similar 'value-based gamification framework for designers aiming to encourage and harness intrinsic motivation' (Seaborn, Fels, 2015). Zichermann (apparently Zichermann, Linder, 2010) propose 'to craft extrinsic motivators – external controllers of behavior – such that they feel like or become internalized as intrinsic motivators' (Seaborn, Fels, 2015).[5]

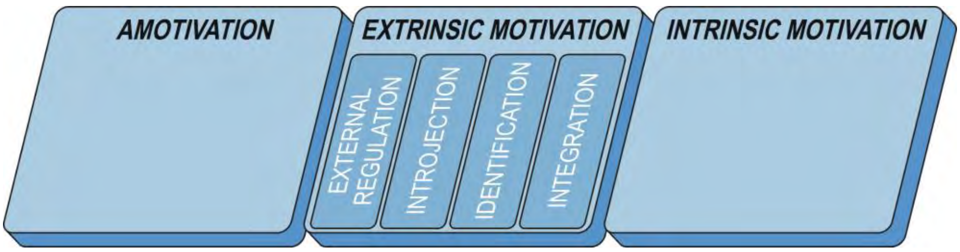


Figure 2: Regulatory styles in human motivation (after Ryan, Deci, 2000)

Zichermann (2011) judges the appeal to 'specific intrinsic motivators' (Seaborn, Fels, 2015) in gamification as too unreliable, 'given [the] individual variability in what is intrinsically motivating' (ibid.). Linderoth (2014) similarly observes that 'there is no one-size-fits-all relationship between game design and intrinsic interest and enjoyment'. Zicherman thus 'argue[s] that extrinsic motivators should be designed with the goal of addressing intrinsic factors' (Seaborn, Fels, 2015). However, addressing generic intrinsic motivators may not simply be a (technical) question of picking and using certain (game) design elements – how a system or 'a given motivator –

[4] Deterding (2015) criticizes Nicholson's model for failing to articulate an 'actual method'.

[5] Rapp (2017) identifies and outlines an internalising strategy in *World of Warcraft* that stimulates players 'to interiorize new habits' based on 'the norms of the guild which they belong to'.

game element, feedback, piece of information' (ibid.) is read by its users 'depends on individual and contextual factors' (ibid.; see Deterding, 2015). Nonetheless, a number of models are proposed of how to represent external motives 'in concrete game elements' (ibid.) which then translate those into intrinsic motivations. Seaborn and Fels comment that 'more research on how to design for intrinsic motivation using extrinsic motivators as well as the effects of non-monetary incentives on motivation is needed to validate this approach' (ibid.).

A complementary approach is to use specific, individualized implementations targeted at particular target audiences, rather than an 'ideal gamified system – an optimal combination of game elements, mechanics, and dynamics that always works' (Seaborn, Fels, 2015). Seaborn and Fels propose that the design of gamified systems would negotiate the 'individual differences in *what* is intrinsically motivating' with 'the objectives, requirements, and restrictions of the designer (or client)' (ibid.; see Deterding, 2015). Such 'gamified systems may need to be selectively designed given the individual makeup of the end-user population or even be designed flexibly and inclusively, allowing for personalization and customization, to accommodate individual users' (ibid.).

6. Challenges of gamification

Many expectations are expressed about effects of gamification, for instance, in the area of education. Researchers speculate 'that the incorporation of certain game mechanics with clear learning objectives in mind can create an engaging and meaningful experience' (Hanus, Fox, 2015), and that '– provided a non-controlling setting, – the well-thought out implementation of game elements may indeed improve intrinsic motivation by satisfying users' innate psychological needs for autonomy, competence and relatedness' (Mekler et al., 2017).

A number of meta-studies or literature reviews attempt to establish empirical results of gamification. But the number of empirical studies of gamification is relatively low yet (Johnson et al., 2016; Hanus, Fox, 2015; Lieberoth, 2014); Richter et al. (2015) note that while an increasing number of 'applications use game design elements to motivate user behavior in non-game contexts [...] there is to date little empirical research on how gamification works and whether it succeeds in promoting user motivation'. Johnson et al.'s review (2016) only 'identifie[s] 19 papers that report empirical evidence on the effect of gamification on health and well-being'; Seaborn and Fels (2015) review 30 papers which investigate 31 instances of gamification; and Hamari et al. (2014) find '24 empirical studies' that respond to the question, 'Does gamification work?'.

So far, the results appear to be mixed or inconclusive (Hanus, Fox, 2015; Seaborn, Fels, 2015), 'with mostly moderate or lower quality of evidence provided' (Johnson et al., 2016). Many studies 'suffer from methodological problems' (Hanus, Fox, 2015) such as small sample sizes, missing control groups, gamification variously applied to initially boring or interesting tasks (Hamari, Koivisto, Sarsa, 2014; Johnson et al. 2016). Johnson et al. (2016) report 59% positive and '41% mixed effects'; of the 24 studies Hamari et al. (2014) review, two are fully positive and 13 are partly positive; and Seaborn and Fels emphasize that the '[f]indings concerning the effectiveness of gamification were mostly positive (61%), but there were a fair amount (39%) of mixed results' (2015). They posit that '[m]ore research is necessary to determine if these results are significant and reproducible' (ibid.).[6]

Empirical of gamification studies usually test combinations of multiple elements. Hamari et al. (2014) find in their 'literature review' that '[t]he majority of the reviewed studies did yield positive effects/results from gamification' but that 'most of the quantitative studies concluded positive effects to exist only in part of the considered relationships between the gamification elements and studied outcomes'. Hanus and Fox (2015) observe that 'the effectiveness of various gamification elements ha[s] not been sufficiently tested'.

Many studies report non-uniform or even erratic user behaviours, and significant variances across application contexts (Hamari, Koivisto, Sarsa, 2014). For instance, while their 'review indicates that gamification provides positive effects', Hamari et al. (ibid.) report that 'the effects are greatly dependent on the context in which the gamification is being implemented, as well as on the users using it'. While 'in all of the studies', users of gamified applications experienced 'engagement and enjoyment', the 'same aspects were most often disliked by some respondents in the study' (ibid.). A study by Denny (2013) of 'an online multiple-choice question (MCQ)-based learning system [...] investigate[s] how badges could be used to motivate participation' (Seaborn, Fels, 2015). He finds that the use of badges 'motivated the number of answers submitted and [the] duration of [the]

[6] Seaborn and Fels also offer that 'the file-drawer effect – where null or negative results are not considered or published – may also be at play' (2015), that is, explain reports of positive results of gamification.

engagement, without impacting response quality' (ibid.). However, unaffected by the badges were 'the number of questions authored or [the] perceived quality of the learning environment'; and 'students who did not use badges submitted four times the amount of answers required, indicating that the activity was intrinsically motivating regardless of the gamification features employed' (ibid.). An 'interest in viewing, if not collecting, badges was not uniform across students, suggesting that students were motivated for different reasons' (ibid.). Hamari et al. offer as an explanation of the variances across users that 'people in fact interact with game-like systems in different manners, and for different reasons' (2014), and with different experiential results (ibid.). Seaborn and Fels (2015) share a similar observation from their meta-study, that '[i]n some cases', for instance, Gåsland (2011), Passos et al. (2011) and Witt et al. (2011), 'the effects of gamification varied among individuals'. They report that several studies such as Bagley (2012) show 'an impact' of 'demographic variables and the expectations attached to those variables [...] on the effectiveness of gamification factors'. Context exhibits a decisive influence on the effects of gamification. Seaborn and Fels (2015) find that 'similar implementations of gamification in different domains did not necessary impact participants in the same way'.

The results reported for gamification centre on behavioural effects, rather than on cognitive or motivational. Mekler et al. find that 'the majority of currently available gamification literature focuses predominantly on studying the effectiveness of game design elements in promoting certain behavioral outcomes [...], largely ignoring the underlying psychological mechanisms that may actually account for these effects' (2017; cf. Lieberoth, 2014). Given the focus of and interest in creating, maintaining and increasing intrinsic motivations, it might surprise that what can be observed in empirical studies so far is rote reinforcement learning (Johnson et al., 2016). In their meta-review of '19 papers', Johnson et al. (2016) find that results 'were largely positive for behavioural impacts (13 positive, 6 mixed or neutral)' (ibid.) such as 'physical activity' (ibid.), 'whereas the evidence for cognitive outcomes is less clear-cut, with an approximately equal number of reported positive (n=8) and mixed/neutral (n=9) impacts' (ibid.). They find that '[a] notable 84% of all individual studies involved rewards in some form (16 out of 19 studies)' (ibid.). Johnson et al. do not find 'a single included study' which 'capture[s] effects of game design elements on intrinsic motivation as a direct outcome'; they take this to indicate, 'together with the fact that the majority of studies focused purely behavioral outcomes [...] that the dominant theoretical and practical logic of the studied health and wellbeing gamification interventions is positive reinforcement' (ibid.). Thus, 'the promise of intrinsically motivating health behavior by taking learnings from game design is currently neither explored nor tested' (ibid.).

Not all effects of gamification are desirable. Hamari et al. (2014) note that while '[a]ll of the studies in education/learning contexts considered the learning outcomes of gamification as mostly positive [...] at the same time, the studies pointed to negative outcomes which need to be paid attention to', such as increased competition. Hanus and Fox identify as 'potential areas for concern' in education gamification 'increased social comparison, competition, and reward systems [which] might have detrimental effects over the long term for students' motivation, satisfaction, enjoyment, and engagement with class material' (2015). Specifically, they identify 'some common mechanics used in classroom gamification' such as 'leaderboards, badges, and competition mechanics' that 'may harm' intrinsic motivation, 'satisfaction, and empowerment' and lead to 'lower final exam scores' (ibid.).[7] Tohidi and Jabbari posit that competition 'in general' is a factor in extrinsic motivation, 'because it encourages the performer to win and beat others, not to enjoy the intrinsic rewards of the activity' (2012; cf. Hanus, Fox, 2015); they list as examples of extrinsic incentives '[a] crowd cheering on the individual and trophies' (Tohidi, Jabbari, 2012). An empirical study by Mekler et al. supports this view; it finds that 'in this particular study context, points, levels and leaderboards functioned as extrinsic incentives, effective only for promoting performance quantity' (2017). Schunk notes that competitive in-game performance can be a motivating goal for a player; watching competent players or read a highscore list provides models for self-efficacy (2014). But competition can increase as well as decrease users' (extrinsic) motivations. The same 'social features [...] designed to create a competitive environment' which positively and effectively encourage 'self-improvement' (Sardi, Idri, Fernández-Alemán, 2017), might also act as demotivating factors when 'users may actually feel disheartened if they are not able to surpass their fellows or [when] they realize that they do not have in-app friends to connect with' (ibid.).

[7] Hanus and Fox (2015) maintain that their 'findings [...] align with existing literature on the negative effects of rewards on motivation (Deci, Koestner, Ryan, 2001; Lepper, Greene, Nisbett, 1973; Tang, Hall, 1995) as well as the negative effects of social comparison on motivation and performance in educational settings'.

Many studies of gamification measure only short-term effects while long-term effects remain unclear. One specific short-term effect that may interfere with the assessment of empirical effects of gamification is the novelty effect (Hamari, Koivisto, Sarsa, 2014; Lieberoth, 2014). Seaborn and Fels (2015) speculate that 'early positive results may be subject to the phenomenon of regression to the mean due to the novelty factor associated with gamified systems'. They observe a specific 'lack of comparative and longitudinal study designs, despite the literature suggesting that gamification effects, especially if they rely on extrinsic motivation, may be temporary or even damaging over time [...] unless participants never stop engaging with the gamified system'. Wu (2011) explains that 'when the external incentives can no longer keep pace with the users' expectation, they will lose all their motivation to perform the gamified behavior'.[8] Koivisto and Hamari's (2014) study 'show[s] that the appeal of a gamified system might be due to a novelty effect, and that positive effects such as engagement and interest decrease over time' (Hanus, Fox, 2015). Hanus and Fox (ibid.) speculate that '[i]f all of a student's classes were gamified', gamification 'might lose its appeal even faster'; and Wu (2011) predicts that 'at some point, consumers must get tired of gamification' and 'start to resent any type of gamified activity'. Sardi et al. (2017) acknowledge the hope that gamified systems in e-Health 'may positively affect users' emotional experiences and foster their satisfaction and self-esteem' and 'highly motivate users to change their health behaviors and stay engaged with the application', and that gamification 'can be of great assistance in yielding a regular use of the application'. But they also find 'still a dearth of valid empirical evidence' in the area of 'gamification in e-Health'; this is specifically apparent because 'most of the e-Health applications and serious games investigated have been proven to yield solely short-term engagement through extrinsic rewards' (2017). Hamari et al. (2014) report that '[t]he main results' from a study on intra-organizational systems by Farzan et al. (2008) 'indicate that gamification has a positive effect on some users for a short time'. Hanus and Fox's study of educational gamification is a rare example of a longitudinal study of a full '16-week semester' (2015) and compares two instances of a university course; one of which is gamified. While 'students from each course started at the same levels of intrinsic motivation, satisfaction, effort, social comparison, and empowerment' (ibid.) they report a decrease in 'motivation, satisfaction, and empowerment over time' for the 'students in the gamified course' compared to the students 'in the non-gamified class' (ibid.).

7. Conclusion

This survey set out to identify, to briefly present and to discuss definitions, aims, applications, strategies and specifically challenges of gamification. By collating observations from multiple empirical studies and meta-studies, it found problematic definitions, unclear strategies, a low number of empirical studies, methodological problems, mixed and partial results, non-uniform user behaviours, a predominant focus of studies on low-level behavioural effects and short-term effects, as well as undesirable side-effects of gamification. If gamification is to progress and mature, these issues need to be resolved or mitigated. This author speculates that the most significant handicaps of these are the pervasive reliance on an outdated behavioural understanding of human motivation and the predominance of research on short-term effects.

Not addressed in this study is the question if the challenges pointed out are indicative of shortcomings or faults of the implementations of gamification in particular projects or of conceptual problems. If a conceptual incompatibility between play and purpose exists (see, for instance, Raczkowski, 2014), the identified challenges might be symptoms rather than causes of the mixed practical results and sceptical academic reception of gamification so far. After approximately ten years of practical application and 20 years of academic research it cannot be long before gamification conclusively validates itself as a concept and practice, finds its niche application where it excels, or is abandoned.

References

Aparicio, A.F., Vela, F.L.G., Sánchez, J.L.G. and Montes, J.L.I. (2012) Analysis and application of gamification, *Proceedings of the 13th International Conference on Interacción Persona-Ordenador*. Paper presented at INTERACCION'12, ACM, Elche, Spain, p 17.

Abt, C.C. (1970) *Serious Games*. Viking Pr., New York.

Bagley, K.S. (2012) *Conceptual Mile Markers to Improve Time-to-value for Exploratory Search Sessions*. PhD thesis. Univ. of Massachusetts Lowell, Ann Arbor.

Blohm, I. and Leimeister, J.M. (2013) Gamification: Design of IT-based enhancing services for motivational support and behavioral change, *Bus. Inf. Syst. Eng.*, Vol 5, pp 275–8.

Bogost, I. (2007) *Persuasive Games. The Expressive Power of Videogames*. MIT Pr., Cambridge.

[8] However, Wu outlines 'two effective strategies that can lengthen the effective window of your gamification' (2011).

Dale, S. (2014) Gamification: Making work fun, or making fun of work?, *Business Information Review*, Vol 31, No 2, pp 82–90.

Deci, E.L., Koestner, R. and Ryan, R.M. (2001) Extrinsic rewards and intrinsic motivation in education: Reconsidered once again, *Rev. Educ. Res.*, Vol 71, No 1, pp 1–27.

Denny, P. (2013) The effect of virtual achievements on student engagement, *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. Presented at CHI13'. ACM, pp 763–72.

Deterding, S. (2015) The lens of intrinsic Skill Atoms: A method for gameful design, *Human-Computer Interaction*, Vol 30, pp 294–335.

Deterding, S., Sicart, M., Nacke, L., O'Hara, K. and Dixon, D. (2011) Gamification: Using game-design elements in non-gaming contexts, *Proceedings of the 2011 Annual Conference Extended Abstracts on Human Factors in Computing Systems*. ACM, Vancouver, BC, pp 2425–8.

Farzan, R., DiMicco, J.M., Millen, D.R., Brownholtz, B., Geyer, W. and Dugan, C. (2008) Results from deploying a participation incentive mechanism within the enterprise, *Proceedings of the Twenty-Sixth Annual SIGCHI Conference on Human Factors in Computing Systems*, April 5–10, Florence, Italy, ACM, pp 563–72.

Fizek, S. (2014) Why fun matters: In search for emergent playful experiences. In: Fuchs, M., Fizek, S., Ruffino, P. and Schrape N. (Eds.). *Rethinking Gamification*. Lüneburg, Meson Pr., pp 273–84.

Fuchs, M. (2014) Predigital Precursors of Gamification. In: Fuchs, M., Fizek, S., Ruffino, P. and Schrape N. (Eds.). *Rethinking Gamification*. Lüneburg, Meson Pr., pp 119–40.

Gåsland, M. (2011) *Game Mechanic Based E-Learning*, Master's thesis. Norwegian University of Science and Technology, Trondheim, Norway.

Hägglund, P. (2012) *Taking gamification to the next level - A detailed overview of the past, the present and a possible future of gamification*, Master's thesis. Umeå, Umeå University, Sweden.

Hamari, J., Koivisto, J. and Sarsa, H. (2014) Does gamification work? A literature review of empirical studies on gamification, *Proceedings 2014 47th Hawaii International Conference on System Science*, pp 3025–34.

Hanus, M.D. and Fox, J. (2015) Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance, *Computers & Education*, Vol 80, 2015, pp 152–61.

Herzig, P., Ameling, M. and Schill, A. (2012) A generic platform for enterprise gamification, *Proceedings of the 2012 Joint Working Conference on Software Architecture (WICSA) and European Conference on Software Architecture (ECSA)*, IEEE, 2012, pp 219–23.

Huotari, K. and Hamari, J. (2012) Defining gamification: A service marketing perspective, *Proceedings of the 16th International Academic MindTrek Conference*, October 3–5, 2012, Tampere, Finland, ACM, pp 17–22.

Johnson, D., Deterding, S., Kuhn, K,-A., Staneva, A., Stoyanov, S. and Hides, L. (2016) Gamification for Health and Wellbeing: A Systematic Review of the Literature. *Internet Interventions*, pp 89–106, pre-print manuscript accepted for publication.

Kapp, K.M. (2012) *The Gamification of Learning and Instruction: Game-based Methods and Strategies for Training and Education*. Pfeiffer, San Francisco.

Koivisto, J., Hamari, J. (2014) Demographic differences in perceived benefit from gamification, *Computers in Human Behavior*, Vol 35, pp 179–88.

Lepper, M.R., Greene, D. and Nisbett, R.E. (1973) Undermining children's intrinsic interest with extrinsic reward: A test of the 'overjustification' hypothesis, *Journal of Personality & Social Psychology*, Vol 28, pp 129–37.

Lieberoth, A. (2014) Shallow gamification: Testing psychological effects of framing an activity as a game, *Games and Culture*, Dec 1, 2014, pp 1–20.

Marczewski, A. (2012) *Gamification: A Simple Introduction & a Bit More*. Self Publishing.

Mekler, E.D., Brühlmann, F., Tuch, A.N. and Opwis, K. (2017) Towards understanding the effects of individual gamification elements on intrinsic motivation and performance, *Computers in Human Behavior*, Vol 71, pp 525–34.

Nicholson, S. (2012) A user-centered theoretical framework for meaningful gamification, paper presented at *Proceedings of Games + Learning + Society 8.0*, Madison, WI.

Passos, E.B., Medeiros, D.B., Neto, P.A.S. and Clua, E.W.G. (2011) Turning real-world software development into a game, *Proceedings of SBGames 2011*. Paper presented at SBGames 2011. Salvador, pp 260–9.

Raczkowski, F. (2014) Making points the point: Towards a history of ideas of gamification. In: Fuchs, M., Fizek, S., Ruffino, P. and Schrape, N. (Eds.). *Rethinking Gamification*. Lüneburg, Meson Pr., pp 141–60.

Rapp, A. (2017) Drawing inspiration from World of Warcraft: Gamification design elements for behavior change technologies, *Interacting With Computers*, Vol 29, No 5, pp 648–78.

Ryan, R.M., Kuhl, J. and Deci, E.L. (1997) Nature and autonomy: An organizational view of social and neurobiological aspects of self-regulation in behavior and development, *Dev. Psychopathol.*, Vol 9, pp 701–28.

Richter, G., Raban, D.R., Rafaeli, S. (2015) Studying gamification: The effect of rewards and incentives on motivation. In: Reiners, T., Wood, L.C. (Eds.). *Gamification in Education and Business*, Springer, Cham, pp 21–46.

Ryan, R. M. and Deci, E.L. (2000) Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions, *Contemporary Educational Psychology*, Vol 25, pp 54–67.

Sailer, M., Hense, J.U., Mayr, S.K. and Mandl, H. (2017) How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction, *Computers in Human Behavior*, Vol 69, pp 371–80.

Sakamoto, M., Nakajima, T. and Alexandrova, T. (2012) Value-based design for gamifying daily activities. In: Errlich, M., Malaka, R. and Masuch, M. (Eds.). *Entertainment Computing – ICEC 2012*, Lecture Notes in Computer Science. Springer, New York, pp 421–4.

Sardi, L., Idri, A., Fernández-Alemán, J.L. (2017) A systematic review of gamification in e-Health. *Journal of Biomedical Informatics*, Vol 71, pp 31–48.

Schunk, D.H. (2014) *Learning Theories – An Educational Perspective*, 6th ed. Pearson, Harlow.

Seaborn, K. and Fels, D.I. (2015) Gamification in theory and action: A survey. *Int. J. Human-Computer Studies*, Vol 74, pp 14–31.

Tang, S.H. and Hall, V.C. (1995) The overjustification effect: A meta-analysis. *Applied Cognitive Psychology*, Vol 9, pp 365–404.

Tohidi, H. and Jabbari, M.M. (2012) The effects of motivation in education. *Procedia – Social and Behavioral Sciences*, Vol 31, pp 820–4.

Tulloch, R. (2014) Reconceptualising gamification: Play and pedagogy, *Digital Culture & Education*, Vol 6, No 4, pp 317–33.

Werbach, K. (2014) (Re)defining gamification: A process approach. In Spagnolli, A., Chittaro, L., Gamberini, L. (Eds.). *Persuasive Technology*, Vol 8462, pp 266–72.

Werbach, K. and Hunter, D. (2012) *For the Win: How Game Thinking Can Revolutionize Your Business*. Wharton Digital Press, Philadelphia.

Witt, M., Scheiner, C. and Robra-Bissantz, S. (2011) Gamification of online idea competitions: Insights from an explorative case. *Proceedings of INFORMATIK 2011 – Informatik schafft Communities*. Lecture Notes in Informatics. Paper presented at INFORMATIK 2011. Berlin, p 192.

Wu, M. (2011) "The gamification backlash + two long term business strategies", [online], community.lithium.com/t5/Science-of-Social-Blog/The-Gamification-Backlash-Two-Long-Term-Business-Strategies/ba-p/30891.

Zichermann, G. (2011) "Intrinsic and Extrinsic Motivation in Gamification", [online], Gamification Co., www.gamification.co/2011/10/27/intrinsic-and-extrinsic-motivation-in-gamification.

Zichermann, G. and Linder, J. (2010) *Game-based Marketing: Inspire Customer Loyalty through Rewards, Challenges, and Contests*. Wiley, Hoboken.

‘Breaking bad’: Overcoming Barriers Preventing Higher Education Faculty From Offering Quality Blended Learning Programs

Paula Charbonneau-Gowdy and Manuel Herrera
Universidad Andres Bello, Santiago, Chile
paula.charbonneau@unab.cl
m.herrerramontoya@uandresbello.edu
DOI: 10.34190/EEL.19.127

Abstract: Proponents of Blended Learning have been predicting for over a decade its transformative potential for higher education, both financial and pedagogical. Educators on the front lines who face the day-to-day challenges of promoting engagement in BL settings have remained particularly sceptical. Considerable scholarship has focussed on faculty reticence in adopting effective BL practices, yet offering few solutions. Results of our earlier 3-year longitudinal study at a private-for-profit university in Chile, shed light on complex circumstances that explain why many faculty have not embraced BL and the often-disappointing results of those who do. The findings provided insight into multi-level identity issues within our institution that influence teaching and learning in BL classrooms. In this paper, we report on a 6-month follow-up AR (AR) study we conducted to address those issues. Our aim was to provide collaborative and sustained expert e-learning pedagogical and IT support for a group of thirteen faculty, including a set of strategies to counteract the barriers preventing these educators and their 320 students from adopting effective BL practices. Framed by theories of identity and transformational change, in the study we co-constructed alternative ways of viewing and doing BL teaching and learning with this group of educators. Qualitative data collection tools involved: interviews, recorded field notes from online participant meetings and class blogs and an end-of-semester student Likert scale questionnaire. Findings indicate that when faculty are provided long-term institutionally-supported opportunities and collaborative guidance in how to assume agency and control in their BL teaching settings and are simultaneously encouraged to empower their students to do the same in their learning, the resulting identities they themselves mediate and in turn foster in their students have positive implications for learning outcomes - increased self-directedness, online engagement, community building and higher order thinking. We believe these results provide renewed and grounded hope for the future of BL.

Keywords: blended learning, higher education, faculty support, identity construction, sociocultural theory

1. Introduction

Scholarship in e-learning in the last twenty years has focussed considerable attention on educators in HE and their reluctance to actively adopt ICT practices in their teaching. Indeed, despite the growing emergence of Blended Learning (BL) as the “new normal” (Norberg et al., 2011) in higher education (HE) program delivery, faculty’s failure to embrace technological change in their teaching practice is still evident, and in traditional cultural contexts all the more so. Efforts to track this reluctance and its impact on the effectiveness of BL in institutions have been fraught with challenges. One thing we know for sure is that the instructional models supporting BL programs that are considered successful most certainly do not consist of simply transferring traditional face-to-face (F2F) modules and practices online (Cobb et al., 2012, Lowe 2013; Baran et al. 2011). Instead, these successful BL programs are being shown to involve new directions in teaching models and practice. Within these new sites there is a significant conversion in the roles and identities that educators, and ultimately learners need to assume. With the transformations that BL implies, many scholars are predicting as do Dziuban et al. (2018, p.13) that: “it seems clear… blended learning is the harbinger of substantial change in higher education….our educational future is about to change”.

Regardless of the enthusiasm and fear that BL continues to raise in educational contexts and scholarship, it is clear that change will neither be linear nor smooth. Scholars focussed on pedagogical transformations remind us that an examination of environmental forces is an important step in understanding how to transform general educational settings (Fullan, 1999). Yet, response to calls for more research focussing on the connections of contextual factors to teacher identities, their pedagogies and their openness to change particularly in BL contexts is only just emerging (Avidov-Ungar et al., 2014; Barran et al., 2011; Bolldén, 2015). These calls presuppose a need for greater understanding of the change process itself - grounded evidence of the complexities involved in individual contexts and how addressing these contextual challenges can lead to establishing BL successfully.

Our own efforts to understand the *how* in establishing successful BL programs has included attempts to uncover certain contextual forces within our own institution and their influence on learning (Charbonneau-Gowdy &

Chavez, 2019). Positioning ourselves in examining our institutional context from a wider contextual lens led to the following important finding: that institutional leaders' neglect to value their critical role in creating a collaborative strong community within the institution where all members have access to decision-making and development opportunities was having grave consequences at the micro level for student learning in the BL programs in which we were involved. Without opportunities for collaboration and building communities in the context of establishing BL programs, members at the *meso* and *micro* levels were denied the right to construct empowered roles with control over their work and thus unsuccessful in turn in modelling or promoting community building and collaboration among learners. The fallout from these conditions was apparent in a general lack of any visible signs of higher order 21st century learning on the part of BL students in classrooms or online. The majority of students enrolled in our BL programs were not becoming the self-directed, collaborative, critically thinking, creative and informed learners for which the BL programs had apparently been established, and this despite well-intentioned institutional policies directed at innovation and a sincere desire for assuming institutional leadership in the region with regard to technology.

The direction we chose to address these findings centred on building a supportive learning community within our institution that was targeted particularly at the micro level of faculty. In setting about this initiative, we kept in mind the words of Fullan and Smith (1999, p. 2: "[W]e also are beginning to realize that the more powerful technology becomes, the more indispensable *good* [emphasis added] teachers are". As the affordances of technologies expand in their ability to shape 21st century learning, especially in BL settings, we believe willingness within the institution to support good teachers to attain those ends is key to successful learning.

2. Purpose of the study

The aim of this study was to document what happens when collaborative and guided support is provided to HE faculty to work within a community of colleagues to build strategies for effective teaching and learning within their BL programs. Our goal was to help empower these individuals through collaborative reflection and action to consider changes to their perspectives and practices. We were cognizant of the complexities and challenges in achieving this goal, which may explain the paucity of literature on the topic of the roles and competencies of online teachers (Baran et al., 2011).

Our focus was on a group of thirteen self-selected HE faculty members involved in teaching BL programs in English as a Foreign Language (EFL). We document their experiences and the changes that that they mediated to their identities and roles over a semester. These changes involved replacing traditional pedagogical approaches with effective BL practices based on sociocultural principles in their online and face-to-face teaching. Our interest was in supporting and collaborating in the professional development of these individuals while at the same time examining their lived experiences during the process in the context of their BL teaching practices. Our intention was to focus on these teachers "not as passive learners and performers of established roles and competencies, but as participants, expressing potentially varying degrees of conformity with and resistance to the roles of online teaching" (Baran et al., 2011, p. 431).

The questions that guided the study were the following:

- In what way does the guided support of educators to co-construct socio-culturally based strategies in their BL courses influence their attitudes towards BL?
- How does the transition to a community of learners' perspective in their BL teaching impact their identities?
- What are the observable signs of effective BL teaching, if any, in terms of changes to teaching and learning practices?

In the remainder of the paper, we describe the theoretical and methodological frameworks that guided our inquiry, next provide an analysis of our findings and finally the conclusions we reached as well as their implications for further study.

3. Transforming to a BL teaching approach

With the advent of each new theoretical revelation in educational scholarship that seeks to introduce more effective ways to learn, educators are inevitably called upon to apply these new ways of thinking and doing in their day-to-day teaching practices. In this iterative cycle, educators are often thrust into actions that are beyond their control with little in the way of sufficient time or adequate preparation, where they see a disconnect with their own pedagogical values and where their roles as subject matter experts are destabilized. Resistance on the part of some teachers both in attitude and behaviours are usually the visible signs of these scenarios. Uncritical passive acceptance on the part of other teachers could be considered equally disturbing. Identity theories help to explain these divergent but both non-productive positions (Saunders, 2013) that most educators assume in relation to change. Identity, or a sense of self, is defined by one's relationship to others in an environment and to their position and role in that setting. Both resistance in all of its forms and passivity are signs of an individual's loss of control.

Norton's (Norton Pierce, 1995) seminal work in identity in the field of second language education where our research locates itself is useful to our understanding of the nature of educators' reactions to change. Drawing on the work of Bourdieu (1991), she explains that in all social environments individuals are positioned in unequal relationships of power. For example, individual educators may consider themselves as powerful subject experts in front of a group of students in a classroom but feel marginalized in a faculty meeting in which their views are neither solicited nor considered. Identity has been shown to be multiple, changing, and a site of struggle (Darvin and Norton, 2015, p.36). In any learning situation, like the ones educators find themselves when faced with an organization's directive to adapt to new programs such as those requiring using a BL modality, the conditions of power in those contexts can position stakeholders – teachers, coordinators and academic leaders, in multiple and often unequal ways, leading to varying outcomes. Norton's has coined the term investment to explain the reaction of learners, in this case HE teachers, when faced with deciding whether to accept to make changes to their pedagogical practices or not. Norton's (Darvin and Norton, 2015) work has shown that investing in change or learning is contingent on the dynamic negotiation of power in these contexts and that investment in these instances is thus complex, contradictory and in a state of flux (Norton, 2013).

Understanding that educators' investment in change is dynamic rather than fixed and immutable offers some hope for institutions and their trajectories towards BL programming. Mezirow's transformative learning theory (2000) adds to our further understanding of how to create the ideal conditions for HE educators to invest in learning by accepting change. Mezirow (2000, p.20) explains the transformative learning process as "a way of problem solving by defining a problem or by redefining or reframing the problem. We often become critically reflective of our assumptions or those of others and arrive at a transformative insight… but we need to justify our new perspective through discourse." In other words, transformation is dialogic and social bound. Important to our discussion of identity and investment, Evan and Nation (1993) point out that empowerment of individuals is at the core of transformative learning. They (Evan and Nation, 1993, p. 91) explain that empowerment in the context of transformative learning involves three criteria: 1) the notion of choice 2) access to control 3) emancipation from situations where control and choice are denied. In our own HE context, the lack of freedom of choice and control on the part of faculty over the installation and nature of BL programming sheds light on the difficulties many teachers experienced when considering investing, or not, in transforming their practices in line with effective BL teaching. In the context of our AR study, we sought to reverse this scenario by putting in place ideal conditions essential for transformation combined with instigating a dialogic process of "how to" connect theory to practice in an effort to effect real changes in BL.

Philipson et al.'s (2019) recent study shares similar goals to our own - to contribute to the need for in-depth research on instructional models and the nature of grounded support needed by educators to ensure the success of BL programs in promoting 21st century learning (Orcutt and Dringus, 2017). Philipson et al. (2019)'s study centred on the feelings of a group of ten educational staff in Belgium involved in a co-constructed professional development program for online and BL programs. The five main feelings that were uncovered in the qualitative study were – chaos, frustration, feelings of connectivity, satisfaction and responsibility. These results served as a point of departure for discussion in our own study as we set about to co-construct with the participants new strategies for teaching in their BL programs.

4. Methodology

We conducted our AR study between July 2018 and January 2019 at a large Chilean private-for-profit university. We chose to work within the qualitative paradigm 1) for the advantages this methodology offers for involving participants in the research process and 2) due to diverse data-collection tools available within this paradigm to support an in-depth effort to uncover detailed data about the feelings and experiences of the participants over the period of the phases of the study. We were also aware of the reported need for more studies in BL that lie within the qualitative paradigm (Steinart et al., 2006) and that go well beyond reports of participant satisfaction data (Brinkley –Etzkorn, 2018).

4.1 Context

The Chilean university in which these inquiries took place belongs to a corporate Network of private affiliated universities worldwide. It is important to point out that the university functions according to Network directives. Much of the decision-making regarding the BL program offered in Chile is made at the Network, or *macro* level. *Meso* level academic leaders in Chile administer the BL programs - a director as well as coordinators for the various campuses in the capital city and two secondary cities in the regions.

Faculty 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 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, with reportedly little time for preparation and/or reflection, let alone professional development. Generally students and their family assume a significant financial burden to attend the university. Indeed, many students are full time, 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. 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.

4.2 Participants

Of the 114 in the English Language Learning (ELL) Program solicited to participate in the AR training program, a total of 13 - 9 female and 4 male professors representing each of the six campuses of the university, agreed. The participating teachers ranged in age from 25 to 55 and with a mix of teaching experience. The total number of students exposed to the changes being put in place as a result of the training program numbered 390 from a cross section of academic disciplines.

4.3 Research design

As is the nature of AR, the design of our study consisted of offering a professional development collaborative project in which participants actively engaged while data was collected and analyzed simultaneously and on an ongoing basis. In keeping with this particular research methodology, the design was built on a series of steps that coincided with meetings held with participants over the period of the study (see Table 1).

Table 1: Research design

Steps	Description	Purpose
1	Online and f2f Individual meetings with participants	Establish rapport with participants. Discuss challenges in teaching and learning in a BL setting. Explore reasons for joining the AR team Discuss scholarship pertaining to the changes being operationalized
2	Group meeting	Develop a needs analysis and goals for the project Initiate a learning community among participants, including a whatsapp group Negotiate innovative strategies and materials for participants to incorporate in their courses, including more responsible learner roles.
3	Group meeting	Model examples of blogs for individual course sites Discuss feedback from initial class sessions Negotiate assessment expectations in line with pedagogical approach
4	Individual meetings	Co-constructing individual course blogs for each participant (shared screens)
5	Group meeting	Negotiate and design assessment materials collectively Gather feedback on student engagement and revise action plans accordingly
6	Group meeting	Address problems and student reactions to assessments and quizzes Share stories of final assignments of students (group videos)
7	Group meeting	Plan end of semester final assessment
8	Group meeting	Hold final individual and group interviews - experiences and reactions

Throughout the various steps, the lead researcher saw her role as facilitator of the online group meetings and an experienced BL practitioner who could act as a resource when needed. Indeed, through a *Whatsapp* connection with each participant, support was offered 24/7. Both teachers and students assumed agentive roles in constructing the courses. The director of the BL program who herself had gone from resistance to embracing effective BL practices as a result of participating in an earlier inquiry with the lead researcher, sanctioned the project and provided free reign in decision making to the lead researcher and participants regarding teaching and assessment materials, including importantly the choice of online tools.

Another facet of the course preparations in the earlier phases of the project was the process of designing individual class blogs. The lead author and the co-author who acted as IT expert worked alongside each of the participants to support their development of individual blog templates for the teachers and to guide their design in ways that would require the collaboration of both teachers and students to build over the period of the semester. These blogs were designed as sites for community building activities - student-led group projects and discussions on learner-generated internet-sourced materials based on course themes.

Assessment materials, rubrics and innovative testing procedures were developed and established by the team with the support of the lead researcher. These materials were designed to closely reflect the new pedagogical perspectives and practices being put in place in class and online as a result of the AR project including the learner-generated content of the course.

During the four phases of the study (see Table 1), we collected data on an ongoing basis using various ethnographic tools: pre and post individual interviews with participants, document analysis of assessment materials, field notes generated from: a) bi-weekly group and individual online meetings b) activity in the online individual class websites of each participant c) informal conversations with participants, other faculty and administrators. An end-of-semester student feedback questionnaire distributed to learners in BL classes of teachers involved in the training program resulted in a total of 160 responses.

Table 2: Data collection phases of the study

Phases of the Study	Type of Data	Examples
Phase 1: Building a BL AR team Jun. – Jul., 2018	Interviews (individual online and f2f) Field Notes Documents	-Recordings from online meetings between individual participants and lead researcher -E-mails to prospective team members and responses -Lead researcher's accounts of meetings -Official program documents
Phase 2: Exploring new e-approaches and strategies Aug. – Sept. 2018	Field Notes from online individual and group Zoom meetings Documents	-Recorded discussions on building new approaches to teaching and technology decisions with AR team participants and IT support -Multimedia and social media blog sites Course re-design materials
Phase 3: Experiencing change Sept. – Dec. 2018	Field Notes from online individual and group Zoom meetings Field Notes	-Recorded discussions of classroom experiences and challenges; constructing assessment materials -Informal online meetings and calls, text messages, and e-mails from participants
Phase 4: Reflecting and evaluating Dec. 2018 –Jan. 2019	Individual and group Interviews Questionnaire	Recorded reflections of the participants on their BL experiences Student feedback on changes they experienced during the semester

4.4 Data collection and analysis

Thematic analysis, a standard method used in qualitative research, was employed to organize the data and generate responses to the research questions. The process involved descriptive coding of the extensive data generated from the various data sets according to King and Horrock's model (2010). Recurrent and representative codes were gathered, labeled and these labels were then refined in order to best describe the themes that emerged. Finally, these themes and the supporting evidence were matched to the literature and constructs used for framing the inquiry. Together the cross-referencing of theory with evidence helped provide reliable and grounded answers to our research questions. We adopt a narrative approach to the representation of the analysis and findings.

4.5 Ethical considerations

High standards for ethical research were maintained throughout the AR project. Maintaining participants' anonymity especially in view of the precarious nature of their employment status with the university ensured an open and transparent dialogue throughout the AR project and data collection process and the reliability of the findings. Cross-referencing data from end-of-semester individual interviews conducted with faculty participant, with field notes from *meso*-level administration meetings and data that emerged from the student questionnaire served as a further assurance of the legitimacy of our analysis of the data.

In the next section in the limited space we have available, we discuss the analysis and conclude with some of the key findings that have responded to our research questions.

5. Findings and analysis

From the Initial interviews that launched the AR process, data indicated a clear acknowledgement of the their lack of control over the current status of what was happening within the BL program and at the same time openness to change, at least in principle on the part of participants. This enthusiasm was expressed and repeated throughout the semester with comments such as: "*Things can't be worse*!"; "*Anything we do will be better than nothing*!"; "*Something has to be done.";" There's nothing to lose."; "I really want to make some changes".* (Initial interviews, June- July, 2018).

Yet, the distance between acknowledging the dire need for taking action to improve BL programs and actually making those changes, as many who work within HE can appreciate, is not a straightforward trajectory. Indeed, our analysis of the abundant data we collected from the various data sources reveal two major themes that emerged and characterized our own AR process: changing roles and identities on the part of many teachers and changing roles and identities on the part of learners, i.e. students. While the changes were certainly not universal, within each of these themes, there is strong evidence of how the collaborative, community-based and guided nature of the process led to significant, yet uneven, improvements in the BL courses. In the next subsections, we describe and provide evidence of these changes.

5.1 Changing roles and identities of teachers

In initial discussions of what we as a team sought to accomplish in terms of goals over the semester, Valeria (a pseudonym), an experienced teacher in the BL program, explained the aim of the project: "*Thinking about what we are more than what we do*." (Group Interview, June, 2018). Valeria's comment attest to her belief that changes to ways of *doing* teaching, i.e. the role of a teacher in the BL program, involved first and foremost understanding one's sense of self, one's identity, in other words one's way of *being* a BL educator.

In Table 2, we provide evidence from the data sources of the trajectory we witnessed in teachers in terms of the salient differences in identities they mediated during the period of the research, followed by a brief explanation and analytical discussion of the data.

Table 2: Evolving changes to teacher identities

Stages of change	Nature of teachers' identities	Evidence
Initial: June -July, 2018	Lacking in conviction and resolve to make changes, Insecure in oneself as a professional Conflicted Mistrustful of students' abilities to assume responsibility Fear of risk taking	- " *I'm really worried about that.*" (Online meeting, June, 2018 - "*Maybe I don't trust much my students*." (Online meeting, June 20, 2018) - "*I'm looking forward [to making changes in my teaching] but a little bit scared*" (Online meeting, June 22, 2018) - "*I got very enthusiastic, you know…I want to do [take steps to change]. I'm kind of frustrated with my students*." (Online meeting, June 18, 2018)
Middle: August to October, 2018	Increasingly confident that positive change was possible	- "*You know that was my main concern that they're not going to do things, that they were not going to send the*

Stages of change	Nature of teachers' identities	Evidence
	Emerging sense of empowerment as a change maker	*information but at least the first group did. I hope everybody does*." (Online meeting, August, 2018) - "*I would like to do it* [make the changes we are negotiating] *in all my classes*." (Online meeting, August, 2018).
End: November –December, 2018	Self-assured Empowered Expert guide in community building Team player Critically thinking Sense of pride in learners' accomplishments	"*So once I got my own head around the new approach, um, I was able to communicate that and they* [students] *actually got the idea and they went along so..*" (Final interview, December, 27, 2018) "*I was just checking and giving them suggestions*" (Online meeting, Dec. 20, 2017). "*I never gave them* [students] *the options of not doing these things*." (Online meeting, Dec. 20, 2017). "*And on top of that, for me it* [the AR] *was a process of learning so I think I can do much better next year*". (December, 2018)

As the information in Table 2 illustrates, the combined set of practices we were mediating through the AR process represented an innovation for many that appeared both foreign and daunting. As one participant remarked: "The first couple of weeks…it was actually painful." (Carlos, Final Interview, January 2019). After years of being considered and/or considering themselves as primarily transmitters of information and all-knowing subject experts, our participants were expected to negotiate a more personal, collaborative position vis à vis learners in which an innovative and social learning based use of technology was being planned. Accepting this challenge certainly meant important identity changes for which, according to the participants, they were most unprepared due in part to institutional decision-making (RPR) as well as to their own background in learning and training.

By the midpoint of the period of research, the beginnings of encouraging signs of change in students in their reaction to teachers' sociocultural-based practices propelled many of the participants towards persevering and mediating small but critical changes to their teacher identities. This period was marked by three milestones: 1) the first few student groups having already assumed the responsibility for producing content online and in the classroom as well as leading online discussions, 2) the combined decision to establish group as opposed to individual-based quiz formats and 3) the design of the first major assessment being aligned closely with the video/text/ case study scenario used for course content instead of the traditional online text book used in regular programs. Analyzing the data that was emerging at this point, we noted that some participants began demonstrating more critically minded identities as opposed to passive ones as BL professionals and seemed more determined in their decision making as opposed to automatic adherence to traditional course practices - all visible of their increased control and agency over their teaching practices. .

At the end of the project, changes to identities and teaching roles being assumed by some of teachers were even more pronounced (see Table 2). One area that was particularly reflective of such changes was in their behaviours, reactions and roles in terms of assessment. One teacher, Sophia, for example described the final in-term assessment as an opportunity for fun and community building. She reported: "so..we shared breakfast together watching the [student group-prepared] videos.. so it was a lot of fun and some of the videos were really funny. I couldn't stop laughing". (Interview, November 14, 2018). When compared with the usual formal and stressful nature of the assessment scene, Sofia's innovative decision to create a decidedly different setting reflected a significant change in her attitude and role as teacher as well as those of her students.

Another notable area indicating change to teachers' roles were in the online course blogs. The determination of one such teacher to ensure more engagement of students online by collaborating with them to capture the essence of the unit through images, to structure the blog in a more visibly appealing media-based way which acted as a lively discussion site for the class community as well as to implicate student-generated content into the site, are all indicative of her resolve. In this way, she shows evidence of her new role as an expert guide and team leader, which manifests the deep learning curve that she herself was experiencing professionally. Comparing the text-based, unappealing, and information manipulation nature of the institutional LMS site being used in regular BL courses, this particular teacher's course site collectively designed with her students attests to her empowered resolve to change her role as teacher and the ways she viewed the identities and roles of learners.

5.2 Changing roles and identities of students

With regard to students over the period of the AR period, we are able to make several claims based on our analysis of the data from various sources, including results of the end-of-semester student feedback questionnaire. Reversing the affects of years of information transfer and consumer-style pedagogical practices on students' identities as learners in the first few months of launching a new direction in teachers' practices in the BL program was indeed a noble, albeit ideal, goal of our AR study. Yet, the evidence we collected strongly suggests that deep reversals in learners' roles, attitudes and identities did transpire over the course of the AR. Many students reportedly were happy to assume a more active and involved role in the learning that accompanied the new approach evidenced by their exchanging passive, resistant and unengaged learner identities for actively invested and empowered ones. These results, surprising to many of the teachers, were demonstrated in the lively group discussion activity on some course blogs, the creative quality of the group-generated content produced online and presented in-class, the relaxed more positive behaviours during assessment processes as well as through the questionnaire responses (See Figure 2). These responses along with the written comments attest to students' positive reaction and recognition of the advantages that occurred in the BL during the semester – to their identities, attitudes and roles as learners.

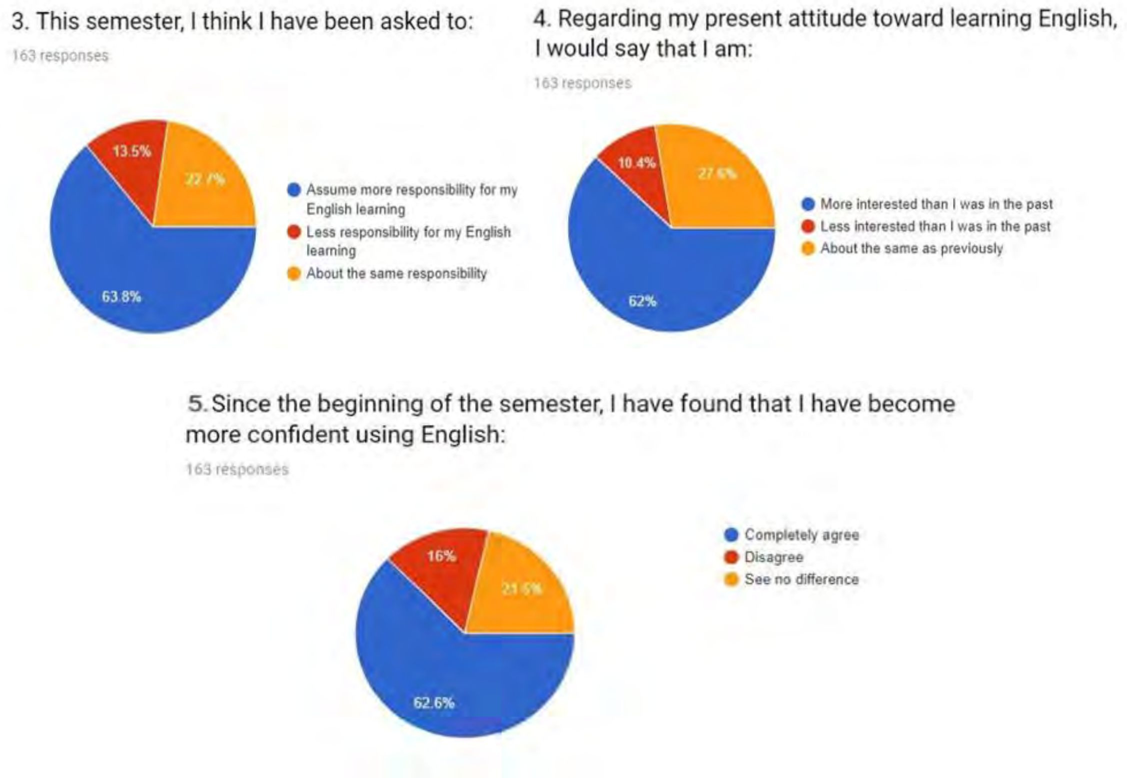


Figure 2: Survey results

6. Conclusion

Working with human beings is never a uniform endeavour. A picture of complex mediation in teachers' identities that emerged from the data, although uniquely specific to each individual, nonetheless reflected a pattern that we understood as moving from fear and insecurity through an interim stage of critical awareness and renewed determination and by the end of the study to self-directedness and a sense of empowerment as 21st century educators. A similar trajectory was evidenced in some groups of students – from indications of general apathy observed by teachers to self proclaimed feelings of accomplishment and confidence in learning by students themselves.

Armed with these findings, at this point we consider that we can clearly envisage a setting in which BL is the catalyst for reforming HE in terms of knowledge generating 21st century learner-centred institutions. What has not been clear is how to get there. Our AR was not successful in affecting the degree of change to which we aspired in *all* participants – teachers and learners. Yet, based on the significant changes we were able to affect in both teachers' and students' identities and roles through the various community building and sociocultural strategies we initiated, the path to such goals for us is far clearer. This research has confirmed our strong beliefs, also shared by others (Dringus and Seagull 2015, Dziuban et al. 2018), that more in-depth research into *sustained* efforts to bring about change must match our knowledge generating of the ideal BL models to which we aspire.

By exposing the paradigm shift experienced by this group of BL teachers and learners in terms of their roles and identities we believe we have uncovered the kinds of grounded knowledge we critically need as stakeholders in education to finally break down the barriers preventing BL from achieving its transformational potential - a potential that researchers and institutions have been predicting for over a decade and as yet have failed to realize. (Garrison and Kanuka, 2004).

References

Avidov-Ungar, O. and Magen-Nagar, N., 2014. 'Teachers in a changing world: Attitudes towards organizational change'. *Journal of Computers in Education*, 1(4), 227-249.

Baran, E., Correia, A.-C. and Thompson, A., 2011. 'Transforming online teaching practice: critical analysis of the literature on the roles and competencies of online teachers', *Distance Education*, 32(3), 421-439.

Bolldén, K., 2015. 'The emergence of online teaching practices: a socio-material analysis'. *Learning, Media and Technology*, 1-15.

Bourdieu, P., 1991. *Language and symbolic power*. Cambridge, MA: Harvard University Press.

Brinkley-Etzkorn, K., 2018. 'Learning to teach online: Measuring the influence of faculty development training on teaching effectiveness through a TPACK lens'. *Internet and Higher Education*, 38, 28-35.

Charbonneau-Gowdy, P. and Chavez, J. (2019). 3-M Model for Uncovering the Impact of Multi-level Identity Issues on Learners' Social Interactive Engagement Online, *Electronic Journal of e-Learning* 17(2), pp. 131-143.

Cobb, C., deNoyelles, A., and Lowe, D., 2012. 'Influence of reduced seat time on satisfaction and perception of course development goals: A case study in faculty development'. *The Journal of Asynchronous Learning*, 16(2), 85–98.

Darvin, R. and Norton, B., 2015, 'Identity and a model of investment in Applied Linguistics'. *Annual Review of Applied Linguistics*, 35, 36–56.

Dringus, L. P., and A. B. Seagull. 2015. 'A five-year study of sustaining blended learning initiatives to enhance academic engagement in computer and information sciences campus courses'. *Blended learning: Research perspectives*, 2, 122-140. New York: Routledge.

Fullan, M. and Smith, G., 1999. 'Technology and the problem of change'. Retrieved from http://www.michaelfullan.ca/Articles_98-99/12_99.pdf.

Garrison, D. R. and Kanuka, H., 2004. 'Blended learning: Uncovering its transformative potential in higher education'. *The Internet and Higher Education*, 7, 95–105.

King, N. and Horrocks, C., 2010. *Interviews in qualitative research*. Thousand Oaks, CA: Sage.

Mezirow, J., 2000. Learning to think like an adult. In J. Mezirow (Ed.), *Learning as trans- formation: Critical perspectives on a theory in progress* (pp. 3–34). San Francisco, CA: Jossey-Bass.

Norton, B. 2013. *Identity and language learning: Extending the conversation* (2nd ed.). Bristol, UK: Multilingual Matters

Norton Peirce, B., 1995. 'Social identity, investment, and language learning'. *TESOL Quarterly*, 29 (1), 9–31.

Norberg, A., Dziuban, C. D., and Moskal, P. D., 2011. 'A time-based blended learning model'. *On the Horizon*, 19(3), 207–216.

Orcutt, J. and Dringus, L., 2017. 'Beyond being there: Practices that establish presence, engage students and influence intellectual curiosity in a structured online learning environment'. *Online Learning* 21(3), 15-35.

Philipsen, B., Tondeur, J., McKenney, S., Pynoo, B. Vanslambrouck, S., and Zhu, C., 2019. 'Examining livedexperiences in a professional development program for online teaching: A hermeneutic phenomenological approach'. *Australasian Journal of Educational Technology,* 35(5), 46-59.

Saunders, R., 2013. 'The role of teacher emotions in change: Experiences, patterns and implications for professional development', *Journal of Educational Change*, 14, p. 30 – 333.

Using VLEs to Offer Higher Education Students Choice and Differentiation in Learning Activities: Micro-Pathway Learning Design Implementation and Opportunities

Simon Cross
The Open University, Milton Keynes, UK
Simon.j.cross@open.ac.uk
DOI: 10.34190/EEL.19.096

Abstract: Conventional models of distance e-learning course delivery are increasingly coming under pressure as designers struggle to reconcile the diversity of learner interests, abilities, prior learning, and study demands with needing to adhere to a single linear structure pitched at the average learner. However, course designers have an alternative and using technology can design and build differentiated paths, or learning micro-pathways, through sequences of learning materials and activities which have the effect of delivering a more personalised learning experience. One approach is to hide the personalisation decision-making from the student whilst a second – that explored in this paper - is to give the student agency by offering them a choice of differentiated learning pathway through a sequence of learning activities. This paper will present a small-scale pilot study intervention that spanned a week of learning activity in a postgraduate online module. This was achieved by using existing Moodle VLE functionalities associated with conditionality operators and the student options to create two, student selectable (and re-selectable) differentiated paths through part of a learning week. The design approach will be described in relation to twelve Design Goals and a focus on the following questions: (1) Does being offered a choice increase the learners' sense of control, engagement, and perception the course is meeting their needs? (2) What guidance do learner need to make effective decisions, and can visualisations of learning design support this? (3) Can differentiated learning by achieved within a VLE by individual teachers at an appreciably low effort and resource? (4) What design skills and conceptual competencies are required to do this? Feedback from repeated use of the intervention shows that learners responded positively, found the choice-making process clear, and would support use of the technique in other modules. Learners also suggested a range of potential teaching uses. This feedback will be discussed along with consideration of learning design challenges and opportunities.

Keywords: differentiation, personalisation, learning paths, learning maps, VLEs, learner agency

1. Introduction

Teachers of distance and blended learning are increasingly expected to deliver online learning experiences that are, or at least are perceived to be, more flexible and personalised (e.g. EDATU 2016, Gordon, 2014). Flexible, personalised learning is concerned with offering students more choices for, and involvement of, students in their own learning (Boelens et al, 2017). Doing so can deliver benefits for the learner – such as greater sense of control and empowerment (Ryan and Tilbury, 2013) - but also for the teacher and the teaching institution in the form of improved learner achievement, retention and student satisfaction. This is particularly relevant in the UK context, where the number of part-time higher education distance learners is falling (Universities UK, 2018) and where the government's National Student Survey asks learners how interesting, intellectually stimulating and challenging their courses are (Office for Students, 2019).

The key challenge explored in this paper is how can greater differentiation be built into courses themselves so as to be cost effective, useful to learners, practicable for teachers, and contributing to building the perception of personalisation within the course. Creating a more nuanced learning design that better meets learner interests, abilities, level of prior learning, and study demands may not, however, fit well with current enculturated design approaches and institutional processes that are predicated on a single linear structure designed for the average learner and on the need to deliver within cost and staffing constraints (Boelens et al, 2017). This issue of cost is important and means that whilst commercial and research-funded research continue to develop, pilot and probe the potential for technologically complex solutions, lower-cost approaches that employ technologies already integrated into university teaching such as VLEs that are should not be overlooked.

This paper reports the findings of a pilot conducted at the Open University, UK (OU) that used existing VLE functionalities associated with conditionality operators and the Student Choice tool within the student Study Planner to create two, student selectable, differentiated paths through part of a learning week: a route for those with intermediate statistics knowledge and a route for those with little or basic knowledge. This was intended to allow the student to choose the route that they felt was more appropriate and more persona, to their needs.

Once the selection has been made – one which could be changed at any point -, the Study Planner automatically updated and adapted to show only the activities associated with that path.

This pilot comprises part of a wider interest in the following four research questions:

- RQ1 - How does offering a choice of learning activity paths increase learner sense of personalisation, control, agency, and engagement?
- RQ2 - What information does the learner need to make effective decisions, and can visualisations of learning design support this?
- RQ3 - How much effort would be required to implement and add student choices to existing VLE-based online modules?
- RQ4 - What design skills and conceptual competencies are required to create learning activity paths?

2. Literature

Personalisation within a unit of learning will often involve some form of differentiation, be this in the content, the process or mode of learning, the product learners create during activities or assessment or the support and communications learners receive (Wanner & Palmer, 2015). It can also be manifest in the way that learners express their agency - such as deciding when, where and which learning activities to study (Carola, 2011) - and in what order to study units of learning. At the Open University, for example, learning resources are made available in a variety of formats so that students can study whilst mobile and vary the pace, place and time of learning (Cross, 2019), assessments may offer choice in topic or context, whilst the university's Open degree offers complete flexibility in choice of course modules.

However, macro-level definitions of 'flexible learning' centred around learner choice of course modules contrasts with those who seek flexibility at the micro-level (EADTU, 2016). Intelligent Tutoring Systems or Adaptive course generators for example represent one alternative to the pre-authored "one-size-fits-all" courseware (Brusilovsky & Vassileva, 2003). This approach, however, can demand significant investment of time and resource and require the construction of a large instructional knowledge base or model, sufficiently granular and varied learning resources capable of being presented in multiple sequences and organised in repositories, a means of connecting and describing the metadata such as to link repositories to the software, means of generating dynamic text to allow smooth transitions between resources, and mechanism of capturing, determining and representing a learner model on which to base course generation (Ullrich & Melis, 2010). Adaptive courses may not transfer well across contexts, curriculum or learner groups and may work better for more structured subject domains such as Mathematics. Furthermore, the criteria and approach used in producing and fitting the learner model raises significant issues, as do potential solutions, such as the concept of an open learner model (Dimtrova & Brna, 2016).

In recent years, significant effort has also been invested in educational recommender systems and learning analytics dashboards as a means of delivering a more personalised learning experience. Learner data such as VLE usage, assessment submission and grades, and feedback can help determine 'optimal' routes through learning resources (Karampiperis 2005) or be used in recommender systems (Verbert et al, 2011). There are limitations to these approaches, however. Recommender systems may work where there is close cohort heterogeneity (where the learner is assumed to be 'similar' to previous or other learners), a sufficiently large dataset, and where course design and teaching vary little between years. Dashboards tend to be limited to personalising the process of reflection and raising learn awareness of their behaviour whilst ostensibly driven by a concern with retention (Schwendimann et al, 2017; Bodily & Verbert, 2017). Across both there is a paucity of research into learner needs and the perceived learning benefit, let alone on how these enable learner autonomy or choice (Bodily & Verbert, 2017). Furthermore, whilst students may perceive themselves to have agency of choice , the choices and implied expectation of action may often be weighted in favour of following the 'crowd' (i.e. performing in a similar way to others or previous cohorts) and/or repeats and amplifies the expectations of the singular course design already created by the teacher.

Personalisation necessarily requires the striking of a balance between freedom and guidance where the 'learner should be offered optimal and balanced level of control and autonomy for his [sic] own learning process' (Nussbaumer et al, 2015). Learning technologies have a critical role to play (Fitzgerald et al, 2017) yet in digital systems the mechanism by which guidance is determined often remains opaque to the learner. In particular, it may be unclear what role a teacher, and more specifically 'their' teacher, had in crafting and mediating the guidance.

A central challenge to achieving meaningful personalisation is how best to capture teacher expertise and represent this to the learner. Early Learning Design research sought ways to codify past pedagogic design experience and teaching context within the IMS-LD framework (Sicilia, Sanchez-Alonso & Garcia-Barriocanal, 2006; Strobel et al 2008) whilst research into the graphical visualisation of learning design (Brasher et al, 2015) highlighted the need to not only capture but make visible and represent 'teaching intent and purpose' (Cross 2010). Presenting and explaining teaching intent is an aspect of personalisation lacking in many intelligent tutor systems or recommender systems. A learner may be told what learning activity or resources to consult next, perhaps even given some choices, but seldom is there an articulation as to *why* these choices are being presented.

3. Design and approach

3.1 Pilot module

The intervention described in this paper was piloted in one of the twenty teaching weeks of a postgraduate course in the OU's MA in Online and Distance Education. This course was launched in 2017 and is run annually. The pilot intervention took place midway through the module and replaced the original standard linear sequence of learning activities. The Open University is the largest distance learner provider in the UK and adopts a supported open learning model of teaching. Entry to truly open to anyone regardless of prior educational attainment and background. At present, the structure of most modules continues to follow a single path that must somehow be designed to satisfy as many students as possible with individual support provided in a variety of ways such as tutor feedback on assessments. A central component of OU teaching is the VLE which is used to deliver high-quality teaching and learning materials and provide access to digital resources and learner support. The focus of the pilot is one key element of the e-learning experience - the Study Planner. This tool provides a central place for learners to view their weekly programme of learning and assessment.

3.2 Design goals

Twelve key design goals were developed to help guide the implementation of the pilot (Table 1). These goals underscore how the pilot was serving a dual purpose – to deliver benefits to module teaching and learning and to deliver strategic benefits to the university.

Table 1: Design goals

Teaching and learning goals	Institutional goals
To increase student sense of control and ownership of their learning by allowing the student choice in their preferred pathway To improve student engagement and motivation To make visible aspects of the learning design and *teaching intention* to students To allow the student to switch freely between choices at any point or re-step over the same learning with, for example, increasing difficulty, challenge or emphasis To heighten student perception that modules are providing for their needs – i.e. providing more personalised learning To deliver a more appropriate pedagogic fit by offering an option(s) that better fall within a students' current zone of proximal development	To help module teams better deliver differentiated learning that recognises not all students require, or want, the same learning path through a topic To find a low-cost high-impact solution for delivering differentiation that can be actioned today within the existing system architecture without the need for further software To find a teaching technique that can be retrofitted to existing modules without a costly complete module redesign. To increase institutional understanding about what choices students expect and need, and how they want them presented. To determine potential benefits to learner engagement, retention, sense of value for money and satisfaction To find ways of making the online Study Planner in the VLE more interactive and agile such that learners use it more for organising their study

3.3 Implementing student choice of learning pathway in Moodle

The pilot sought to create an integrated user experience where learners are first given information about and asked to select one of the two learning pathways offered and then, according to this decision, are shown relevant learning resources in their online Study Planner. Each pathway consisted of three activities (4.5 hours of learning) and that re-combined for the remaining activities in the week (6 hours). The activities in each pathway differed in their assumed level of prior knowledge of statistics – the intermediate pathway assumed greater prior knowledge than the basic path.

Figure 1 is an excerpt from the week's 'Learning Map' and shows the two paths in pink (left) and purple (right). Whilst the activities may have similar titles, it is important to note that what the student is asked to do differs. The Learning Map was a second innovation piloted in the module. Each map summarises a week of learning in a graphic that fits on a single page of A4. A timeline runs from top to bottom and shows: (1) the order and length of each learning activity and linking texts, (2) resources associated with each activity (rated essential=black, optional=green and user generated=white), (3) points at which the learner needs to be connected to the internet (for V=video streaming, C=online forum and other communicative activities, S=search activities, etc.), and (4) titles and short description of each activity. The design builds on earlier research (Brasher, 2015; Cross et al, 2012; Cross, Clark & Brasher, 2009). For the purposes of the pilot, the Learning Map was intended to help learners visualise the pathway options.

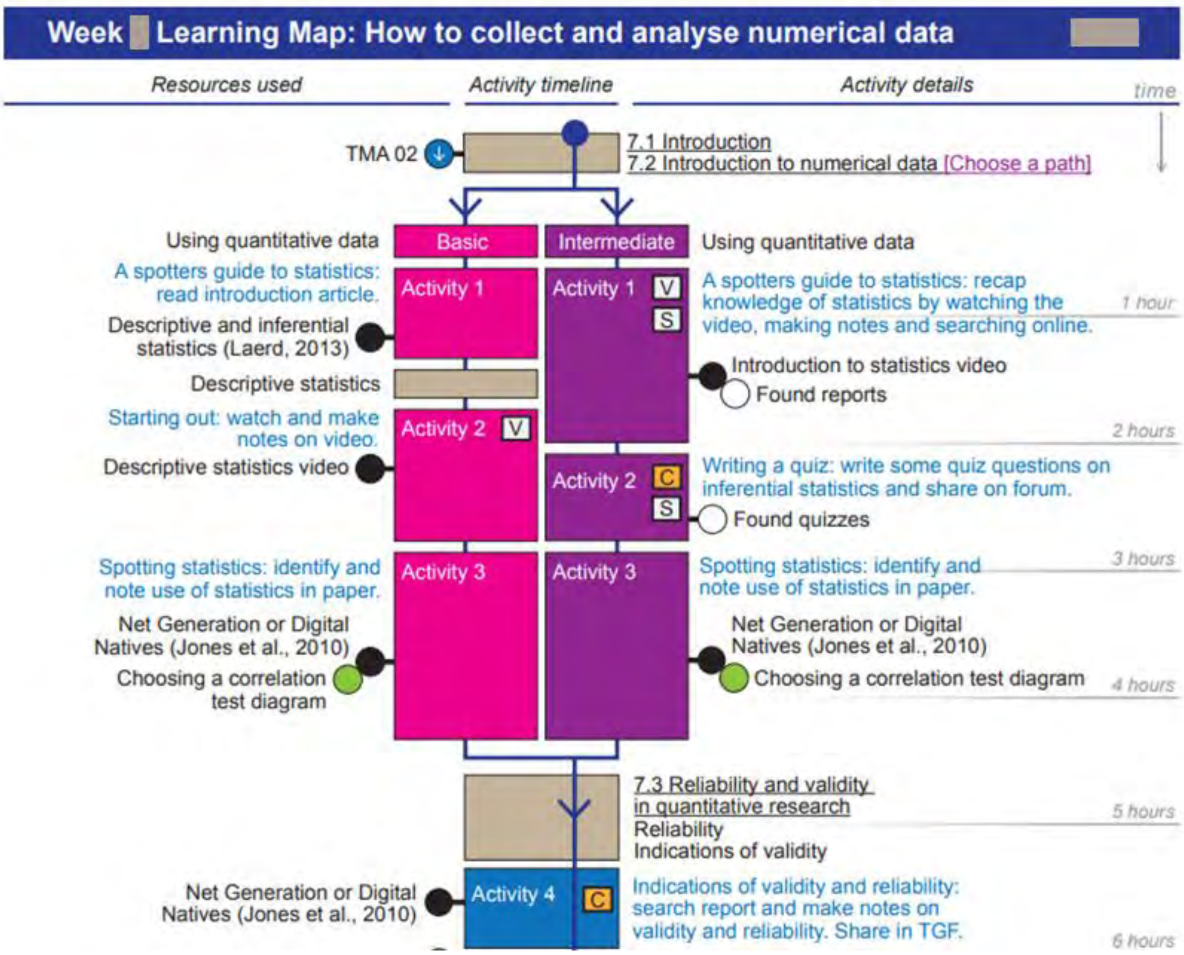


Figure 1: Excerpt from the Learning Map of relating to the week of the pilot

Building the pilot intervention in the VLE made use of the Conditional APIs in Moodle including, more specifically, functionality relating to Student Options. Experimentation in a 'sand-box' version was required to determine the most appropriate settings.

Building the 'student choice' interaction required two steps. Firstly, a Student Option item is added to the course as a separate 'page' (see tabs in Figure 2). The student choice item/page permits the learner to set one (or more) conditions and save these preferences to the system. In our design (Figure 2), condition setting was presented as a choice between condition 1 (basic path) and condition 2 (intermediate path). Several iterations of the introductory text were tested with colleagues. In particular, it was felt important to include text to reassure the learner that both paths should adequately prepare them for learning activities later in the week, that they retained control of the pathway selection and could switch at any time, the rationale for offering two paths, and a default or recommended path (for learners disinterested in or unwilling to make the choice themselves).

The second step was to add the learning resources and activities for each pathway to the Study Planner but to make their visibility conditional of the choice of the learner (the choice made in step 1). Only learning resources relating to the conditional state will be displayed and neither will be displayed *until* the learner makes a selection (sets the condition). In our case, only resources relating to one or other of the learning paths were shown, the other was hidden. Moodle will permit much more complex responses (such as selecting multiple conditions) however, as this was an initial trial of this functionality, a simple binary choice was offered.

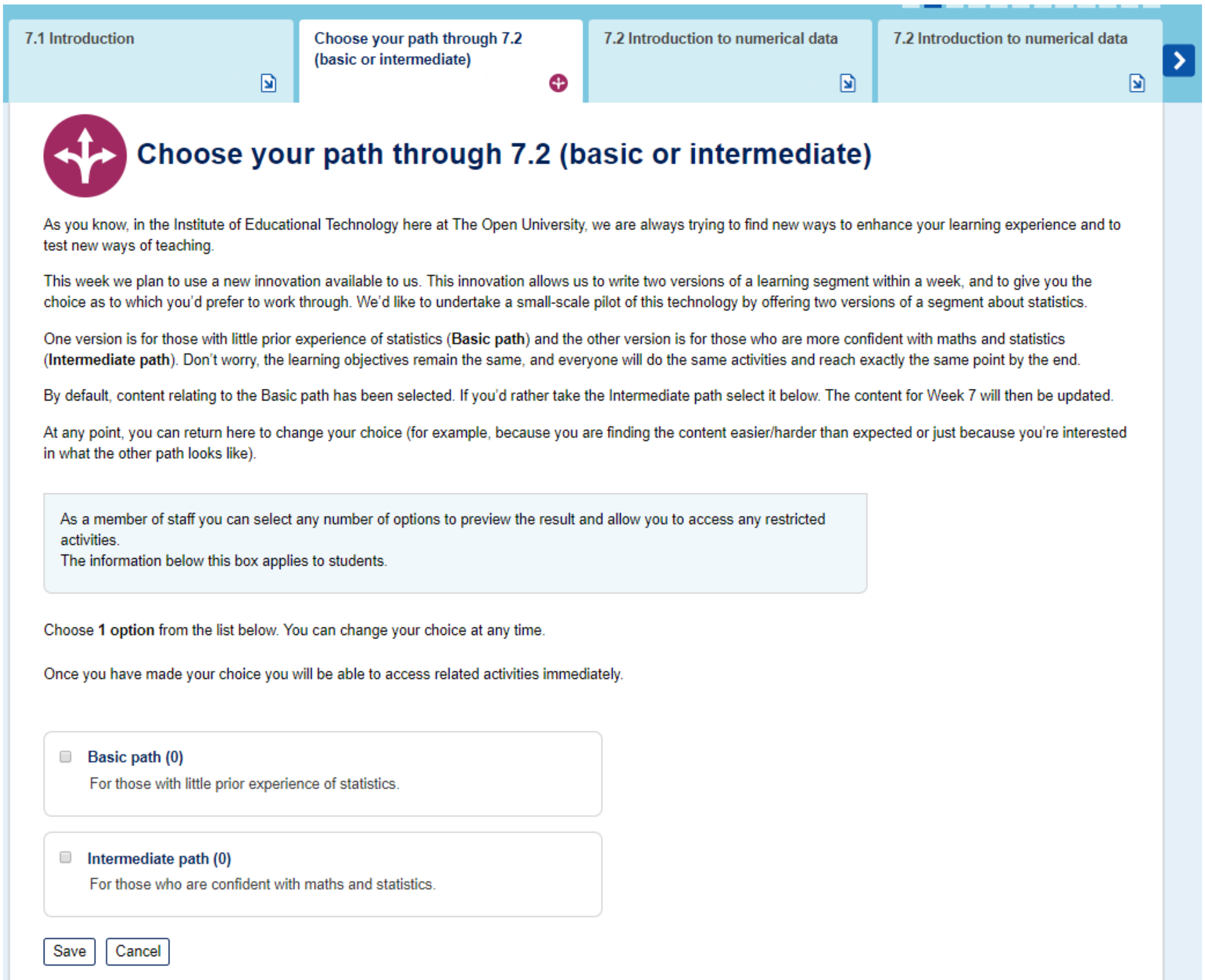


Figure 2: The pathway choice page slots in between other pages in Week 7 on the VLE

This process used existing functionality and no system development was required. Indeed, one aim of the project was to determine whether personalised differentiated learning could be delivered effectively within the capabilities of our existing technologies. Rather than focus on technical challenges, the pilot was able to focus on the pedagogic and design related challenges instead.

3.4 Learner feedback

All learners studying the 2017 and 2018 presentations of the pilot module were invited to answer a questionnaire about the educational technologies used. This was intended to serve a dual purpose: to support student reflection on the effectiveness of the technologies and to provide feedback to the teaching team. The questionnaire asked about the Student Choice pilot and six other teaching tools used including tutor group forums, live seminars, weekly reflection points, and learning design maps (see earlier). Twenty students responded to the questionnaire over the two years. This represents a response rate of 24%.

4. Results

Students were overwhelming positive about being given a choice of learning activity pathways (Table 2). In response to four questions probing RQ1, 95% of respondents liked being given a choice between a basic and intermediate path, 90% felt this gave them a sense of control over their learning and 90% agreed that that in choosing a path they felt the materials were better tailored to their needs. Furthermore, 90% of respondents agreed that the university should aim to use this technique in other modules. Informal feedback from one of the module tutors corroborated that the majority of students responded favourably to having a learning choice. Only one student disagreed with some of the statements (Table 2) however, even they agreed the process of choosing the path was clear, that they liked having the choice and that the university should use this elsewhere.

Table 2: Student feedback about the implementation of the Student Choice tool (n=20)

	Agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Disagree
I liked having a choice between a basic and an intermediate path	85%	10%	5%	-	-
Choosing a path gives me a sense of control over my learning	60%	30%	5%	-	5%
By choosing a path I felt the materials were better tailored to my needs	65%	25%	5%	-	5%
The university should use this technique in other modules	65%	25%	10%	-	-
The process of choosing a path was clear	90%	10%	-	-	-

All respondents agreed that the process for choosing a path as implemented by the pilot was clear (100%). This helps to confirm that no learner was disadvantaged by the approach and that in general it worked well (despite a relatively basic implementation on the university's VLE). Open-comment data relating to the presentation of choice and option of pathways (RQ2) confirms this. One student wrote 'I think it was clear and easy to follow. I liked the option to switch between the basic and intermediate path – and at no point felt that I was 'trapped' with no option to return.' The freedom to take a 'step-back' – to do one pathway and then another – was mentioned by two students. One student liked the idea that 'after completing one path, [I] have the option (time permitting) to go to the other path, particularly where it is a basic – intermediate – advanced structure.' Another student explained that the learning maps were a useful companion:

> *'I chose to do both paths as I wanted to see what the difference was… and to see at [what level] my knowledge [was]. Do you remember the Steve Jackson adventure books? It's a bit like that. I thought the design maps were very useful and would appreciate having a copy of them at the beginning of each week.'*

For another student, the pilot intervention helped expose the implicit assumptions regarding how differentiation is expected to occur in current learning activity design:

> *'the [intervention] is an effective way to apply differentiation and makes me realise that this is an essential teaching skill that has not been applied to all activities. Rather, [in other activities] it has been assumed [students] would all work at their own level or would [themselves] adapt the activity.'*

Not all students had time to complete both paths. For example, one student reported having done some maths, but not statistics, and therefore opted for the intermediate choice which they subsequently found 'fiendishly difficult.' In this case, the student may have benefited from a greater level of guidance and perhaps also a more careful reading of the guidance (as the advice given did state that intermediate was for those 'more confident in maths *and* statistics').

Two students noted that in some cases more information, such as a preview of the pathways, may be useful to help inform the choice. This would suggest that Learning Maps could be made more prominent at the point of decision-making. Across the module in general, opinion was split with respect to the utility of Learning Map visualisations. Around half (55%) had used them, and a similar proportion (60%) agreed that they were helpful to their learning and that the university should use this technique elsewhere.

Other suggestions to make the decision-making process easier included (1) presenting or signposting the choice in good time, (2) creating overlapping activities relevant to ‘pass’, ‘merit’ and ‘distinction’ levels and allowing learners to join the sequence at any point, (3) providing clear pedagogic rationale, and (4) stressing that the teaching decision to offer a choice of options is a positive step so as to avoid giving the impression that “the learning designers lacked confidence in what we should be learning.’

Student comments sometimes revealed quite opposing views. For example, one student saw potential in pathways for helping them save time (by providing tailored paths for time-poor learners) whilst another student was concerned that pathways would increase their workload because they would feel compelled to study all paths so as not to ‘miss anything.’ In another example, whilst the majority of learners recognised the teaching and learning value in designing differentiated activities because student experience ‘vary[s] quite a bit,’ one student said they were concerned that providing choice, differentiation and ‘allowing students to tailor content to their ability [was] a bit of a copout.’

Students also offered suggestions for how different pathways through learning activities could help improve the learning experience. This feedback gives an indication of the potential pathway design ‘types’ that learners may be looking for from their teachers (RQ4). Students suggestions included: (1) catering for different abilities, (2) providing a better fit with learners’ previous knowledge and experience, (3) catering for different interests and level of interest in a topic, (4) offering supporting activities for those struggling to complete an activity or who lack confidence, (5) filling gaps in key areas of skills or knowledge when learners first enter study at university, (6) offering short-cuts for learners short of time, (7) testing different teaching approaches to the same content, and (8) varying questions or scenarios depending on job role or sector.

5. Conclusion

The findings of this pilot study indicate that learners are receptive to and positive about being offered a choice of learning activity paths (RQ1). Almost all learners said that they (1) liked having a choice, (2) that the approach used in the pilot had improved their sense of control, (3) that in choosing a path they felt the materials were better tailored to my needs, and (4) supported the proposal that the university use this approach more widely. Learners felt that the implementation used in the pilot was clear and made suggestions about how to articulate and present the choices available (RQ2). One such articulation trailed in the pilot itself was a purposely designed Learning Map visualisation. Just over half the learners used the maps and found them helpful. This was expected because not all students or staff are necessarily receptive to visualisations of learning activities (Cross, Clark & Brasher, 2009) although this could be mitigated with training to build confidence and competence in the use of visual representation.

The pilot achieved its aim to find a low-cost means of delivering differentiated learning and student choice using existing VLE functionality (Moodle’s conditionality APIs and associated tools). Setting this up on the VLE was relatively quick (although a reasonable amount of effort was spent initially to work out *how* to implement the approach) meaning that the majority of the effort in implementation was expended on the process of learning design (i.e. to properly design the parallel pathways) and producing learning product (the additional content and learning activities) (RQ3). Some technical improvements in the Moodle user interface would further help improve the learner experience. The approach raises new learning design challenges such as ensuring all pathways adhere to good design practices (such as alignment with learning outcomes) and that the user experience (such as leaving and returning to the ‘single’ path) is handled well (RQ4). Yet designing differentiation may also be liberating. For example, saving teachers from feeling constrained to a ‘one-size-fits-all’ approach when they are aware this will put some learners at a disadvantage, or feeling frustrated that having to ‘cover’ all possible gaps in prior knowledge or skills in their main teaching will result in an experience that may seem unengaging or poor value for some learners. The pilot developed twelve design goals which, with context-specific adaption, could provide a useful framework for guiding the development of differentiated personalised learning within a VLE context.

Potential applications for offering learners a choice in learning activity pathways include: (1) parallel differentiated pathways that better challenge curious or higher ability students or that better support low ability students, (2) additional, targeted activities for learners who have insufficient prior knowledge or a skills gap without interfering with the learning paths of other students, (3) confidence-building and reinforcement such as quizzes or experiential learning activities, (4) induction pathways for multi-disciplinary students who are unfamiliar with the disciplinary approach or the particular online or distance teaching adopted by the module, (5) pathways that require less or more effort so that learners can better flex their weekly study around changing demands from personal, professional or voluntary commitments, (6) alternative teaching models where each pathway adopts a different pedagogic approach such as a path that utilising collaborative learning and a second focused on situated learning. This latter approach would also be useful for the testing and evaluating new learning designs or teaching innovation. In summary, designing for parallel, alternative, auxiliary and challenge learning pathways – be these short micro-pathways or of greater reach across a module – continues to offer opportunities to increase the learner perception that they are receiving a more personalised learning and the ability of teachers to design and deliver learning that is better differentiated and relevant to their students.

Acknowledgements

Thanks to those participating in the development and piloting of the intervention.

References

Brasher, A. and Cross, S. (2015) "Reflections on developing a tool for creating visual representations of learning designs: towards a visual language for learning designs". In: Maina, Marcelo; Craft, Brock and Mor, Yishay eds. *The Art and Science of Learning Design.* Technology Enhanced Learning (9), Sense Publishers, Rotterdam, pp 169–180.

Bodily, R. and Verbert, K. (2017) "Review of Research on Student-Facing Learning Analytics Dashboards and Educational Recommender Systems", *IEEE Transactions on Learning Technologies,* Vol. 10, No. 4, pp 405–418.

Boelens, Voet and De Wever (2018) "The design of blended learning in response to student diversity in higher education: Instructors' views and use of differentiated instruction in blended learning", *Computers & Education*, Vol. 120, pp 197–212.

Brusilovsky, P. & Vassileva, J. (2003) "Course sequencing techniques for large-scale webbased education", *International Journal of Continuing Engineering Education and Lifelong Learning*, Vol. 13, No. 1/2, pp 75-94.

Carola, M. (2011) "Learner Agency", *European Educational Research Journal*. Vol. 10, No. 4, pp 559–571.

Cross, S. (2010) "Lattice Model of the Designed Learning Problem Space", webpage. Available at: https://latestendeavour.wordpress.com/lattice-model/

Cross, S., Clark, P., and Brasher, A. (2009) "Preliminary findings from a series of staff surveys on perceptions, attitudes and practices of learning design", *ALT-C 2009 Conference*, 8-10 September 2009, Manchester, UK.

Cross, S., Galley, R., Brasher, A. and Weller, M. (2012) *OULDI-JISC Project Evaluation Report: the impact of new curriculum design tools and approaches on institutional process and design cultures.* OULDI Project (Open University). Available at: http://oro.open.ac.uk/34140/

Cross, S., Sharples, M., Healing, G. and Ellis, J. (2019) "Distance Learners' Use of Handheld Technologies: Mobile Learning Activity, Changing Study Habits, and the 'Place' of Anywhere Learning", *International Review of Research in Open and Distributed Learning*, Vol. 20, No. 2, pp 224–241.

Dimtrova, V. and Brna, P. (2016) "From Interactive Open Learner Modelling to Intelligent Mentoring: STyLE-OLM and Beyond", *International Journal of Artificial Intelligence in Education*, Vol. 26, pp 332–349.

FitzGerald, E., Kucirkova, N., Jones, A., Cross, S., Ferguson, R., Herodotou, C., Hillaire, G. and Scanlon, E. (2017) "Dimensions of personalisation in technology-enhanced learning: a framework and implications for design", *British Journal of Educational Technology*, Vol. 49, No. 1, pp 165–181.

Gordon, N. (2014) *Flexible Pedagogies: technology-enhanced learning*, HEA, York.

Karampiperis, P. and Sampson, D. (2005) "Adaptive learning resources sequencing in educational hypermedia systems", *Educational Technology & Society*, Vol. 8, No. 4, pp 128-147.

Nussbaumer, A., Hillemann, C., Gütl, C. and Dietrich, A. (2015) "A Competence-based Service for Supporting Self-Regulated Learning in Virtual Environments", *Journal of Learning Analytics*, Vol. 2, No. 1, pp 101–133.

Office for Students (2019) *National Student Survey*. Accessed 1 June 2019 from: https://www.officeforstudents.org.uk/advice-and-guidance/student-information-and-data/national-student-survey-nss/

Sicilia, M.-A., Sanchez-Alonso, S., and Garcia-Barriocanal, E. (2006) "On supporting the process of learning design through planners", *Virtual Campus 2006 Post-proceedings, Selected and Extended Papers*, pp 81-89.

Strobel, J., Lowerison, G., Cote, R., Abrami, P.C., and Bethel, E.C. (2008) "Modelling Learning Units by Capturing Context with IMS-LD". In Lockyer, L., Bennett, S., Agostinho, S. and Harper, B. (Eds.) *Handbook of Research on Learning Design and Learning Objects*, ISR.

Universities UK (2018) *Higher Education Facts and Figures 2018*, Universities UK, London. Available at: https://www.universitiesuk.ac.uk/facts-and-stats/data-and-analysis/Documents/higher-education-in-facts-and-figures-2018.pdf

Verbert, K., Drachsler, H., Manouselis, N., Wolpers, M., Vuorikari, R. and Duval, E. (2011) "Dataset-driven research for improving recommender systems for learning", *Proceedings of the 1st International Conference on Learning Analytics and Knowledge*, ACM, New York, USA, pp 44-53.

Wanner, T., & Palmer, E. (2015) "Personalising learning: Exploring student and teacher perceptions about flexible learning and assessment in a flipped university course", *Computers & Education*, Vol. 88, pp 354–369.

Experience of Using Project-Based Learning in the URFU Hypermethod e-Learning System

Lyudmila Daineko, Yury Davy, Viola Larionova and Inna Yurasova
Ural Federal University, Ekaterinburg, Russia
lula75@mail.ru
yury.davy@urfu.ru
viola-larionova@yandex.ru
islobodkina@mail.ru
DOI: 10.34190/EEL.19.066

Abstract: This paper covers use of project-based learning principles in the “Territorial Development and Realty Management” Master program using Hypermethod e-learning system of the Ural Federal University. The number of educational institutions using projects in their practice grows. Successful implementation of project-based learning can be attributed to practical nature of the projects, use of real cases, and involvement of industry professionals as experts that evaluate project results. The purpose of the work was to develop a project-based methodology for training master students of the “Territorial Development and Realty Management”, and assess its efficiency. The work included evaluation of the current master program supported by Hypermethod e-learning platform, and statistical analysis of electronic resources attendance by the students. Results include assessment The study reviews existing master program and is centered on e-learning Hypermethod platform. Statistics of student visits to the Hypermethod platform confirmed relevance of the resource. The work includes results of a survey of program students and practitioners involved in thesis examination. Suggestions on using project learning as a basis for practice-oriented education were provided. Results of the study can be used to substantiate implementation of interdisciplinary projects for training master students.

Keywords: project-based learning, URFU, Hypermethod ELMS, learning organization, practice-oriented approach

1. Introduction

The value of traditional face to face learning is on decline. It is often enough to make a query in an online search engine to get required information, so today’s students do not apprehend traditional lectures. At the same time practical experience is the best way to memorize information. Things done at least once are better remembered than words. Therefore, project-based training becomes a popular trend in modern education.

Project-based learning implies real case studies, and independent case solution by the students, which motivates learners to collect and study the required data. Teacher’s role transforms form being a knowledge translator to an assistant in search for required information, and a mentor in joint project activities.

It is necessary to understand that these joint activities are not aimed at writing essays, or making conference presentations, but the goal is to obtain real, professional skills and knowledge required for the student to move across disciplinary boundaries and solve problems outside of textbook scope.

The following paper describes authors’ experience of using project-based learning principles with support of the Ural Federal University Hypermethod e-learning system (ELS). The ELS was used to organize learning process for management master students involved in “Territorial Development and Realty Management” program. Students are required to prepare an investment project in the development field, covering entire project life cycle. Real cases have precedence (most of the students are practitioners working in construction business or development), if a real case is not available, students perform analysis of a construction company, select and solve a theoretical problem. Project results are used to prepare master thesis paper.

Authors hope that their experience can help to disseminate principles of project-based learning.

2. Data and methods

Project-based learning gains increased popularity in Russia. National Technological Initiative-2035 is based upon creating project teams for solving perspective scientific and technical problems (http://nti2035.ru/nti/). Project-based learning is used in multiple institutions, including Tyumen Industrial University (Kutrunova et al., 2017), Ural State Economic University (Bortnik et al., 2016), Voronezh State Technical University (Rodionova et al., 2019), St.-Petersburg University named after Peter the Great (Gerebkina, 2019, Nam, 2017). Starting in 2017, Ural Federal University is actively introducing project-based training in its institutes, including School for IT, telecommunications, and control systems, and Ural Power Engineering Institute. Graduate School of Economics and Management plans start of project-based activities in the coming academic year, nevertheless, there already are several positive use cases.

Other examples of project-based learning in Russia include "Mentors Academy" initiative for training project-based learning mentors that is successfully implemented by Skolkovo Foundation, task force of the "Learning Circlers Movement" Association, and Agency for Strategic Initiatives (https://sk.ru/academy/), and supported with a free mass open online course "How to become a project mentor" on a Lectorium platform (https://www.lektorium.tv/tutor)/). Initiative also includes multiple workshops conducted in several Russian cities including Ekaterinburg (https://sk.ru/academy/p/2019-04-09-camp.aspx).

Experts of the "Mentors Academy" define the following stages of project-based learning:

- Situation analysis (preliminary analysis, preparation of experts, texts, and materials);
- Problem statement (problem hypothesis definition);
- Project-based solution (formulation of several solution hypotheses);
- Development (assessment of necessary resources), and
- Reflection

Project method methodologist Karl Frey describes (Frey, 1997) the project-based learning process as a student-tutor collaboration aimed at achieving a desired result that includes the following components:

- project initiation, participants involvement and creating teams;
- discussion of approaches and ways to solve the project problem;
- project planning, distribution of responsibilities among the participants;
- project design and implementation;
- the end of the project and preparation of results;
- presentation and fixation of the results;
- discussion of the results (reflection).

Therefore, project –based learning can be considered to be a collaboration process involving mentors and students, and allowing involving the latter into professional activities.

3. Results

"Territorial Development and Realty Management" master program started in 2015 and has more than 50 graduates. The keystone of the program is project-based learning, allowing students to obtain experience of preparing a complete investment project using real and actual data.

Target audience of the program includes recent university graduates, and industry professionals intending to excel in the fields of territorial development, revitalization of urban environments, social and transportation infrastructure, ecology and urban agglomeration psychology as well as urban planning and development. Issues studied include major national and international concepts and practices of urban and territorial development, urban planning, visual images, branding and creative transformation of urban environment; urban legislation; management, and socio-cultural design. Students study concepts of human-scale environments and professional terminology, and obtain professional skills through a variety of practices including lectures, workshops, internships, master classes, and involvement in research and consulting projects, mentored by leading Russian and international experts.

Educational process is a blended one, including both traditional classroom studies, and remote e-learning. Students area able to choose learning methods they prefer. Program professional and competitive quality is assured through quality of supporting online courses, and through involvement of industry professionals in preparation and presentation of the course contents.

Program consists of three parts – basic, advanced, and elective courses. Basic part (27 credits or 927 academic hours) includes courses in the field of economics, state examination, and thesis preparation and defense. Advanced part (57 credits, 2052 academic hours) includes disciplines aimed at developing professional skills and knowledge in the area of development. 48 credits in this part are gained through practice and research work. Electives provide 36 credits (1296 academic hours).

Upon admission to the program, student selects a theme for the future thesis and discusses it with a professor appointed as a thesis advisor. Further studies include blended learning, data collection and academic research.

Mandatory part of any thesis includes preparation of a commercial property development project. The task requires extensive amount of calculations, and, cannot be efficiently performed within a framework of a single discipline. Therefore, a decision was made to study certain aspects within the different courses and combine them by means of a single interdisciplinary project centered on preparation of a master thesis.

The project includes the following stages, that are performed is sequences or simultaneously:

- 1. Stage one includes selection of a construction site. During the territory marketing course students select and substantiate selection of a location for building a specific commercial (or non-commercial) property object, such as a hotel, an office centers, shopping center, university campus, museum or park, etc.
- 2. Development of a cost estimate for a construction object. Students take a "Cost engineering in construction" course, where they study estimation basics, and make a cost estimate for a selected object
- 3. Development of a construction schedule is performed within a framework of a “Construction management” course
- 4. Construction financing. “Financing the infrastructure projects” course supplies students with knowledge possible project financing options. Students are required to analyze financing alternatives for the project they develop, and select the best variant.
- 5. Establishing legal basis for the project, including obtaining construction permits, issues related to land and property laws, insurance requirements, and other issues related to urban planning, construction, and property are covered by “Legal issues for Development” course.
- 6. Selection of an optimal taxation regime for a business is performed in “Taxation in Construction” course, where students examine taxation alternatives and select one that will be most favorable with regard to the project they prepare.
- 7. Company efficiency analysis and estimation of project impact on the company efficiency is performed by the students using data and tools from “Economic Analysis” course. During the course the students assess efficiency of the project investment.
- 8. Estimation of operational costs for a new asset is performed during the “Operations management” course, devoted to asset maintenance, turnarounds, and interaction with regulatory authorities.
- 9. Asset maintenance is supplemented by the “Management of residential buildings and utilities” course, devoted to urban development, interactions with utility vendors (providing power, water, etc.), and the Housing and Public Utilities Sphere” tells about the improvement of the territory, interaction with resource suppliers (electricity, water supply, etc.), and utility pricing policies.
- 10. Overall project analysis, process development, and planning for project implementation is performed in “Managing development projects” course. At this stage students define processes and structures for managing their project, learn to design project management offices, and use project management software and international standards.
- 11. The final stage of creating an interdisciplinary project is performed during the course of “Evaluation and analysis of development projects”. This is the summary course devoted to making investment decisions, and investment decision support. Students review previous planning decisions in the areas of project scope and schedule, financing, and perform overall analysis required to make an investment decision.

The set of skills students develop in two years includes

- data collection and analysis skills;

- ability to draw business plans for development and infrastructure projects, make forecasts of the real estate market using analytical approaches and mathematical models;
- practical skills of project and program organization and implementation;
- practical skills in the area of applying mathematical methods and models to assess investment efficiency, and compare investment alternatives;
- application of analysis methods and simulations for managing project and program risks;
- use of professional software solutions.

Nine out of eleven courses listed above are taught in a blended mode using Hypermethod ELS. That allows providing opportunities for blended learning Most of the courses (9 out of 11) are provided with courses in the URFU Hypermethod system, which allows students to receive information in a convenient format. Electronic courses are also used to provide informational resources and organize tests.

Course contents can be studied online through Hypermethod system, or used by a teacher to illustrate a specific problem in class. Students are also encouraged to search for data independently, both online and through offline interaction with teachers, practitioners and experts.

Usual contents of the courses include lectures with assignments to be performed out of class, and tests for self-control and evaluation of the study results. At the end of each course students take tests, and solve practical problems. Each discipline is also followed by online or offline discussion of results.

Program is completed by an open defense of a master thesis that includes a development project covering a whole lifecycle from ideation through investment and operation stages. Students is to perform efficiency evaluation of a proposed project. Thesis is reviewed by a board including real estate and construction practitioners.

4. Discussion

Development and implementation of the program involved evaluation of the following options:

- Traditional learning approach including lectures, case reviews and workshops, where students solve teacher-designed problems. This approach was considered inefficient due to a fact that most of the students are able to search for required information on their own, thus lowering value of the knowledge they receive in class, and small amount of practical skills obtained, along with inability to apply theoretical knowledge provided to real world problems;
- Totally online course. Recent research of student motivation displayed low student motivation to study online due to the specific traits of “Z generation”, namely, gadget dependence, impatience, and the habit of obtaining information through web surfing (Sheka et al 2018).
- Blended project-based learning using electronic resources, ability to communicate with teachers, practitioners, and experts online and offline, and ability for the student to select the most-preferred mode of communication. Blended learning format was selected due to its flexibility that allows students sle3cting the most comfortable way of obtaining skills and knowledge. Despite the fact that teachers design scenarios used in project-based learning, the learning process itself has wide perspectives for self-learning and mutual learning for all people involved into projects. Changes in teacher’s roles include forbearance from retelling textbooks for the sake of collaborative and creative learning that allows development of both student and teacher through obtaining empirical knowledge.

Due to the fact that most of the master students (92%) are working, classes were organized in the evening. It is a common practice for people to work late, or take business trips, and, therefore, be unable to attend the university in person. In this case electronic resources allow to get the required data, and not fall behind. Courses are also used by the students attending classes to review data, or structure the knowledge.

Online courses based on mind maps (Larionova 2015) allow altering discipline teaching structure and course contents in cases when it is necessary to accommodate for new knowledge or particular needs of the students.

Statistics related to accessing the “Evaluation and analysis of development projects” online course was reviewed. Results are presented in table 1.

Table 1: Access statistics for the “Evaluation and analysis of development projects” online course, 2016-2019

Time interval	Number of successful access attempts	Time of the day	Working/non-working hours
00.01-01.00	72	night	Non-working
01.01-02.00	8	night	Non-working
02.01-03.00	4	night	Non-working
03.01-07.00	5	night	Non-working
07.01-08.00	66	morning	Working
08.01-09.00	29	morning	Working
09.01-10.00	55	morning	Working
10.01-11.00	37	morning	Working
11.01-12.00	39	day	Working
12.01-13.00	33	day	Working
13.01-14.00	34	day	Working
14.01-15.00	26	day	Working
15.01-16.00	85	day	Working
16.01-17.00	43	day	Working
17.01-18.00	111	evening	Working
18.01-19.00	242	evening	Non-working
19.01-20.00	102	evening	Non-working
20.01-21.00	55	evening	Non-working
21.01-22.00	35	evening	Non-working
22.01-23.00	70	night	Non-working
23.01-24.00	56	night	Non-working
TOTAL:	1207		

As it can be seen from Table 1, students attended electronic resource on a constant basis, each of the students visited a course about 30 times in 2 times time (course takes one half of a semester, there are 8 lesons). Statistics for visiting sections of the e-course are presented in Table 2.

Table 2: Visit statistics for the “Evaluation and analysis of development projects” course sections - 2016-2019

Section	Number of visitors	Share of all visits, %
Introduction	89	5,80
Glossary	1	0,07
Section 1. Role of investments in social and economic development of a territory	275	17.93
Section 2. Tools for investment activities aimed at territory development	312	20.34
Section 3. Financing of development projects	426	27.77
Section 4. Investment project analysis methods	209	13.62
Section 5. Large-scale territory development projects	163	10.63
Additional materials	49	3.19
Consulting forum	10	0.65
Total:	1534 - keeping in mind that in course of one visit it is possible to view several sections	100

Data in Table 2 demonstrates that students display stable interest in the course, the maximum number of visits is noted for Section 3, devoted to the interdisciplinary course project developed by a student. Students also pay attention to the computational tools used in the projects. At the same times student rarely visit forum, due to the fact that information provided is usually enough to make required calculations.

A survey was also conducted by the authors to obtain feedback from the students and experts reviewing master theses.

98% of the program graduates displayed overall satisfaction with the learning process, while remaining 2% responded that they were rather satisfied than dissatisfied. 100% of the graduates were satisfied with quality of key contents of electronic courses, while 79% also used additional materials. The usual time for obtaining feedback from teachers through electronic resources was equal to 2-3 days.

Feedback from experts evaluating master theses based on interdisciplinary course project, displayed increasing quality of the papers, use of relevant data, and the applicability of the results for actual projects in the industry.

5. Conclusion

Project-based methods become an indispensable educational tool by providing chances to implement practical-based learning. Current market requires educated labor force that was trained using real industry data. Project-based learning allows students obtaining knowledge both individually, and from other participants, including getting new knowledge through reflection. Self-and mutual learning is indispensable for further practice after graduation. The paper describes experience of using project learning principles in UrFU Hypermethod ELMS to support "Territorial Development and Realty Management" master program. Results demonstrate success of the selected blended learning format, combining interpersonal live communication, and e-learning capabilities. The paper also illustrates logics of the designed master program, where each discipline is a step towards a final interdisciplinary project that in term becomes basis for a thesis. Further activities include braking large interdisciplinary project into several smaller ones, where each project is aimed at solving a small concrete problem that becomes an element of an overall solution. Based on the experience of using interdisciplinary projects authors can recommend using them as a basis for practice-oriented master programs.

References

Bortnik, B. , Stozhko, N., Kozhin, A., et al. (2016) "Experience of organizing project-based learning using interdisciplinary interaction" Herald of North-Ossetian State University named after K. Hetagurov, 2016, issue 3, pp 127-131.

Frey, K. (1997) Die Projectmethode, Der Weg zum bildenden Tun. Weinheim und Basel: Belts (12Auflage)

Kutrunova, Z., Maksimova, S., and Voronov, A. (2017) "Experience of teaching engineering disciplines using practice – oriented "Conceive - Design - Implement – Operate" approach", World of Science Internet journal, Vol. 5, issue 1, January-February, [online], http://mir-nauki.com/PDF/08PDMN117.pdf.

Larionova, V. A. (2015) "Use of virtual mind mapping to organise effective colaboration of students in project activities", New Educational Technologies in a University: Proceedings of the XII International conference (NOTV-2015), pp 101-105.

Nam, T. (2017) "Practice of applying project technologies in a technical university (teaching foreign languages)" "Foreign languages: linguistics and methodology" journal, issue 37, pp 106-110.

Rodionova, V., Turovets, O., Shotylo, D. (2019) "Use of project-based learning in development of a master course devoted to organization of hi-tech production", "Production organizer" journal, Vol. 27, issue 1, pp 90-102.

Sheka A., Larionova, V., Vasilyev, S., Pevnaya, M. (2018) The early bird fails the test: behavioral patterns of the online course students. Proceedings of the international conference: Elearning stakeholders and researchers summit 2018, pp 195-210

Zherebkina, O. (2019) "Project activities as a tool for teaching foreign languages in technical master courses", Science Perspective, issue 2 (113), pp 150-155.

Effects of Blending Digital Games into Traditional Lecture-Based Learning on University Students' Programming Learning Achievement

Kannika Daungcharone
College of Arts, Media and Technology, Chiang Mai University, Chiang Mai, Thailand
kannikadaung@gmail.com
DOI: 10.34190/EEL.19.070

Abstract: Learning programming is a difficult course because the students need to remember the various type of program's syntax, create complicated commands, and solve the errors that difficult to understand. Therefore using modern technology such as online learning, social media and educational games may support students to learn to programme. In this study, computer programming games, which are educational computer games simulating the compiler working with the scenarios of daily human life, were employed in the new approach called a blended learning digital game. The approach was designed by integrating traditional lecture-based learning model and the educational computer game. Quasi-experimental research was conducted to examine the effectiveness of the proposed approach by comparing to the traditional lecture-based learning approach. This research examined the learning achievement of male and female students who learn in different environments. This was based on the blended learning digital game approach and the traditional lecture-based learning approach. An analysis of 94 university students shows that using the game as a cognitive tool in part of the traditional lecture-based learning had significantly positive of C programming language achievement. While the new approach can support the students to learn C programming in both genders, it also supports the notion that students can achieve C programming language performance through the game, mainly when using the traditional lecture-based learning environment.

Keywords: programming learning, digital game, blended learning, higher education

1. Introduction

Learning the programming concept is important in the field of information technology, computer science and related fields because it can support students to construct and solve the algorithm problem (Niekerk and Webb, 2016). Those students may find programming difficult and struggle to master the core concepts. Such that, in many countries, computer science has worryingly high dropout rates often the highest among all disciplines (Bati, Gelderblom and Biljon 2014; Niekerk and Webb 2016). The motivation to learn for university students was one issue, which affected dropout's rate and delays in the study (Pedditzi and Spigno 2012). Therefore interesting and motivating instruction could help the students to achieve a well-academic record in any subject (Omar, Mohamad and Paimin 2015), especially in the computer programming course. To date, the advancement in computers and communication technologies have changed the approach of teaching and learning process (Yang 2008). Besides, the policy of the National Education Thailand on 21st century which aim to reform the education system by focusing on the learning process and improving quality of learning and teaching. Therefore, many institutes plan to reform the learning process by adopting ICT to be a part of reaching the learning successful and also succeed in careers and lifelong learning. This is because ICT in learning and teaching can support students' thinking, communication, and collaboration skills (Pheeraphan, 2013). The various technologies can be employed to make instruction more exciting and motivating to the students. According to the research of Harandi (2015), the main principle for creating efficient education was promoting motivation to learn. Researchers suggested that game-based learning could help students in higher education improved their conceptual understanding in several domains such as commercial, mathematics, statistic, information technology, biology, and psychology through the process of gamification (Tan et al, 2014; Mayer, Warmelink and Bekebrede 2013; Qian and Clark 2016). Moreover, the computer game enables the students to increase new knowledge, feel attracted, and accomplish better performance (Coller and Scott 2009). Several researchers argued that the pedagogy for the game could deliver more effective learning activities (Dorji, Panjaburee and Srisawasdi 2015; Hwang, Chiu and Chen 2015); therefore, systematically blending the game with the traditional lecture-based learning environment has not been well addressed yet, especially in a computer programming course.

The main purpose of this study was to apply a traditional lecture-based learning approach for an educational computer game, in which a novelty approach is named a blended learning digital game approach. Thus, this study empirically compares the learning C programming language achievement and motivation of students in both genders between the blended learning digital game approach and traditional lecture-based learning approach as the usual-university setting.

2. Related work

2.1 Game in programming learning

Programming is an essential skill for students who learn in the computer curriculum (Becker et al, 2016). In general, higher education students might have problems in programming learning because they usually have less capability in logical reasoning and algorithmic thinking (Kalelioglu 2015). Bati, Gelderblom and Biljon (2014) presented that the challenges of learning and teaching programming are the cognitive activities relating to problem-solving, representing algorithms, creating the syntax of code those mechanics of debugging, editing, compiling and the internal behaviour of executing code. Furthermore, the traditional approach to learning programming is paying attention to the syntax and structure of the programming language rather than encouraging students to understand the problem and be able to solve the problem (Oddie et al, 2010). Besides, understanding the compiler error message is an essential factor in determining the students' level of achievement because the compiler error messages are technical words that are not used in daily life. Therefore, it is challenging for students to understand these error messages and to try to solve the problem (Becker et al, 2016). Several researchers carefully investigated how to motivate students to enhance their programming learning. For example, Kalelioglu (2015) asserted that learning programming through the visual environment, such as diagrams, animation, drag and drop type applications, can support most students. This is because they are happy and comfortable to learn, enabling them to develop their higher-order thinking skills rather than passive receive conceptions. Such that, the simulation tools could be used to demonstrate the program's execution steps and runtime behaviour; therefore, the students would no longer feel anxiety and low self-esteem in programming learning (Bati, Gelderblom and Biljon 2014; Meerbaum-Salant, Armoni and Ben-Ari 2013).

Researchers argued that game-based learning is a useful cognitive tool for supporting students to gain knowledge through the gaming process (Wang and Chen 2010). The game-based learning provides an environment where knowledge and skill acquisition could be enhanced by gaming activities involving problem-solving spaces and challenges (Qian and Clark 2016). Trial-and-error during playing games allow students to promote their attention, selection, activation and retention skills. Besides, it encourages the students learning motivation and helps them acquire knowledge to real-life problem-solving situations (Wang and Chen 2010; Sung et al, 2017). Sung, Hwang and Yen (2015) suggested that an educational computer game provided students with gaming elements, such as humour, suspense and drama. In addition to these components, having a challenging aspect of the game was said to promote the students' learning motivation (Daungcharone, Panjaburee and Thongkoo 2019). Additionally, there are usually some rules and rewards in the game, guiding and encouraging students to think and analyse when making the correct and meaningful decisions. For example, hints or guides are provided to students when solving problems. This initiates thinking or completing learning tasks. Recently, researchers have investigated the game-based learning effectiveness in several fields, such as computer science, math, statistics, business, psychology, and biology (Qian and Clark 2016).

2.2 Blended Learning in higher education

The term blended learning, which is used to name the approach of merging face-to-face instruction with technology-based learning in a unique learning scenario, has become popular in educational settings (Tsai, C.W., Shen and Tsai, M. C. 2011; Graham, Woodfield and Harrison 2013; Porter et al, 2016). Tsai, C.W., Shen and Tsai, M. C. (2011), Campbell et al (2008), and Pereira et al (2007) revealed that the blended learning approach had better efficiency than traditional teaching as it leads to a positive learning environment. Blended learning is a type of modern teaching and learning process which integrates didactic pedagogy with various media technologies. Blended learning materials with didactic lectures have been progressively popular in the university teaching practices because of the observed learning benefits through verbal, visual, and auditory stimulations (Ngan et al, 2018). The interactive technologies, such as simulations, interaction, and gaming have been very influenced by students' performance (BakarNordin and Alias 2013). Several researchers argued that blended learning has been recognized as an effective learning strategy in higher education because it combines different modes of delivery, models of teaching, and transparent communication among all parties involved in a course (Heinze and Procter 2004; Owston, York and Murtha 2013; Boelens, Voet and Wever 2018). For example, Wai and Seng (2014) and Nor and Kasim (2015) applied blended learning into the business courses and found that it could promote the students' learning satisfaction and learning outcome. This was also apparent in Deschacht and Goeman's study (2015) which found that the blended learning has been an authority on enhancing university students' success in an academic business education, which leads to learning achievement and higher course pass rates of students. It also created the opportunity for students to learn in the new environment, leading to positive satisfaction to learn. Moreover, Bati, Gelderblom and Biljon (2014) and Grover, Pea and Cooper (2015) who applied a blended learning approach for learning and teaching computer programming in higher education, found that the learning had a positive effect and was very helpful for managing learning and teaching in the large classroom.

According to literature reviews in this study, blended learning approach combining active lecture-based instruction with a computer game in a unique learning scenario was developed and applied to the C programming language subject of a university to evaluate the performance of the proposed approach.

3. Setting blended learning digital game activities

For this study, we used a C programming language game named CP m-Game (Daungcharone, Panjaburee and Thongkoo 2017). The game was analysed, designed, and developed for the beginner of C programming language in higher education. The primary objective of the CP m-Game is to simulate the computer processing system (compiler) with real-life activities. This, in turn, encourages undergraduate students to understand programming principles more easily. Furthermore, gaming scenarios in the CP m-Game support them to analyse the problem, design the algorithm, create the program, and debug the errors in a basic C programming language. The features of CP m-Game transfer the code editor format to be the real event's gaming representing the compiler working steps; that is, it motivates students to understand the coding message better than reading a message from general program editors. This is because most of the coding messages are technical words that are difficult for students to understand and follow. In regards to playing the CP m-Game, a player is defined to solve the problem by trying to design the algorithm then allocating the code block followed by the problem as shown in Figure 1.

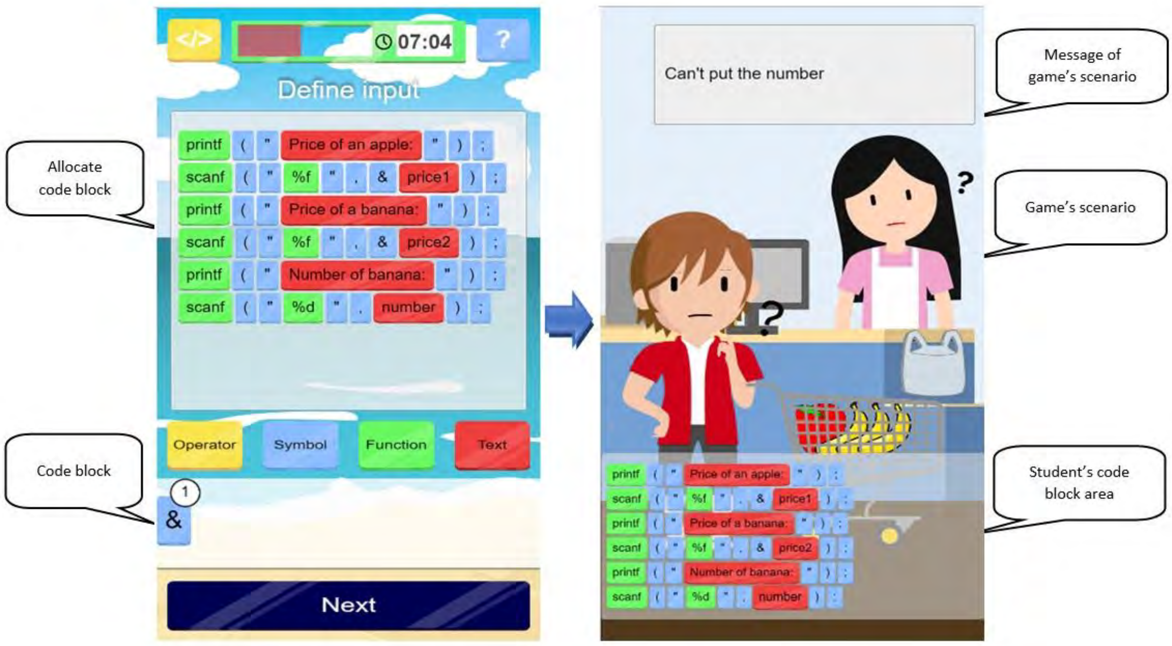


Figure 1: Example of CP m-Game screenshot followed by student's allocate code block

The order of code block will define the game's event by comparing real-life activities to compiler working. For example, Figure 1 presents the screenshot of the incorrect allocates code block. In this case, a student forgot to put the "&" code block in the 6th line. After clicking the next button, the game scenario will guide him/her an error via the game activity and error message. It means that he she is encouraged to observe the exact position of an error within the gaming scenario. Afterwards, he she is asked to allocate a code block once again for solving the error until it is solved. In this error case, if the student put the "&" code block at the 7th position of the 6th line, the expression will correct, and the game will continue the next step within the game. Besides, during the presentation of the game activity based on the students allocate code block, students can view and observe step-by-step activities of each command (code block) at the student's code block area.

To set up the blended learning digital game approach, it combines the CP m-Game with the traditional lecture-based learning, as shown in Figure 2. In the traditional lecture-based learning approach, the teacher plays the primary role in the C programming language classroom. The teacher describes the learning content, while students' role is listening and taking note. When the teacher provides students questions, the students response the questions and teacher and students discuss the answers together. The teacher may ask the students to discuss the answer together with their peers, afterwards conclude the answer to specific knowledge together. In the blended learning digital game approach, the traditional lecture-based learning and CP m-Game were blended. That is the teacher and CP m-Game play essential roles in the learning activities in the classroom. The CP m-Game is used as the medium for supporting the teacher's lecture other than discussing.

Figure 2: The conceptual model of the blended learning digital game approach

Focusing on the blended learning digital game approach, the CP m-Game approach is combined with the traditional lecture-based learning approach. It is designed by considering the continuation of knowledge among three learning units. These include the basic C programming language, including sequence structure, selection structure, and repetition structure. Each learning unit is divided into three respective parts, such as learning content, playing CP m-Game, and doing the lab assignment, as shown in Figure 3.

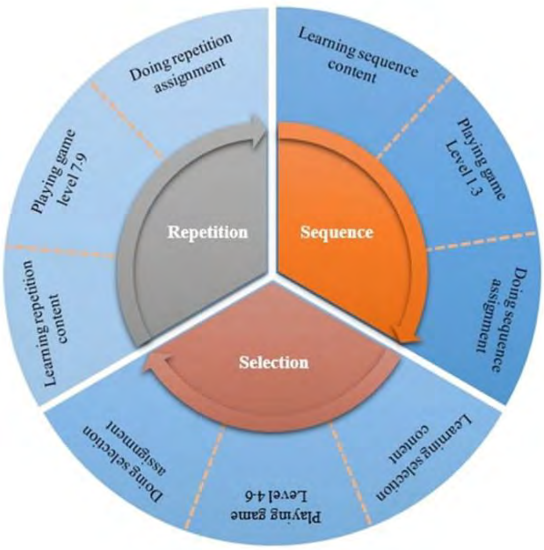


Figure 3: The continuation of knowledge among the three basics C programming language

The objective of the blended learning digital game approach is to support students to apply the knowledge or content from lecture to solve the problems in the gaming scenarios of the CP m-Game. During playing the CP m-Game, the students can also gain further knowledge of the C programming language occurring from analytical thinking, problem-solving, observation, and memorisation. Afterwards, they can use the knowledge they have gained from both lecture and game for completing the C programming language lab assignment.

4. Research methodology

4.1 Participants

In this study, the participants were 94 1st year university students who had not learnt in a Fundamental of Computer Programming subject before. They were categorized into two different groups by using random sampling technique. A control group consisting of 39 students (20 male and 19 female) receiving the traditional lecture-based learning approach. An experimental group consisting of 55 students (30 male and 25 female) receiving the blended learning digital game approach.

4.2 Measurement tools

Two kinds of measurement tools were designed, developed and used in this study. Firstly, the pre-test and post-test were created by lecturers who teach in the Fundamental of Computer Programming subject. The tests consist of twenty-four multiple-choice questions for measuring the C programming language learning achievement. The tests cover sequence, selection and repetition contents. The tests have reliability with KR-20 value of 0.72 and 0.70. Secondly, the motivation questionnaire was applied from Glynn et al (2011) and translated in Thai version for investing C programming language motivations. The questionnaire is a five-point Linkert rating scale ranging from 1 to 5, including strongly disagree, disagree, neutral, agree, and strongly agree respectively. It consists of 25 items dividing into five dimensions (five items per each). Intrinsic motivation (IM) refers to the inherent satisfaction to learn specific content. Career motivation (CM) refers to applying the knowledge to the career. Grade motivation (GM) refers to getting a good grade to learn. Self-determination motivation (SDM) refers to the students' belief they have over their learning. Self-efficacy motivation (SEM) refers to the students' belief they can achieve well to learn. The questionnaire is reliability with the Cronbach's alpha (α) value 0.94.

4.3 Experimental procedure

The experiment of this study examines the differences between the students' C programming language learning achievement and learning motivation between the two groups, as shown in Figure 4. In addition, all procedures performed in this study involves human participants in accordance with the ethical standard of Mahidol University Central Institutional Review Board, Thailand.

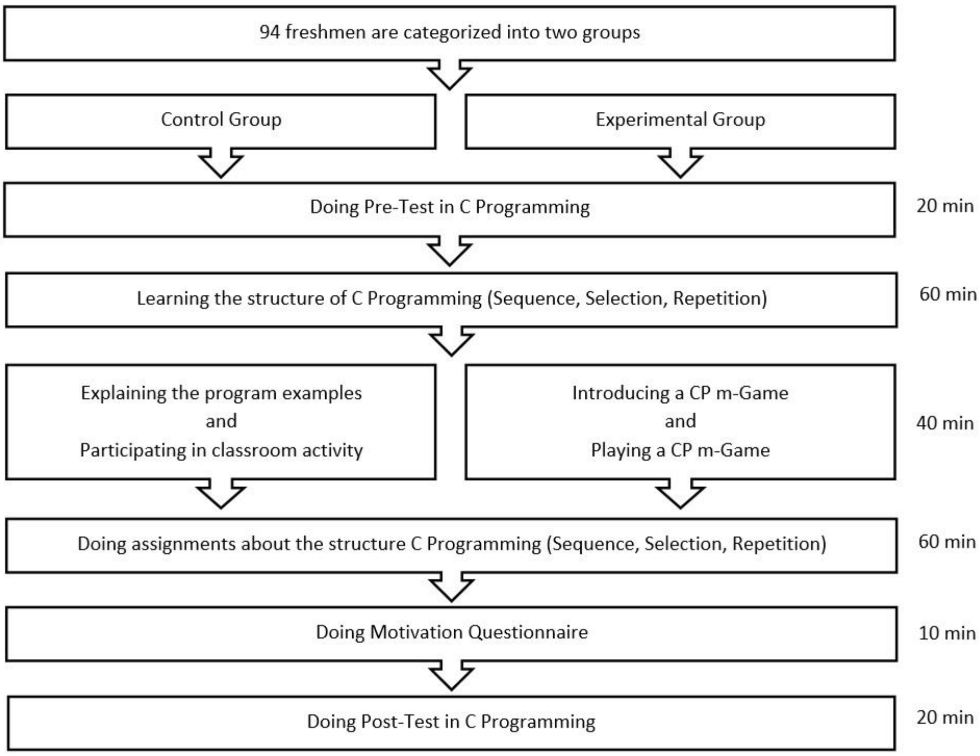


Figure 4: The experimental procedure

5. Experimental result

To examine how two different learning approaches affecting learning achievements regardless of the influence of their prior knowledge, a two-way ANCOVA was performed with Levene's test $F_{(3,90)}$ = 1.057 and p = 0.372. The pre-test score is a covariate, learning approach and gender are independent variables, and the post-test score is a dependent variable. Table 1 presents that the post-test score was a significant difference between two approaches and gender ($F_{(1,89)}$=5.065, p=0.27) on students' learning achievement. Besides, Table 2 further depicts descriptive data of learning achievement on gender indifference learning approach. It shows that students who learn in the blended learning digital game approach, both male and female have learning achievement better than those who learn in the traditional lecture-based learning approach. This is because blending the CP m-Game with the lecture in the classroom enable students to learn to programme by observing and trying to solve the errors via the game's scenario which can support students' motivation and desire to learn.

Table 1: Two-way ANCOVA results of students' learning achievement

Source	*SS*	*df*	*MS*	*F*	η^2
Gender	26.144	1	26.144	5.426*	.057
Learning Approach	55.401	1	55.401	11.497*	.114
Gender * Learning Approach	24.405	1	24.405	5.065*	.054
Note: *p < 0.05					

Table 2: Descriptive data of the learning achievement between two different learning approaches

Gender	*Learning Approach*	*N*	*M*	*SD*
Male	Blended learning digital game approach	30	2.766	2.167
	Traditional lecture-based learning approach	20	2.740	2.049
Female	Blended learning digital game approach	25	2.792	2.282
	Traditional lecture-based learning approach	19	2.316	2.854

Furthermore, the two-way ANOVA test was performed with Levene's test $F_{(3,90)}$ = 0.521, 0.668, 0.904, 0.732, 0.148 and p = 0.669, 0.574, 0.443, 0.535, 0.930 of IM, CM, GM, SDM, and SEM ratings, respectively. It was conducted for each dimension of motivations by using the learning approaches and gender as an independent variable, and motivation scores was a dependent variable. Table 3 shows that the students who learn in the blended learning digital game approach had better C programming language motivations in the dimension of IM, CM, SDM, and SEM than those in the traditional lecture-based learning approach, significantly. There was no significant difference in GM between the two groups. In term of gender, there was no significant difference in all motivation dimensions. Table 4 depicts that students who learn in the blended learning digital game approach both male and female have learning motivation in terms of IM, CM, SDM, and SEM better than those who learn in the traditional lecture-based learning approach except the GM that students both male and female still believe in the traditional lecture-based learning approach.

Table 3: Two-way ANOVA results of students' learning motivation

Motivation	*Source*	*SS*	*df*	*MS*	*F*	η^2
IM	Gender	1.22	1	1.22	.163	.002
	Learning Approach	94.772	1	94.772	12.665*	.123
	Gender * Learning Approach	7.962	1	7.962	1.064	.012
CM	Gender	1.809	1	1.809	.115	.001
	Learning Approach	142.313	1	142.313	9.084*	.092
	Gender * Learning Approach	5.635	1	5.635	.360	.004
GM	Gender	6.611	1	6.611	.640	.007
	Learning Approach	8.203	1	8.203	.794	.009

Motivation	*Source*	*SS*	*df*	*MS*	*F*	*η²*
	Gender * Learning Approach	1.608	1	1.608	.156	.002
SDM	Gender	2.388	1	2.388	.264	.003
	Learning Approach	56.326	1	56.326	6.221*	.065
	Gender * Learning Approach	6.691	1	6.691	.739	.008
SEM	Gender	5.725	1	5.725	.767	.008
	Learning Approach	79.648	1	79.648	10.670*	.106
	Gender * Learning Approach	.139	1	.139	.019	.000
Note: *p < 0.05						

Table 4: Descriptive data of the learning motivation between two different learning approaches

Motivation	*Gender*	*Learning Approach*	*N*	*M*	*SD*
IM	Male	Blended learning digital game approach	30	3.960	2.917
		Traditional lecture-based learning approach	20	3.670	2.455
	Female	Blended learning digital game approach	25	4.032	2.868
		Traditional lecture-based learning approach	19	3.506	2.525
CM	Male	Blended learning digital game approach	30	4.220	5.708
		Traditional lecture-based learning approach	20	3.620	2.929
	Female	Blended learning digital game approach	25	4.064	2.780
		Traditional lecture-based learning approach	19	3.664	3.163
GM	Male	Blended learning digital game approach	30	3.566	3.770
		Traditional lecture-based learning approach	20	3.740	2.736
	Female	Blended learning digital game approach	25	3.512	2.873
		Traditional lecture-based learning approach	19	3.578	3.143
SDM	Male	Blended learning digital game approach	30	3.854	3.342
		Traditional lecture-based learning approach	20	3.430	2.560
	Female	Blended learning digital game approach	25	3.680	3.109
		Traditional lecture-based learning approach	19	3.474	2.733
SEM	Male	Blended learning digital game approach	30	3.980	2.808
		Traditional lecture-based learning approach	20	3.590	2.837
	Female	Blended learning digital game approach	25	3.864	2.704
		Traditional lecture-based learning approach	19	3.506	2.525

6. Conclusion

This study examined the differences in freshmen's learning performance in terms of C programming language motivations to learn and learning achievement between the two learning approaches in both genders. According to the result of C programming language learning achievement, the two-way ANCOVA results of the pre- and post-tests reveal that the students who learned in the blended learning digital game approach have better learning achievement of C programming language more than those who learned in the traditional lecture-based learning approach in both genders (Table 1 and Table 2). Additionally, the two-way ANOVA results of C programming language motivations show that the students are happy and enjoy learning the C programming language content during participating in the blended learning digital game approach (Table 3). Male students have a higher motivation than female students in the dimension of CM, GM, SDM, and SEM, except for the IM that female students have motivation higher than male students (Table 4).

There are reasons to support these results. Blending the CP m-Game with traditional lecture-based learning approach can change the learning format to be more attractive, exciting and can improve students' motivation to learn. It causes the attraction characteristic of the game such as enjoyment, temptation reward, and game's hints creating the students' happiness to learn continuously. The findings of this study are in line with Kalelioglu (2015), Bati, Gelderblom and Biljon (2014), and Meerbaum-Salant, Armoni and Ben-Ari (2013), who concerned that learning programming using visual tools could promote students' motivation to learn and problem-solving skill. The tools could lead students to construct knowledge from ambiguity, trial an error, and to assimilate new knowledge (Wang and Chen 2010). Moreover, blending computer game as a cognitive tool into the lecture-based learning activities led students to achieve the learning goal and acquire specific knowledge (Tsai, C.W., Shen and Tsai, M. C. 2011; Kumar and Pande 2017).

To sum up, this research, blending the CP m-Game with the traditional learning style by using it to be a media instead of the lab's explanation after learning the C programming language theory can help students to achieve the learning and also promote the motivation to learn. There are many reasons such as transforming the complicated programming to be the fun game, observing the compiler programming steps and error messages via the game's scenario instead of the program editor and learning and understanding to the programme by trial an error instead of remembering the program's syntaxes.

References

BakarNordin, A. and Alias, N. (2013) "Learning outcomes and student perceptions in using of blended learning in history", *Procedia-Social and Behavioral Sciences,* Vol 103, pp 577-585.

Bati, T. B., Gelderblom, H.and Biljon, J. V. (2014) "A blended learning approach for teaching computer programming design for large classes in Sub-Saharan Africa", *Computer Science Education,* Vol 24, No. 1, pp 71-99.

Becker, B. A., Glanville, G., Iwashima, R., McDonnell, C., Goslin, K. and Mooney, C. (2016) "Effective compiler error message enhancement for novice programming students", *Computer Science Education,* Vol 26, pp 148-175.

Boelens, R., Voet, M. and Wever, B. D. (2018) "The design of blended learning in response to student diversity in higher education: Instructors' views and use of differentiated instruction in blended learning", *Computers & Education,* Vol 120, pp 197-212.

Boelens, R., Wever, B. D. and Voet, M. (2017) "Four key challenges to the design of blended learning: A systematic literature review", *Educational Research Review,* Vol 22, pp 1-18.

Campbell, M., Gibson, W., Hall, A., Richards, D. and Callery, P. (2008) "Online vs. face-to-face discussion in a web-based research methods course for postgraduate nursing students: A quasi-experimental stud", *International Journal of Nursing Studies,* Vol 45, pp 750-759.

Coller, B. D. and Scott, M. J.)2009) "Effectiveness of using a video game to teach a course in mechanical engineering", *Computers & Education*, Vol 53, No. 3, pp 900-912.

Daungcharone, K., Panjaburee, P. and Thongkoo, K. (2017) "Using digital game as compiler to motivate C programming language learning in higher education", *6th IIAI International Congress on Advanced Applied Informatics,* pp 533-538.

Daungcharone, K., Panjaburee, P. and Thongkoo, K.)2019("A mobile game-based C programming language learning results of university students' achievement and motivations", *International Journal of Mobile Learning and Organisation,* Vol 13, No. 2, pp 171–191.

Deschacht, N. and Goeman, K. (2015) "The effect of blended learning on course persistence and performance of adult learners: A difference-in-differences analysis", *Computers & Education,* Vol 87, pp 83-89.

Dorji, U., Panjaburee, P. and Srisawasdi, N. (2015) "A Learning Cycle Approach to Developing Educational Computer Game for Improving Students' Learning and Awareness in Electric Energy Consumption and Conservation", *Educational Technology & Society*, Vol 18, No. 1, pp 91–105.

Glynn, S. M., Brickman, P., Armstrong, N.and Taasoobshirazi, G. (2011) "Science motivation questionnaire II Validation with science majors and nonscience majors", *Journal of Research in Science Teaching,* Vol 48, pp 1159-1176.

Graham, G. R., Woodfield, W. and Harrison, J. B. (2013) "A framework for institutional adoption and implementation of blended learning in higher education", *Internet and Higher Education,* Vol 18, pp 4-14.

Grover, S., Pea, R. and Cooper, S. (2015) "Designing for deeper learning in a blended computer science course for middle school students", *Computer Science Education,* Vol 25, No. 2, pp 199-237.

Harandi, S. R. (2015) "Effects of e-learning on students' motivation", *Social and Behavioral Sciences,* Vol 181, pp 423-430.

Heinze, A. and Procter, C. (2004) "Reflections on the use of blended learning", [online], University of Salford, http usir.salford.ac.uk 1658

Hwang, G.J., Chiu, L.Y. and Chen, C.H. (2015) "A contextual game-based learning approach to improving students' inquiry-based learning performance in social studies courses", *Computers & Education,* Vol 81, pp 13-25.

Kalelioglu, F. (2015) "A new way of teaching programming skills to K-12 students Code.org", *Computers in Human Behavior,* Vol 52, pp 200-210.

Kumar, R. and Pande, N. (2017) "Technology-mediated learning paradigm and the blended learning ecosystem what works for working professionals?", *Procedia Computer Science,* Vol 122, pp 1114-1123.

Mayer, I., Warmelink, H. and Bekebrede, G. (2013) “Learning in a game-based virtual environment a comparative evaluation in higher education”, *European Journal of Engineering Education,* Vol 38, No. 1, pp 85-106.
Meerbaum-Salant, O., Armoni, M.and Ben-Ari, M. (2013) “Learning computer science concepts with Scratch”, *Computer Science Education,* Vol 23, No. 3, pp 239-264.
Ngan, O. M. Y., Tang, T. L. H., Chan, A. K. Y., Chen, D. M. C. and Tang, M. K. (2018) “Blended learning in anatomy teaching for non-medical students: An innovative approach to the health professions education”, *Health Professions Education,* Vol 4, pp 149-158.
Niekerk, J. V. and Webb, P. (2016) “The effectiveness of brain-compatible blended learning material in the teaching of programming logic”, *Computers & Education*, Vol 103, pp 16-27.
Nor, A. S. M. and Kasim, N. A. A. (2015) “Blended learning web tool usage among accounting students: A Malaysian perspective”, *Procedia Economics and Finance,* Vol 31, pp 170-185.
Oddie, A., Hazlewood, P., Blakeway, S. and Whitfield, A. (2010) “Introductory problem solving and programming robotics versus traditional approaches”, *Innovation in Teaching and Learning in Information and Computer Sciences,* Vol 9, No. 2, pp 1-11.
Omar, N., Mohamad, M. M. and Paimin, A. N. (2015) “Dimension of learning styles and students’ academic achievement”, *Social and Behavioral Sciences,* Vol 204, pp 172-182.
Owston, R., York, D. and Murtha, S. (2013) “Student perceptions and achievement in a university blended learning strategic initiative”, *Internet and Higher Education,* Vol 18, pp 38-46.
Pedditzi, M. L. and Spigno, M. (2012) “Motivation to learn a research on university students”, *Social and Behavioral Sciences,* Vol 69, pp 1198-1207.
Pereira, J. A., Pleguezuelos, E., Meri, A., Molina-Ros, A., Molina-Tomas, M. C. and Masdeu, C. (2007) “Effectiveness of using blended learning strategies for teaching and learning human anatomy”, *Medical Education,* Vol 41, pp 189-195.
Pheeraphan, N. (2013) “Enhancement of the 21st century skills for Thai higher education gy integration of ICT in classroom”, *Procedia – Social and Behavioral Sciences,* Vol 103, pp 365-373.
Porter, W. W., Graham, C. R., Bodily, R. G. and Sandberg, D. S. (2016) “A qualitative analysis of institutional drivers and barriers to blended learning adoption in higher education”, *Internet and Higher Education,* Vol 28, pp 17-27.
Qian, M. and Clark, K. R. (2016) “Game-based learning and 21st century skills A review of recent research”, *Computers in Human Behavior,* Vol 63, pp 50-58.
Sung, H. Y., Hwang, G. J., Lin, C. J. and Hong, T. W. (2017) “Experiencing the Analects of Confucius An experiential game-based learning approach to promoting students’ motivation and conception of learning”, *Computers & Education,* Vol 110, pp 143-153.
Sung, H. Y., Hwang, G. J. and Yen, Y. F. (2015) “Development of a contextual decision-making game for improving students’ learning performance in a health education course”, *Computers & Education,* Vol 82, pp 179-190.
Tan, J., Guo, X., Zheng, W. and Zhong, M. (2014) “Case-based teaching using the laboratory animal system for learning C C++ programming”, *Computers & Education*, Vol 77, pp 39-49.
Tsai, C. W., Shen, P. D. and Tsai, M. C. (2011) “Developing an appropriate design of blended learning with web-enabled self-regulated learning to enhance students’ learning and thoughts regarding online learning”, *Behaviour & Information Technology,* Vol 30, No. 2, pp 261-271.
Wang, L. C. and Chen, M. P. (2010) “The effects of game strategy and preference-matching on flow experience and programming performance in game-based learning”, *Innovations in Education and Teaching International,* Vol 47, No. 1, pp 39-52.
Wai, C. C. and Seng, E. L. K. (2014) “Exploring the effectiveness and efficiency of blended learning tools in a school of business”, *Procedia – Social and Behavioral Sciences,* Vol 123, pp 470-476.
Yang, Y.T.C. (2008) “A catalyst for teaching critical thinking in a large university class in Taiwan Asynchronous online discussions with the facilitation of teaching assistants”, *Educational Technology Research and Development*, Vol 56, No. 3, pp 241–264.

Students' Learning Experience Within a Blended Learning Environment in a Higher Education Institution in Ghana

Emmanuel Freeman[1], Ahmed Antwi-Boampong[2] and Odeneho Baffoe-Kodom Agyemang[3]
[1]Centre for Online Learning and Teaching, Ghana Technology University College, Ghana
[2]Aalborg University, Denmark
[3]Arden University, UK
efreeman@gtuc.edu.gh
DOI: 10.34190/EEL.19.117

Abstract: Advances in information, communication, technology (I.C.T) particularly the internet is driving universities worldwide into integrating technology into teaching and learning in the classrooms. Ready access to multimedia learning platforms are encouraging faculty members to move away from traditional print-based and face-to-face teaching approach into adopting blended learning. However, insufficient learner satisfaction has been noted as an obstacle in most universities. In view of this, this paper assesses the learning experience of students within a blended learning environment in a Higher Education Institution (HEIs) in Ghana Technology University College (GTUC). The driving force for this study is to enhance students' learning experience with the use of technology within a blended learning environment. The Learning Management System (LMS) adapted to engage students within the blended learning environment is Moodle. The study employed both qualitative and quantitative methods to measure the students' learning experience. A total of 244 respondents from three different faculties and levels offering bachelors and master's degree were used. The study employed simple descriptive analysis and thematic analysis to measure the student's learning experience within the blended learning environment. The impression from the findings indicates that the online learning engagements enhanced the face-to-face teaching and learning and also increased retention and performance among the students. It was however noted that poor internet connectivity, reluctant of some lecturers, lack of orientation affected the effective implementation of the blended learning. More so, most of the learners affirmed that there is no clear-cut policy that enforces effective implementation of the blended learning approach in the university. The study affirmed that effective usage of blended learning approach enhances students' learning experience in HEIs.

Keywords: blended learning, learning experience, Moodle, higher education institution

1. Introduction

Recent practices and teaching in Higher Education Institutions (HEIs) has gone several changes (Moorthy & Arulsamy, 2014). This global reformation is needed in HEIs as result of the changes in societal developments, socio-economic developments and other political influences. As a result of this there is the need to make some absolute reformations in the teaching and learning in HEIs to enhance global development (Margaryan, Collis & Cooke, 2004). In spite of the significate contribution in HEIs through the use of technology, most HEIs especially in Sub-Sahara Africa still remains with the traditional face-to-face method of teaching and learning. The situation is however not different from the case of Ghana. Hence, the need to adopt a blended learning approach that can augment the traditional face-to-face approach of teaching and learning.

Blended learning is the combination of traditional face-to-face delivery and online delivery. In recent years, there has been an increasing adoption of blended learning in in higher education. This is spurred by the fact that more and more students are pursuing education whilst working, hence they are looking for more flexible options to the traditional face- to face. Many institutions tend to opt blended mode of delivery in order to increase learning effectiveness, convenience and access, and to increase cost effectiveness (Graham, 2009). Blended learning approach offers the most efficient and effective way of teaching learning process in a fast changing, competitive global arena of higher education (Kumar, 2012).

The degree of learners' satisfaction with blended learning plays a crucial role in evaluating the effectiveness of blended learning adoption (Chen & Yao, 2016). The overall experience of the learner is essential to the implementation and patronage of blended learning programmes in higher education institutions. A study done by Sharpe et al, 2006 in the UK, found that students' response to blended learning was overwhelmingly positive to the provision of online course information to supplement traditional teaching. In Sub Saharan Africa, the outlook is also positive though learners and instructors in this part of the world still struggle with access to appropriate technology and internet connectivity.

2. Literature review

2.1 Blended learning

In recent times, most higher education institutions have adopted the use of blended learning to augment the traditional face-to-face teaching and learning, thus integrating face-to-face learning with an online teaching and learning (Dziuban *et al.*, 2018 and Graham, 2009). A stream of research over the past decade on Blended Learning (BL) identifies predictors of BL success critical success factors (CSFs) Alhabeeb and Rowley, 2017), determinants of students BL adoption (Antwi-Boampong, 2018), and BL challenges (Kaur, 2013). 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. BL determinants for students include designing courses that provide flexibility, convenience and create opportunity for interaction among community of learners (Antwi-Boampong, 2018).

Studies on student's perceptions about BL indicate that perceptions have been positive (Wu, Tennyson and Hsia, 2009). 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). Sajith (2015) investigated student's viewpoints on BL and found that students taking BL courses have a positive perception of the process and content of BL delivery. Also, a study conducted at Muhimbili University of Health and Allied Science (MUHAS) in Tanzania showed that quality instructors, system quality, and information quality were found to be key determinants of success of blended learning that enhances learning experience (Lwoga, 2014).

Aydin *et. al*., (2015) investigated relationships between perception of the online learning, students' approach to online learning, and students' perceptions of online learning and found out that participants did not perceive negative attributes of technology to be inherent in the technology, but they highlighted some troubles about its use and implementation. Among these were that 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.

However, Studies on student's perceptions on BL are not all positive in that there are reported negative experiences. Smyth *et al.*, (2012) reported students feeling isolated and having difficulty maintaining a sense of community in an online environment as well as feeling overwhelmed. Huang, Ma and Zhang, (2008) found support for students learning in a blended learning environment as essential in improving students learning outcomes. They also found constructive feedback from lecturers and tailored review sessions as a few examples of support needed to improve learning outcomes.

2.2 Students' learning experience

Learner experience is about the interaction and the level of engagement between the learner and content. Quality content, effective learner support and motivation as well as the skills of the learner and instructor are important components that enhance the learner experience. The learner seeks the effortless ease of switching between face-to –face learning and online learning.

According to Chen & Yao, 2016, the younger generation regarded the design dimension, factors of perceived usefulness and perceived ease of use, to be the most vital factor in affecting their satisfaction toward the e-learning component within the blended learning environment. This affirms to the studies of Freeman (2016) and Georgiev et al. (2004) who indicated that learning is enhanced when the learner can learn within the learners own pace and time. Hence learning remotely with via an LMS is seen to enhance the learners learning experience. This because blended learning, mobile learning and e-learning provides students a wide range of opportunities for the learners to study seamlessly without the restrictions of the learner's location, time and space (Freeman, 2016).

2.3 Learner support

The help that the instructor or institution offers to the learner beyond the formal delivery of content constitutes learner support which consequently enhances learning experience. Consequently, the provisioning of learner support aids to support learning, provide technical support, and provide motivational and academic guidance. Although good user interface design of an online learning platform can lessen the need for learner support, however learner's need for support varies. Some are self-managed, autonomous learners whilst some lack the confidence or technical knowhow. However no matter how good the design is, learners will always need support. Research indicates that the 'instructor presence' is associated with student success or failure in a course, at least in online learning (Sheridan and Kelly, 2010). Therefore effective learner support enhances learning experience that leads to learner satisfaction with blended learning programmes.

Also, the study of Asunka, Freeman and Sheeta Arthur, (2018) affirmed that blended learning supports flip learning where the learner gains learning satisfaction, engagement, participation, achievement and retention as compared to the traditional face-to face environment.

3. Methodology

The study employed both qualitative and quantitative research design. Data was collected using an online survey (questionnaires), interviews and observation. The population used for the study includes the entire GTUC Students of about 6,000+ population. Also, the targeted population was 1,020 students (i.e. Students that are having their courses on the e-learning platform). The total respondents was 244 representing 24% of the targeted population for both undergraduate and postgraduate students. The qualitative research design was employed to capture a range of students' views. Data was collected by way of three digital voice recorded focus group interviews (n=15). Informants were from a diverse range of faculties and campuses of GTUC (Graduate School, IT Business, Faculty of Computing and Information Systems (FoCIS), and Faculty of Engineering (FoE). The Learning Management Systems (LMS) used by the university is Moodle. Hence, the server logs of student activities on the LMS platform to access learning materials, assignments, quizzes and forum discussions were assessed. Quantitative data were analysed using simple descriptive statistics while the qualitative data was analysed using thematic content analysis.

4. Data analysis and discussion

4.1 Demography

The analysis of the study covered both the qualitative and quantitative data received from the 244 respondents from the Ghana Technology University College in Ghana. The findings of quantitative study begun with the understanding of the demographics of the respondents. The purpose of the demographic understanding of the responded was to find out the gender, age group, degree programmes offering and the students' proficiency with the use of computer. As indicated from Table 1 below, most of the respondents were male students with majority of them within the ages of 20-24. Most of respondents were Bachelor's degree students. It was also noted that most of the respondents have intermediate proficiency skills with the use of computers. This is undoubtedly affirming that, GTUC is really a tech-based school where most students have some level of prior knowledge in computing. With the gender variance, it was noted that most Ghanaian technology universities have same syndrome of low admission rate of females to most of the science programmes. According to World Bank report in 2014 on the percentage of female graduates in the area of Science and Technology in Ghana. Only 24% of female students are reading science and tech based courses.

Table 1: Demographic representation of the respondents. Authors, (2019)

Participants Profile	Classifications	Frequency
Gender	Male Female	195 49
Age Group	14-19 20-24 25-29 30-34 Above 35	43 111 38 34 18
Degree Programme	Diploma Bachelor's Master's	50 156 38

Participants Profile	Classifications	Frequency
Proficiency with the use of computer	Beginner Intermediate Expert	6 134 104

4.2 Courses running on the GTUC blended delivery mode

To ascertain students learning experience within the learning environment, the study sort to gather the students' courses running on e-learning platform from February to April 2019. It was found out that maturity of the courses running on the e-learning platform were between 2- 3 courses followed by courses between 4-5 courses. In all, out of the 244 respondents, most students are having at least 2 or 3 course running on the e-learning out of a total of 120 courses running on the e-learning platform. Considering the population, it can be concluded that majority of the students are not using the platform.

On another note, it can be deduced that there had not been stringent policy by the university to enrol all their courses on the e-learning platform to embrace blended learning as depicted in figure 1. From the qualitative data gather from the Head of the Centre for Online Learning (COLT) at GTUC, it was inferred that there had been a significant improvement with the adoption of blended learning at the university as compared to previous years of only 12 courses running on the e-learning platform. This hike in the adoption of blended learning at the university affirms to the study of Adams Becker et al. (2017) who in their research in the 2017 New Media Consortium Horizon Report indicated that blended learning is a strong force that is driving the integration of technology in higher education in the next few years. It is however not different from the EDUCAUSE key learning initiatives to propagate the adoption of blended learning in higher education (EDUCAUSE, 2017).

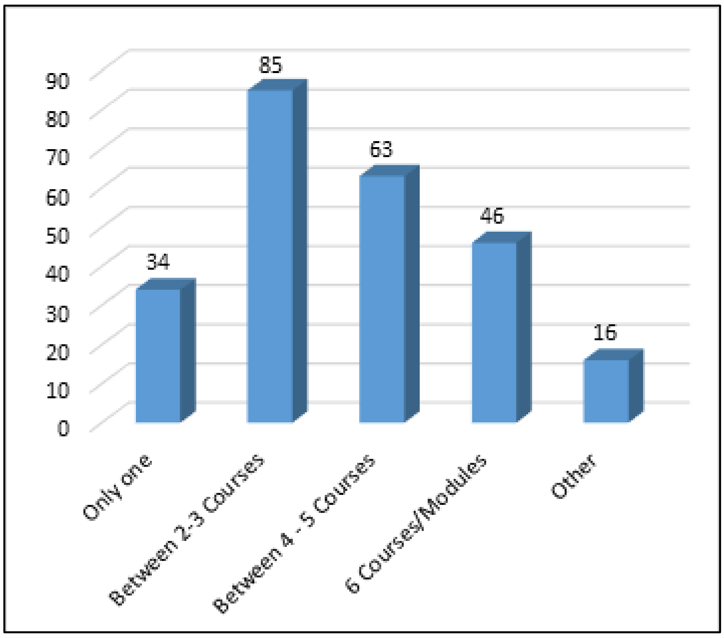


Figure 1: Student's course running on the e-learning platform. Fieldwork, Authors, (2019)

4.3 Learning experience 1: Using the e-learning platform within the blended environment

In order to establish the various learning experiences of the respondents, the students were asked to indicate their learning experiences as users on the e-learning platform within the blended learning environment. The data indicated top three indicators of learning experiences on the online platform signifying that 172 students uses the online platform to download course materials, 155 students likewise indicated that they uses the platform for the submission of assignments while 152 similarly uses the platform for quizzes as depicted in figure 2 below.

On the other hand, a whopping 109 respondents uses the platform for online forum discussions, charts and collaborative learning online. This supports existing literature that affirms that BL aids in the improvement of students' academic satisfaction, success (Dziuban and Moskal 2011; Dziuban et al. 2011) and also an enhancement of the students' community and social learning experiences (Rovai and Jordan 2004) as compared with the traditional method of delivering face-to-face teaching (Dziuban *et al.*, 2018).

Moreover, the learning experience within the face-to-face lectures also improved since most students indicated from the qualitative data the integration of the e-learning platform within the lecture-based classroom improved on their retention and performance. This supports the studies of (Dziuban *et al.*, 2018, Robinson et al. 2014; Fischer et al. 2015; Hilton et al. 2016).

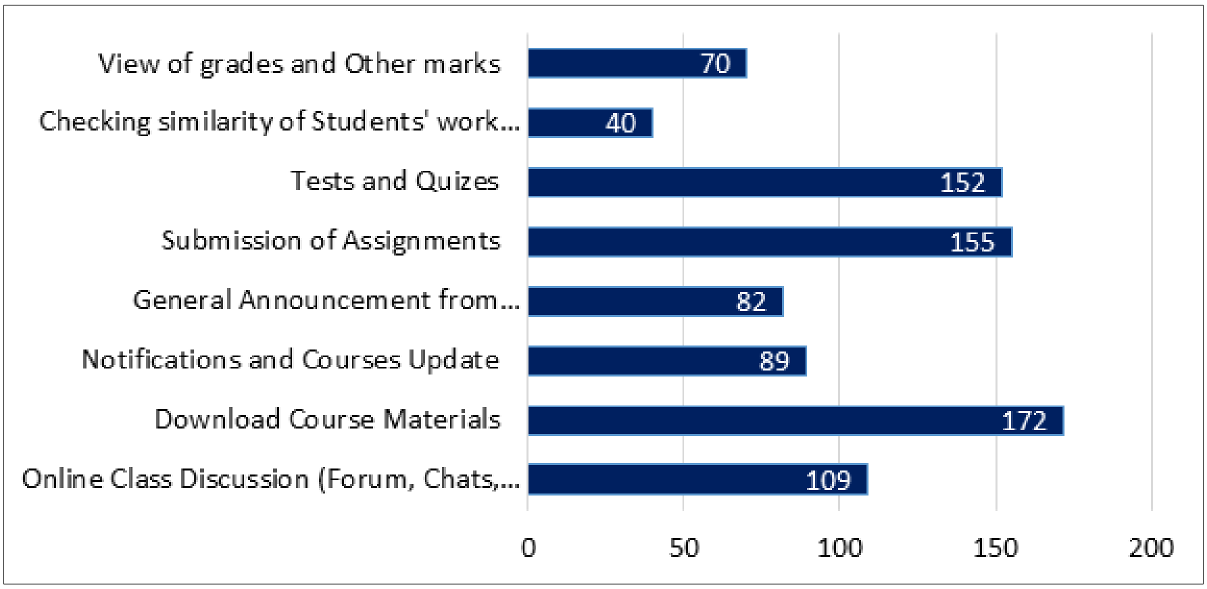


Figure 2: Learning experience and activities on the e-learning platform. Authors, (2019)

The study further assessed the students learning experience on the e-learning platform adopted by the university with 3-months to measure the activity log details on the student's effective usage of the e-learning platform. As indicated in in figure 3 below, a hopping 70,000 activity logs history was recorded from students that downloads learning materials. Also, assignment submissions, conducting quizzes and forum discussions recorded a significant learning experiences on the e-learning platform of about 60,000, 55,000 and 45,000 activity logs respectively.

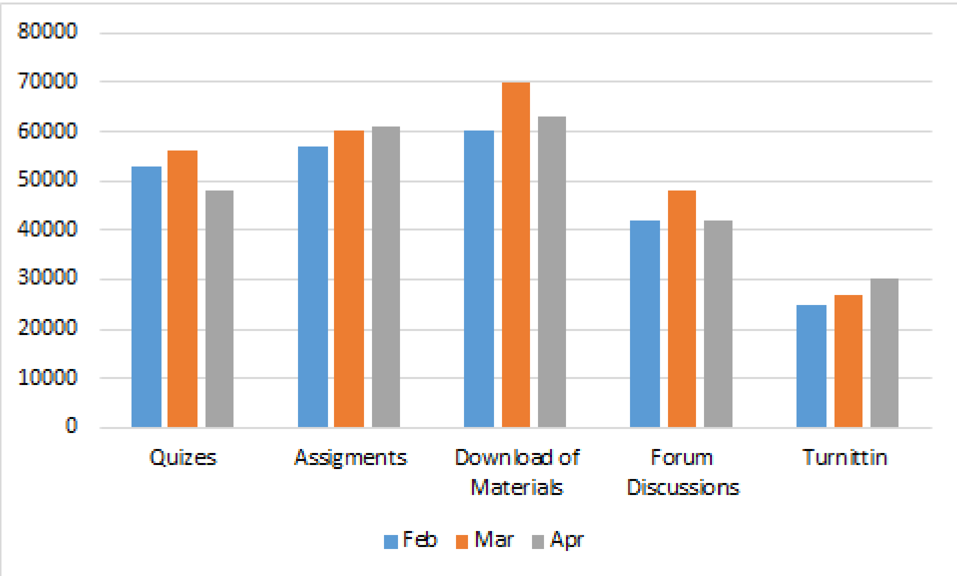


Figure 3: Activity Logs on the Learning Experience of Online PlatformAuthors, (2019)

4.4 Learning experience 2: Academic quality

To establish the effectiveness of the blended learning environment at GTUC, the study also examined the quality implication of the learners learning experiences. Hence, a five-scale likert was used to measure the quality of the learning experience of the students within the blended learning environment on the scale of 5- Excellent, 4- Very Good, 3- Good, 2- Average and 1- poor.

Based on the quantitative data, a mean of 3.32 and a standard deviation of 1.09 indicating a positive representation of a good user friendliness of the online platform was discovered as indicated in table 2 below. This affirms why most students are on the platform to download course materials, submitting assignments and contributing to forum discussions. Furthermore, it was also indicated that the platform used by the university was effective with a mean of 3.33 and a standard deviation of 1.11. It was though noted from the qualitative data that the platform is very effective yet internet connectivity of the university is not steady to enhance seamless learning while on campus.

Also, to establish the quality learning experience of the students within the blended learning environment, the study ascertained from the students how effective the university's similarity or plagiarism plugin (turnitin) on the e-learning platform. It was noted that the turnitin platform aided the writing styles of the students and consequently shaped their academic writings and submission of assignments and projects with a mean of 3.25 and standard deviation of 1.18 representing a positive indication of academic quality.

Lastly, the learning experience within the face-to-face interaction aspect of the students was measured. The findings indicated a positive representation of an effective blended learning experience with a mean of 3.34 and a standard deviation of 1.12.

Table 2: Learning experience: Academic quality. Authors, (2019)

Indicators	Mean	Standard Deviation	Interpretation
User friendliness of the online platform	3.32	1.09	Positive
Effectiveness of the Online Learning Platform	3.33	1.11	Positive
Quality Academic Writings (Turnitin)	3.25	1.18	Positive
Effectiveness of the face-to-face and the online learning experience.	3.34	1.12	Positive

In the nut shell, the quantitative data have shed light on the significant improvement of students learning experience within the blended learning environment bas on the data received. It also demonstrates that the university must establish a conscious effort to harness academic excellence via the use of the e-learning platform.

4.5 Findings from the qualitative data

For the qualitative data, as a first step all the responses from the semi-structured questionnaire we cultivated and arranged onto a word document. These responses were then read over to get an understanding of the meanings from the respondents before they were subjected to the thematic analysis described by Burnard (1991). The data were 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 23 of the responses were randomly selected for testing of coding reliability. The external coder was a lecturer with qualitative research competences and was familiar with the content of the research.

A total of two hundred and forty-four students responded to semi-structured questions asked from a questionnaire which was delivered via Google forms online. The respondents were students from a public-private HEIs in Ghana. Generally, the students were asked about their perception and interest in blended learning and what they thought would improve their learning experience as well the services they received from COLT. The details of the Google form can be provided on request from the authors.

Overall the students had a positive and good perception of 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. There is a sense of students using the LMS to stimulate more learning engagement. An interviewee indicated that: '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'. Again

However, there are reported challenges. This being that BL enabled students were generally frustrated by the apparent lack of faculty commitment to using the system to its optimum. Again, students highlighted the inadequate faculty presence online to engage students concerns and provide feedback as a motivating factor for their continued use of the system. Again, students wanted more of the learning experience and wanted the LMS to be used to stimulate learning. They want more than just using the system to access lecture slides, as one respondent indicates, 'we want more of interactive video session and interaction with our lecturers'.

4.5.1 Thematic analysis of students' learning experience

Using a thematic analysis, responses of two hundred and forty-three students were analysed from a semi-structured questionnaire that was administered via Google forms. Respondents were asked to indicate what they thought would help improve the BL platform and the Centre for Online Learning and Teaching (COLT) services. We used thematic analysis as described by (Burnad, 1991) to get the categories, themes, and sub-themes that reflected the students learning experiences and challenges as indicated in table 3 below.

Table 3: Themes and subthemes of students' BL experiences and challenges using BL, Authors, (2019)

Categories	Themes	Sub-themes
Student BL adoption experience	The personal utility of BL to students	-Flexibility -Convenience -Retrievable by providing room for correction of mistakes -Opportunity for recall - For reading and preparation -Interactivity
	Effective pedagogy tools	-Continuous learning -Extended learning scope -Extended teaching and learning presence -Community of learners -Feedback - Community of learners - Students engagement - Contribution towards discourse - Enhanced student learning - Complimenting teaching and learning
BL challenges	Technological challenges	- Internet and infrastructure inadequacies

Categories	Themes	Sub-themes
	Student centred challenges	-Distractions and focusing -Inadequate user/Student support services -Inadequate accessories to access BL platform
	BL system use challenges	-System Prompt and notification issues -System integrity concerns
	Student perceived faculty challenges	Inadequate learning materials or content Faculty under-utilization of LMS Inadequate faculty presence

4.5.2 Sampled interview responses

"… Lecturers should strictly use the platform for resource delivery as well as a place to communicate to the class. I also believe that student affairs and other departments can use it as a platform to inform the students on current issues of the school."

"… The platform will be effective if all lecturers use the platform"

"… The blended learning approach is very great... I mostly prepare at home, do my assignments, and watch videos. The platform is just awesome.."

"…Lectures should use it and put all the slides there so that we can learn the 60% there and the 40% in the class… Classroom is mostly boring"

"…internet access on campus is bad. The network is very slow. Buying data every time costs us a lot meanwhile all of this is included in the school fees. An IT school with poor internet service? I can't stress this enough. The staff may not know how it feels because they are on a different network. The administration should please do something about this. Thank you."

5. Conclusions

This study has shed light on the relevance of adopting blende learning in HEIs and consequently measured the learning experience of the students. It was found that the integration of online learning and face-to-face experience enhances students learning journey. This support the studies of Dziuban *et al.*, 2018, Robinson et al. 2014; Fischer et al. 2015; Hilton et al. 2016). Also the study addressed the increasingly relevance of students collaborative learning and thus building a community that enhances lifelong learning (Rovai and Jordan 2004). It was noted from the findings that the BL environment enhanced the student's retention, collaborative and social learning experience.

Nevertheless the positive responses of the significance of blended learning experience from the students' perspective, the qualitative responses from the students on the other hand indicated the challenges that hinders seamless learning experience. Among the challenges are distractions and focusing on online learning, inadequate student support services, poor internet connectivity to access BL platform and lack of faculty commitment to support BL at GTUC.

It is however, recommend that the entire university adopt to the changing paradigm of higher education to embrace technology in the teaching and learning as defined in the policies of EDUCAUSE, (2017). Besides, there should be a stringent policy that will enforce the adoption of blended learning the university. Also, future researches should look at the faculty or lecturers experience within the blended learning environments.

References

Alhabeeb A, Rowley J. Critical success factors for eLearning in Saudi Arabian universities. Int J Educ Manag. 2017;31(2):131–47.

Antwi-Boampong, A. & Sørensen, L. T., 2 Nov 2018, Proceedings of the 17th European conference on e-learning. Academic Conferences and Publishing International, p. 642-649 8 p.

Asunka, S., Freeman, E. and Sheeta Arthur, L. (2018) 'Implementing Constructivist Pedagogy in a Flipped Mode in a Postgraduate Course', *ICERI2018 Proceedings*, 1(November), pp. 3301–3309. doi: 10.21125/iceri.2018.1733.

Burnard P. (1991) A method of analyzing interview transcripts in qualitative research. Nurse Education Today 11, 461–466.

Chen, W.S. and Yao, A.Y.T., 2016. An empirical evaluation of critical factors influencing learner satisfaction in blended learning: A pilot study. *Universal Journal of Educational Research*, *4*(7), pp.1667-1671.

Dziuban, C. *et al.* (2018) 'Blended learning : the new normal and emerging technologies', *International Journal of Educational Technology in Higher Education*. International Journal of Educational Technology in Higher Education, 3(15), pp. 1–16. doi: 10.1186/s41239-017-0087-5.

EDUCAUSE. (2017) 2017 key issues in teaching & learning. Retrieved from https://www.EDUCAUSE.edu/eli/initiatives/ key-issues-in-teaching-and-learning.

Freeman, E. (2016) 'Towards The Adoption of M-Learning Technologies in Tertiary Education', in *Proceedings of INCEDI 2016 Conference*, pp. 255–258.

Georgiev, T., Georgieva, E. & Smrikarov, A. (2004). M-learning – A new stage of e-learning. *International Conference on Computer Systems and Technologies – CompSysTech' 2004.* Retrieved from http://ecet.ecs.ru.acad.bg/cst04/Docs/sIV/428.pdf

Graham, C.R., 2009. Blended learning models. In *Encyclopedia of Information Science and Technology, Second Edition* (pp. 375-382). IGI Global.

Huang, R., Ma, D. and Zhang, H. (2008) 'Towards a design theory of blended learning curriculum', in Fong, J., Kwan, R., and Wang, F. L. (eds) *Hybrid Learning and Education*. Berlin, Heidelberg: Springer Berlin Heidelberg, pp. 66–78. doi: 10.1007/978-3-540-85170-7_6.

Kaur M. Blended Learning - Its Challenges and Future. Procedia - Soc Behav Sci [Internet]. 2013;93:612–7. Available from: http://dx.doi.org/10.1016/j.sbspro.2013.09.248

Kumar, A., 2012. Blended learning in Higher Education: A comprehensive study. In *Proceedings of International Conference on Business*.

Lwoga, E., 2014. Critical success factors for adoption of web-based learning management systems in Tanzania. *International Journal of Education and Development using ICT*, *10*(1).

Margaryan, A., Collis, B. and Cooke, A. (2004) Activity-based blended learning, *Human Resource Development International*, 7(2), pp. 265–274. doi: 10.1080/13678860410001676574.

Moorthy, G. T. and Arulsamy, S. (2014) Understanding the paradigm shift in teaching and learning, *International Journal of Social Science*, 3(4), pp. 443–446.

Mtebe, J.S. and Raphael, C., 2018. Key factors in learners' satisfaction with the e-learning system at the University of Dar es Salaam, Tanzania. *Australasian Journal of Educational Technology*, *34*(4).

Robinson, T. J., Fischer, L., Wiley, D. A., & Hilton, J. (2014). The Impact of Open Textbooks on Secondary Science Learning Outcomes. *Educational Researcher.* https://doi.org/10.3102/0013189X14550275

Shantakumari N, Sajith, P (2015) Blended Learning: The Student Viewpoint. Annals of Medical and Health Sciences Research, Vol 5, Issue 5

Sharpe, R., Benfield, G., Roberts, G. and Francis, R., 2006. The undergraduate experience of blended e-learning: a review of UK literature and practice. *The higher education academy*, pp.1-103.

Sheridan, K. and Kelly, M.A., 2010. The indicators of instructor presence that are important to students in online courses. *MERLOT Journal of Online Learning and Teaching*, *6*(4), pp.767-779.

Smyth, S. *et al.* (2012) Nurse Education Today Students' experiences of blended learning across a range of postgraduate programmes', *YNEDT*. Elsevier Ltd, 32(4), pp. 464–468. doi: 10.1016/j.nedt.2011.05.014.

World Bank (2014), Report on women reading science and technology courses in Ghana. https://tradingeconomics.com/ghana/percentage-of-graduates-from-science-and-technology-programmes-in-tertiary-education-who-are-female-percent-wb-data.html accessed on 21-04-19.

WU, J. H, Tennyson, R.D and Hsia, T.L (2010) A student satisfaction in a blended learning environment, Computer and Education 55 (155-164).

Serious Digital Games to Further Human Rights Education

Sonja Gabriel
KPH Vienna/Krems, Vienna, Austria
sonja.gabriel@kphvie.ac.at
DOI: 10.34190/EEL.19.156

Abstract: Human rights education has become more and more important within the last decades. That is why also serious games started to deal with topics about asylum seekers, migration, poverty and human right violations. As for all media, the question arises if digital games might be useful for teaching players or creating empathy. One key element of success is based on the underlying game design. Only if the designer's intended purpose is reflected in all game design elements, the game is perceived as consistent and enables to have an experience that might players encourage to think about situations or topics. The paper uses the Serious Game Design Assessment Framework (Mitgutsch und Alvarado 2012). By analysing the serious game Path Out which is about escape from Syria, it will be shown how the single elements of game design work together to create a game that is useful for teaching about refugees.

Keywords: human rights education, games for change, serious games, game-design, teaching, values

1. Introduction

Human rights education concerns the three pillars of developing knowledge about, skills and values of human rights (Anderson 1999). As Ramírez et al. (2007) state, human rights education has become increasingly important for education all over the world within the last decades and has therefore been introduced in many curricula as well as found entry into educational materials and practices. The United Nations define human rights education (OHCHR | United Nations Decade for Human Rights Education (1995-2004)) as targeting at various objectives as

- strengthening the respect for human rights as well as fundamental freedoms
- development of human personality and the sense of its dignity
- promoting understanding, tolerance, gender equality as well as friendship among all people regardless of their gender, origin, race, nationality, ethnicity, religion and language
- enabling all people to participate in a free society.

Tibbitts und Fernekes (2011) have done meta-research on the implementation of human rights education in schools with young learners and found out that the U.N. Programme "has spawned a growing body of educational theory, practice and research that often intersects with activities in other fields of educational study" (p. 111).

As human rights education, however, is not only limited to children and teenagers but part of life-long learning, there need to be other possibilities to reach out for people. Videogames have become a popular medium for people of all ages. The number of active players is estimated as nearly 2.5 billion people for 2019 (Statista 2019a) whereas the average age of the gamer is starting to climb as well. In the U.S., about 40 % of gamers are older than 35 years (Statista 2019b). Digital games have also been used as a tool for educational means since the 1980s, trying to combine learning with fun. Especially serious games, meaning those digital games whose primary aim is beyond mere entertainment are in the focus of education and training. "The oxymoron of Serious Games unites the seriousness of thought and problems that require it with the experimental and emotional freedom of active play. Serious games combine the analytic and questioning concentration of the scientific viewpoint with the intuitive freedom and rewards of imaginative, artistic acts" (Abt 1987, 1970, p. 11f). Looking at the specific characteristics of digital games like multimodality, interactivity, narrative, social use and the situation of playing a game, serious games might motivate players to elaborate on the content of desired social changes (Klimmt 2009). However, even if the game-designers' intentions are to teach players knowledge or understanding of situations or even to change their attitudes or behaviour, that does not mean that serious games succeed in doing so. The effects of serious games have quite often been discussed but results are ambiguous (Giessen 2015). If a serious game might provide any learning, depends on many factors like preparation and follow-up activities but also on the game itself.

2. Human rights and serious games

Human rights topics have been included in serious digital games since about 2003, when *Escape from Woomera* was published. This game, which is a still unfinished point-and-click adventure based on the ego-shooter Half-Life game-engine, deals with the situation of asylum seekers in Australia. Players take on the role of an Iranian asylum seeker whose asylum request has been denied. As he fears to be killed by the Iranian government, he needs to escape from Woomera, the refugee camp where he is kept. The game succeeded in starting a vivid discussion on Australian refugee camps as well as the topic if videogames should and can deal with such topics (Poremba 2011).

Since this first attempt of using a digital game to make people aware of human rights and human rights violations, numerous videogames have tried to follow close using different approaches to get their message across (Gabriel 2016). Most of them aim at showing human rights violations by putting the player in the shoes of a character whose rights are violated or by having the player take on the role of a helper. The topics covered by these games vary but there are some areas which are more frequently covered than others. As per a web search carried out in 2018 (Gabriel 2018), the most prominent topic is poverty which can be further divided into three subcategories: first, poverty in less economically developed countries, second, poverty in Western civilization, mainly concentrating on factors that might lead to loss of money and home. The third sub-category deals with homelessness in Europe or the USA depicting challenges and obstacles these people face in their every-day struggle to survive. Due to the enormous public discussion in European media in 2015 and 2016 regarding the high numbers of asylum seekers coming to Europe, many games started dealing with the fate of these people and which dangers, problems and stereotypes they have to encounter on their journey as well as in safe countries.

The potential of digital games can be seen in the fact that they “increase capabilities for civic engagement and outreach” (Stokes et al. 2014:11). Bogost (2007) considers serious games as expressive and persuasive medium as they are able to represent real and imaginative systems and invite gamers to interact with and evaluate them. Although there are numerous games available whose aim is to evoke empathy or convey values, not all of them can be regarded successful.

3. Research methodology

In order to find out if a digital serious game provides an opportunity for learning, games dealing with human rights topic are analysed using the Serious Game Design Assessment Framework (SDGA) by Mitgutsch and Alvarado (2012). The SGDA-Framework was chosen as it was especially developed to analyse serious games regarding their intention-based design and thus finding out if their intended purpose might reach the players. As Mitgutsch und Alvarado (2012) argue serious games are considered successful if they are discussed and played but are not looked at regarding their quality of design which is crucial for reaching the purpose as well. The items of the SGDA Framework are chosen according “to offer a basis to study how the design elements are configured formally and conceptually in relation to the game’s aim and purpose” (Mitgutsch und Alvarado 2012, p. 123).

The SGDA Framework consists of six core elements (cf. Figure 1). The starting point of the framework is the purpose as each serious game (especially when dealing with human rights topics) wants to achieve certain goals which do not only lie within the game but should also reach a certain purpose beyond game-playing. In order to be successful, the purpose needs to be reflected in all the other five elements as well. That means aesthetic/graphics, fiction/narrative, mechanic (rules, rewards), framing (audience of the game and their play literacy) and content/information need to support the purpose of the game.

All in all, twenty games dealing with human right topics and aiming at educating the player (or wanting to make players aware of certain situations) were analysed using this framework. The results show that digital games vary a lot regarding their approach towards integrating human rights and only a few of them manage to mirror their purpose in all or most of the other design elements. Some games for example use mechanics (for example in-game currency as reward for actions) that act against the purpose stated by the designer and thus give an ambiguous statement. Others do not integrate content and information well in the game but interrupt the game-flow in order to force the player to read information (which actually can be often simply clicked away without reading). The following section will concentrate on one of the examples where the purpose is supported by the other game-elements. The game will be discussed in detail showing how elements in game-design need to be connected to produce a game that supports the original purpose intended by game-designers.

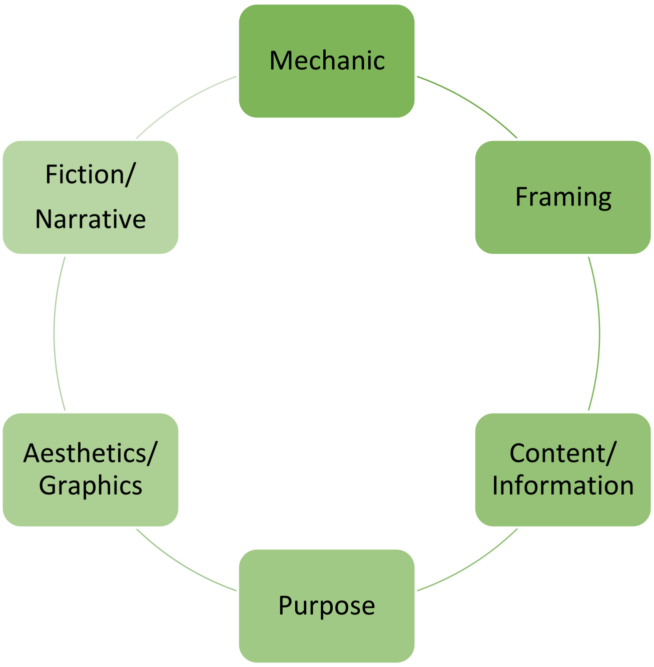


Figure 1: Elements of the serious game design assessment framework

4. Path Out – an autobiographical game

Path Out (2017) is an autobiographical adventure game making the player go on the journey of Abdullah Karam who is a young Syrian artist escaping from war in 2014. The game received many rewards and prizes and is based on the journey Abdullah had to undertake in order to reach a safe place in Europe. The game is divided in episodes starting from Abdullah's memories about life before war broke out, showing himself as a young man interested more in playing computer games than in politics, re-enacting his escape and dangerous journey from Syria through Turkey, Greece and the Balkan and finally arriving his safe destination in Central Europe. The game analysis will concentrate on the first episode of the game where the player meets Abdullah in his home in Syria and learns about the situation in the country as well as the family circumstances and ends with the first part of his journey, him arriving in Turkey.

Figure 2: PathOut (screenshot)

4.1 Purpose

The purpose of the game "is a tale full of surprises, challenges and paradoxical humour, giving insight in this real-life adventure, on which Abdullah comments through youtube-style videos in the game" (Causacreations 2018) which is also shown in the Screenshot of Figure 2. The game-designers intended the game to be "part of the fight against the anti-refugee narrative that pervades much of the western world" (Cox 2017). Thus, the game wants to create understanding and empathy for people leaving Syria by showing the reasons which made them go on such a dangerous journey. This should not be done by a moral pointing finger but by using humor as well. Players should rethink their attitude towards refugees and get to walk some miles in their shoes.

4.2 Content and information

The content and information presented within the game comes in two ways – on the one hand there is much dialogue between the playable and non-playable characters which is used to convey information about the background story, the relation between the characters and is used to drive the story which is typical for the genre of adventure games. However, this game adds an additional layer of information which is quite special for serious games. At some parts of the game the player gets a video message by the real Abdullah commenting on the in-game situation, relating the events within the game to his own experience or making fun of the game: for example when the game-avatar Abdullah leaves the house and sees a camel on the street, the real Abdullah comments on how ridiculous that would be to meet a camel on the street in his old home-town. After the video sequence, the camel is replaced by a traffic cone. This way, information is given within the game and through the videos with Abdullah facts and events are related to each other, either increasing the emotions conveyed, fighting stereotypes with a wink or telling what you cannot experience in the game. Other information presented is the typical adventure in-game inventory symbolized by a backpack – whatever you have collected through your journey will appear there – and disappear when you used it (like for example money you have to spend on bribing soldiers or smugglers). The information given is valid and based on facts or real experience and is easily approachable for players. Although it is possible not to read the dialogues between the characters by just clicking them away, this would not make much sense as the information included is also needed for advancing the game. It is not possible to cut short the video-sequences with the real Abdullah.

4.3 Mechanic

Game mechanics which includes rules and actions the player can do are the core of every digital game. As Sicart (2008) puts it "game mechanics are methods invoked by agents, designed for interaction with the game state". The in-game goal is to collect all necessary items and talk to non-playable characters to progress in the game and to reach the endpoint of the game. Players are quite restricted in their actions – by using the arrow-keys and the space bar they can walk around on the game-map and sometimes look at items by pressing a button which results in a short explanation or comment by the player's avatar. Some things will be put into the inventory and taken out if needed – the game takes over here, there is no player decision needed. Dialogues are started as soon as a non-playable character is approached. In some cases, the player can choose among two answers which will lead to a slightly different story (or might even end the story if a wrong answer is chosen). For example, the player can decide to steal some paper from a neighbor which might be used against him in order to get important documents which might enable the player's easier crossing of the border. The basic verbs in Path Out are walking, collecting, talking and avoiding. The learning curve is rather flat as the game does not get more difficult and there are no levels. There is a win-state which means arriving Turkey safely or losing the game when the avatar is killed by the soldiers.

4.4 Fiction and narrative

We have already discussed content and information but fiction and narrative are something different as this element "focuses on the fictional space and how it relates to the games purpose" (Mitgutsch und Alvarado 2012, p. 125). Path Out belongs to the genre of adventure games – a category which heavily relies on telling a story. As Fullerton (2008, p. 100) points out, many digital games use story only to provide a "setting and context for the game-conflict […] but its progression from one point to the next is not affected by gameplay". This fact is often connected to the gamer's possibility of making meaningful choices (Salen and Zimmerman 2003), meaning that the player can influence the story by taking decisions. As discussed before, mechanics are quite simple for the game and therefore the story is told rather linear even if the player can roam the map quite freely. The game is autobiographical in some way: "While the journey is clearly based on Abdullah's personal path, the player character will also experience stories by friends and relatives" (Causacreations 2018). The plot of Path Out can be described as follows: Abdullah lives in a Syrian city with his parents and his brother at the time when civil war is about to begin. Abdullah's brother engages with protests against the regime and his parents decide to send Abdullah away when he turns 18 so that he will not be forced to join the army. His uncle helps to organize the first part of his escape. The player accompanies Abdullah on his way through the Syrian city and needs to help him cross the border to arrive Turkey safely where the first episode of the game stops. The player learns about different neighbors living in the same house and their attitude towards the regime as well as the challenges people staying behind have to face as the country is more and more torn apart by civil war. As mentioned before, the story is driven forward by the player but is interrupted by video sequences (which can be compared to cut scenes common in videogames) with the real Abdullah commenting on the situation or telling a very personal story when sharing his experience. The videos are also used to point out differences between the game and the real events having taken place as well as to address stereotypes players might have about Syrians or refugees in general, "[…] scolding the player for getting "himself" killed or making snide remark on oriental design elements that might be too stereotypical" (Causacreations 2018).

4.5 Aesthetics and graphics

Aesthetics and graphics in the SGDA-Framework refer to the images, the sound, the style and the computer graphics of the game discussed. For conveying the purpose of the game, this element is quite important as it presents the game to the player and creates a first impression before narrative and content set in. Path Out is designed in the tradition of a Japanese role-playing game which means that it relies on the storyline and fixed characters as well as exploration. When it comes to aesthetics and graphics, the characters are drawn in Manga-style with large eyes, small mouths and abnormal hair color. As Manga characters also usually show overexaggerated emotions, the game also puts symbols for sadness, fear or anger above the heads of the playable character. "The game is deliberately designed in the style of classic role playing games, a graphical language which stands in sharp contrast with the portrayed sujet and the dramatic events of the game" (Causacreations 2018). The background (houses and landscapes) are pictured in detail. Whenever you enter a house you will find many pictures on the walls, vases and other things on tables as well as carpets and furniture. Every house looks different – the game was done in pixel art style inspired by classic 16-bit games and Syrian art. When it comes to color, the game also wants to convey the feeling of destruction: The more the player advances in the story, the darker the colors get. The inner yard in the first scene of the game is colorful, with green grass, flowers and a fountain in the middle. When civil war starts, everything dries out, the player can see more and more bullet holes in wales and destroyed houses. On his journey to Turkey, Abdullah has to roam a deserted village where everything is bleak and empty, giving the player a completely different feeling compared to the first minutes of play. The game is played in third person mode – the player has a bird's eye view on everything happening to the playable and non-playable characters and sees more than the playable character himself. During game-play the gamer can listen to neo-orchestral electronica music with oriental influences, specially created for this game. Music is stopped when there is a video commentary by Abdullah. Although the game with its Manga-characters and playful design seems to contradict the serious topic it discusses, it somehow matches the purpose by showing how fast nice and beautiful surroundings can be affected negatively by war.

4.6 Framing

The last element of the SGDA-Framework deals with the framing of all the design elements discussed before in a context where the target group is included. As Mitgutsch und Alvarado (2012, p. 226) stress "the play literacy of the players can essentially influence the gameplay experience". This means, having a look at game controls, user interface and asking if gamers understand cross-references made in the game. Skills needed to play a game and how these skills can be acquired are questions to be asked as well as expectations gamers might have regarding the plot and the game genre. As far as *Path Out* is concerned, there is no specific target group defined. The game itself is easy to play as one only needs to master the keyboard arrows or a game controller. Players need to be able to read the dialogues as the texts cannot be listened to. The video sequences as well as the dialogues make use of humor. Given this and the seriousness of the topic as well as references to real events and people from Syria's recent history, the target audience needs to be at least teenagers being basically familiar with the situation in Syria. Failing the game (for example taking a wrong decision or not paying attention when wandering through the forest and thus being killed) does not have severe consequences as the gameplay can be saved any time (and also is automatically saved at some points of the game) which means the player does not have to replay the whole game. What is more, *Path Out* includes everything that is known to players who have already played an adventure game before. There are no complicated twists or turns or surprising outcomes. The tasks given within the game are not difficult to solve and the game map is not that large so that players might get lost.

4.7 Path Out as a positive example

After having had a look at the single elements of the game and analyzing it, it is important to regard the game as a whole and ask how the purpose is supported by the key elements. This is called holistic design-related evaluation by Mitgutsch and Alvarado (2012). The light tone and the nice pictures at the beginning of the game *Path Out* draw the player in – there is nobody obviously wanting to teach the player about what they should think about refugees, about Syria or Abdullah himself. The game starts like the character in the game – light-hearted and not thinking that something bad might happen. When the story progresses, and civil war starts, the game suddenly changes and gets darker – not only from the events happening but also aesthetics and graphics and information given within the video sequences with the real Abdullah get more serious in tone and content. *Path Out* cannot be considered as a typical serious game wanting to educate players as there are not many hard facts given. However, because of being able to kind of relive what Abdullah experienced, the player gets emotionally touched and gets an understanding of what it is like to live in a war-torn country and being forced to flee.

5. Conclusion

As the example of *Path Out* shows, serious games can do much more than just be mere entertainment. They can draw players in a story and make them put on the role of somebody else. Thus, they can be regarded as a tool for learning about human rights and human rights violations if all elements of the game-design support the purpose of the game. By deconstructing a serious game and having a closer look at all the elements, it is possible to find out if a game is useful for teaching about certain situations, challenges or problems connected to human rights. When games are used for learning, it is essential that the objective of the game equals the learning objective (Wagner 2009). In the case of *Path Out* the game's objective is to bring the avatar safely across the border, mastering all the obstacles and challenges. The teaching objective is to show how dangerous the journey out of Syria is for people who want to escape war in their home-country. In the case of *Path Out* these two objectives match which makes it probable that players will learn what the game-designers intended.

However, one has to bear in mind that a serious game on its own will rarely be able to change attitudes or beliefs on the long run. Many studies dealing with the use of digital games for teaching skills or behavior have shown that the best approach is to support the use of a digital game with some kind of training or material so that the game-experience is reflected. Wouters und van Oostendorp (2013) found out in their meta-study that instructional support when using digital games facilitates the acquisition of skills and knowledge. The potential of digital serious games in teaching human rights can be seen that they make players aware of certain situations and topics. Therefore, they might be a first contact. They are not really useful for teaching hard facts, but they can provide an immersive experience that might create empathy. The SGDA-Framework can be used to find out how valuable the game on its own can be but it is just the beginning when talking about real teaching.

References

Abt, C. C. (1987, 1970) Serious games. Lanham, London: University Press of America.

Anderson, M. (Ed.) (1999) Human rights here and now. Celebrating the universal declaration of human rights. Human Rights Resource Center. 2nd print. Minneapolis: Human Rights Educators' Network.

Bogost, I. (2007) Persuasive games. The expressive power of videogames. Cambridge, Mass., London: MIT.

Causacreations (2018) "Path Out" [online] https://causacreations.itch.io/path-out.

Cox, M. (2017) "Path Out tells the autobiographical story of a Syrian refugee" [online] https://www.rockpapershotgun.com/2017/11/02/path-out-tells-the-autobiographical-story-of-a-syrian-refugee/.

Fullerton (2008) Game Design Workshop CRC Press.

Gabriel, S. (2016) "Serious Games Teaching Values: Discussing Games Dealing with Human Rights Issues" In: K. D. Valentine und L. J. Jensen (Eds) Examining the evolution of gaming and its impact on social, cultural, and political perspectives. Hershey PA: Information Science Reference (Advances in human and social aspects of technology (AHSAT) book series), pp. 195–218.

Gabriel, S. (2018) "The Potential of Serious Digital Games for Human Rights Education" In: K. Tyner and C. Costa (Eds.): Proceedings of Play2Learn 2018. Play2Learn. Lissabon: Cicant, pp. 52–66.

Giessen, H. W. (2015) "Serious Games Effects: An Overview" In: Procedia - Social and Behavioral Sciences 174, pp. 2240–2244.

Klimmt, Ch. (2009) "Serious Games and Social Change. Why They (Should) Work" In: U. Ritterfeld, M. Cody and P. Vorderer (Eds.) Serious Games. Mechanisms and Effects Routledge, S. 248–270.
Mitgutsch, K.; Alvarado, N. (2012) "Purposeful by design?" In: M. Seif El-Nasr (Ed.) Proceedings of the International Conference on the Foundations of Digital Games. the International Conference. Raleigh, North Carolina, 5/29/2012 - 6/1/2012. New York, NY: ACM (ACM Digital Library), pp. 121–128.
OHCHR | United Nations Decade for Human Rights Education (1995-2004). [online] https://www.ohchr.org/EN/Issues/Education/Training/Pages/Decade.aspx.
Poremba, C. K. (2011) Real|Unreal: Crafting Actuality in the Documentary Videogame. PhD. Concordia University. [online] https://spectrum.library.concordia.ca/15136/.
Ramírez, F. O.; Suárez, D.; Meyer, J. W. (2007) "The Worldwide Rise of Human Rights Education" In: A. Benavot, C. Braslavsky and N. Truong (Eds.) School knowledge in comparative and historical perspective. Changing curricula in primary and secondary education. Dordrecht: Springer (CERC studies in comparative education, 18), pp. 35–52.
Salen, K.; Zimmerman, E. (2003) Rules of play. Game design fundamentals. Cambridge, Mass., London: MIT.
Sicart, M. (2008) "Defining Game Mechanics" In: The International Journal of Computer Game Research 8 (2). [online] http://gamestudies.org/0802/articles/sicart.
Statista (2019a) Number of gamers worldwide 2021 | Statistic. [online] https://www.statista.com/statistics/748044/number-video-gamers-world/.
Statista (2019b) U.S. average age of video gamers 2018 | Statistic. [online] https://www.statista.com/statistics/189582/age-of-us-video-game-players-since-2010/.
Stokes, B.; Seggerman, S.; Rejeski, D. (2014) "For a Better World: Digital Games and the Social Change Sector" Games for Change. [online] https://gamesforchange.org/g4cwhitepaper.pdf.
Tibbitts, F.; Fernekes, W. R. (2011) "Human Rights Education" In: Samuel Totten und Jon E. Pedersen (Eds.) Teaching and studying social issues. Major programs and approaches. Greenwich, Conn.: Information Age, pp. 87–117.
Wagner, M. (2009) "Serious Games: Spielerische Lernumgebungen und deren Design" In: L. J. Issing and P. Klimsa (Eds.) Online-Lernen: Planung, Realisation, Anwendung und Evaluation von Lehr- und Lernprozessen online: De Gruyter, pp. 297–306.
Wouters, P.; van Oostendorp, H. (2013) "A meta-analytic review of the role of instructional support in game-based learning" In: Computers & Education 60 (1), pp. 412–425.

Flipped Classroom: A Renewal Opportunity or a Pedagogical Cul-De-Sac?

Dorina Gnaur
Institute of Learning and Philosophy, Aalborg University, Denmark
dg@learning.aau.dk
DOI: 10.34190/EEL.19.137

Abstract: Flipped classroom (FC) has gained significant recognition in higher education as a way to fundamentally alter the course structure and revolutionize the teaching and learning experience. FC entails assigning digitally mediated instructional content as preparation before class, and thus free up class time to cultivate higher-order thinking skills, problem solving, threshold concepts and engage in collaborative learning. Despite a predominantly large interest in this educational innovation, there are a number of pedagogical challenges that need to be highlighted. This paper examines the educational implications of using FC in a higher education context, which emerged from my own experiences with the systematic use of FC in teaching a course in Change Management (CM). Based on recent literature within the use of FC, I discuss both the pedagogical rationale and the critical points that I have become aware of in my teaching. I thus extend the argument to question the adherence to any particular model or delivery modes, as in the case of FC, which risks reinforcing various content transmission paradigms. Rather, the attention should at all times be on the underlying pedagogy, focused on developing, delivering, and evaluating learning experiences that promote effective and significant improvements in student achievement. Using technology to enhance learning requires a more radical redesign of the teaching and learning experience, which takes advantage of the technological affordances for creating hybrid, flexible learning and enabling new ways of knowing, working and becoming within and across various disciplinary and professional fields. Based on recent literature regarding FC, I identify the pedagogical challenges that exist, despite the popularity of FC as educational innovation. I compare some of the critical points with my own experience with adopting FC in a course in Change Management (CM). I discuss the pros and cons with FC in the light of a written student evaluation of experienced learning from the CM-course as FC. The discussion will lean against research in university pedagogy and learning design.

Keywords: flipped classroom, learning design, technology enhanced learning, university pedagogy

1. Introduction

The present paper examines the educational implications of the use of Flipped Classroom (FC) in a university teaching context. Based on recent literature regarding FC, I identify the pedagogical challenges that exist, despite the popularity of FC as educational innovation. I compare some of the critical points with my own experience with adopting FC in a course in Change Management (CM). I discuss the pros and cons with FC in the light of a written student evaluation of experienced learning from the CM-course as FC. The discussion will lean against research in university pedagogy and learning design.

The rationale for involving FC in the CM course was to align the teaching with the learning objectives and increase learning outcomes. I decided to transform my lectures into presentation videos that the students had to see prior to class teaching. In class, the focus would be on discussion, casework and reflection. In spite of the great effort, time and resources invested in the production of the 27 video podcasts, and the students showing great interest in the FC-approach, the expected improvement of the quality of learning was difficult to assess for both the teacher and the students.

The research question addressed in this paper is: *How can the intention behind FC, related to active learning and reaching higher taxonomic levels, contribute to bring about an educational innovation?*

2. Flipped classroom: Opportunities and challenges

Recent research in university pedagogy places active learning and constructive alignment at the center of the quality of teaching in higher education (Biggs & Tang 2011). Active learning refers to the students' role as active knowledge creators, as opposed to simply reproducing knowledge. This is often expressed in terms of the dichotomy between in-depth learning in contrast to surface learning (Marton & Säljö 1996). This agrees with a constructivist view of learning as a knowledge and meaning creation process based on experience. Consequently, the role of education is to create an activity and experience based environment that promotes student learning.

The pervasiveness of technology in modern society and its possibilities for producing learning materials, and as a media for learning, places renewed expectations for quality and efficiency in teaching. This reflects in the diffusion of ambitious digitization strategies in higher education (HE) institutions in order to respond to demands for digital readiness. It is important to signal actuality by offering students a modern digitized study environment and the prospects of building competencies within digitally supported communication, collaboration and learning, as to become digitally educated and be able to engage in a digitized world (e.g. Aalborg University's Digitization Strategy, 2016-2021). This development calls for new digitized teaching methodologies, which, if driven by technology considerations only, risk growing in a theoretical vacuum (Laurillard 2002). Technology has made HE a global affair, severing not only the qualitative, but also the quantitative demand, which is progressively increasing worldwide (Laurillard 2008).

The dual requirement of enhanced quality and quantitative productivity in HE, intensified by the demand to keep up with the technological pervasiveness in society, offers an unparalleled opportunity for a radical pedagogical innovation. This differs from an incremental innovation, which aims solely at improvements within a given frame of solutions (Norman & Verganti 2014), and may convey a false sense of achievement. Radical innovation requires a change of frame, which goes with understanding how society and culture are changing in order to track innovative designs, without being trapped by dominant patterns of use (id.). While the quest for both a qualitative and a quantitative leap in HE points at technology as a potential solution, this is not likely to happen without a radical shift in university teaching. Hence the need for education driven-, rather than technology imposed innovation in HE (Laurillard 2008).

In the New Media Consortium Horizon Report for HE 2015, FC was identified as a major means to transform teacher-centric instruction into student-centric, interactive learning in HE classrooms (Johnson et al. 2015). Today, FC stands as one of the most important technology-enhanced pedagogic innovations in HE (Jong 2019). FC is essentially an educational model for active learning and has since its inception, around the turn of the millennium (Baker 2000), gained a rapid spread throughout the education sector, from elementary school to university. One of the reasons for its popularity may be that FC focuses the broad interest in active learning into a concrete approach, while incorporating digital technologies, which signals the actuality of the method. There have been various designations in circulation besides FC, which came into being with Sams (2011), but the basic principle is the same: that the dissemination of content, which was previously the focal point of teaching, is now handled by digital technologies and is placed before class. Valuable class time can now be devoted to conduct active learning (EDUCASE 2012, Tucker 2012). The educational gain lies in student-centric teaching and collaborative activities, which are paramount in developing important competences for the 21st century, e.g. problem solving, interdisciplinarity, teamwork, critical reflection and dialogue.

Efforts have been made to conceptualize FC pedagogy in order to meet educational expectations. One such conceptualization is summarized by the acronym F.L.I.P., which accounts for the four pillars that support FC: Flexibility, Learning culture, Intentional content and Professionalism in teaching (Flipped Learning Network 2014). *Flexibility* refers to freeing up education in terms of time and space, so that the technology-mediated content is freely available and can be accessed as needed, to support individual and group learning purposes. *Learning culture* refers to the students' learning being at the center, and all teaching and learning activities, as well as feedback and assessment, being consistent with this purpose. As mentioned, the FC concept is closely associated with technology, both in the production and diffusion of different types of content (LaFee 2013). Here, the teacher has a deliberate *Intention* about the choice of what is to be communicated prior to the teaching, and which digital format is used. A focused review shows that teachers use podcasts, videocasts, pencasts, screencasts, and video clips of different nature to mediate knowledge content, which students are expected to prepare prior to class (O'Flaherty & Phillips 2015). Finally, *Professionalism* refers to the fact that teaching should be part of the academic expertise, in line with the professional and research competencies.

However, there are a number of problematic aspects with FC and its four elements. Firstly, despite the obvious benefits, flexibility can challenge students in several respects. It may take time as a student to adjust to a new way of studying when a large part of the teaching moves home, which leads to an increased workload and requires special abilities for self-organization and study competences. This can be confusing and contribute to resistance to this new way of studying (O'Flaherty & Phillips 2015, Owston, York, & Murtha 2013, Fischer et al. 2017). Secondly, learning culture is not an unambiguous or easily attainable ideal.

Throughout the Western world, HE not only submits to quantitative demands, but also to an efficiency rationale. Here, education adopts certain commodification perspectives on knowledge, skills and academic production, which are translated into economic capital and subject to the value for which they can be sold on the global marketplace (Shumar 2013). Tests are one way to determine this value, which is linked to political interests in ensuring business-like efficiency, quality control and financial accountability. Tests and measurement have become standard practice thanks to the spread of digitized evaluation systems (Linn 2001). This efficiency culture may lead to a superficial teaching-to-the-test practice, which counteracts deep learning (Biggs & Tang 2011). The result is a kind of reversed alignment - where the teachers plan for the students' test performance, which thus becomes a measure of the effectiveness of the teaching (Linn 2000).

The third and fourth element, educational intentionality and teaching professionalism are also critical as FC paradoxically risks reinforcing teacher-, rather than student-centeredness. This is due to the teaching still revolving around a transmission paradigm in the form of a teacher determined knowledge hegemony (Tucker 2012, Hoffmann et al 2014). FC has been criticized for just changing the order without really doing away with the lecture-based approach and being "simply a time-shifting tool that is grounded in the same didactic, lecture-based philosophy… a better version of a bad thing." (Ash 2012). The digitally mediated content dissemination might furthermore diminish the students' critical analytical skills compared to text and literature-based preparation, as the intentional digital content appears deprived of its context. Students learn from the teacher's crafted knowledge without considering how this knowledge has been created and without constructing their own approach (Sadaghiani 2012).

Leading researchers in university pedagogy have emphasized the need for teaching competences to match research competence, even more so, when it comes to the inclusion of technology in education (Laurillard 2002). Teaching professionalism requires institutional support, especially in the case of technology-enhanced teaching. Developing digital pedagogical skills cannot be left to the discretion of the teachers, but requires a more fundamental organizational and administrative support. The resource-related challenges involved in producing digital material for FC are widely acknowledged: from high development and production costs, to the need to rethink how programs are organized, as technology enhanced education can be difficult to incorporate into existing structures. The teachers call for a substantial technological-pedagogical support, which must be institutional, accessible and flexible (O'Flaherty & Phillips 2015).

According to Shulmann (1987), teaching is a learned profession comprising complex knowledge and skills regarding pedagogical and content insight, knowledge of learners and of educational contexts and goals. Teaching professionalism is not static, but rather a continuous design process, "a design science", where the teachers engage as "designers", and work purposefully on developing and testing design principles for teaching and learning in practice (Laurillard 2013). Just moving lecture content outside of the teaching might not suffice if we want to evolve beyond the outdated knowledge transmission paradigm. Without a redesign of the underlying educational pattern involving technology, FC may elude the educational renewal opportunity. Obviously, FC has put technology on the teaching agenda and highlighted some obvious advantages herewith. The challenge is to conceive of a deliberate educational strategy that promotes individual and collaborative learning dynamics and prepares students to navigate in complex environments.

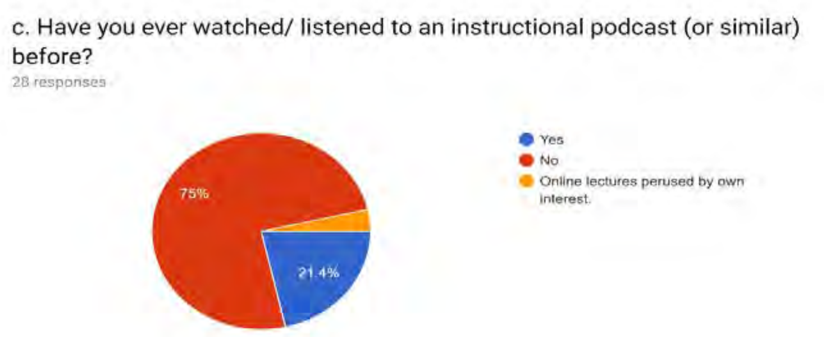
3. My flipped classroom experiment

I had been teaching Change Management (CM) for three semesters - an English language course on 10 ECTS for 5.th semester Danish-speaking BA-students in International Business Communication. In their evaluations, students reported overwhelmed by the vast content knowledge in CM, which draws on many different disciplines, e.g. organizational theory, management theories, human resources, learning and psychological processes, as well as specific change theories and methods. The learning goals, however, exceeded the declarative level of knowledge and required learning of functional knowledge and skills in order to *describe, analyze and discuss organizational change projects* and *organize and implement organizational change projects*. The classes were dense consisting mainly of lecture-based teaching with dialogue and occasionally short exercises. I tried to adjust the structure in order to release more time for active learning to support the complex learning goals, though without any notable success, while the students remained unsecure when it came to performing change-related tasks in real organizational environments – which they had to do in the ensuing project work, which released the final exam.

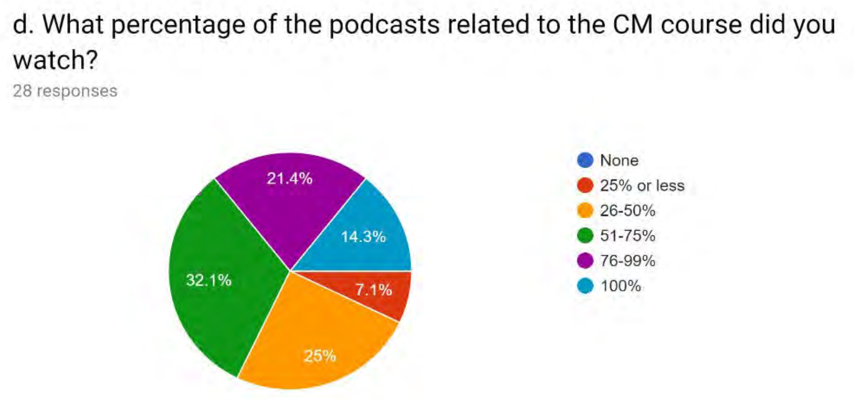
The rationale for involving FC in connection with the CM course was to align the teaching with the expected functional learning outcomes, by moving the subject content online, as preparation for each course session. In class, the focus shifted to difficult or critical aspects that needed further elucidation, discussion, exercises and case-based work. I had been co-researcher on similar teaching experiments with flipping the classroom (Gnaur & Hüttel 2014, Gnaur and Clausen 2015; Gnaur & Hüttel 2016) and felt confident in embarking onto this new form of teaching. I thus turned all my lectures into pre-recorded presentation videos to be visited prior to class, together with the assigned literature teaching. Besides, I produced an initial video where I explained the FC approach to learning suggesting that FC relied on the use of the lecture podcasts as a means to substitute content-based lectures, implying that they should be used for preparation. The 27 videos covered the 8 course sessions of 2-4 videos, each 11-18 min. long. In addition to the standard end-course evaluation, where the students report higher degrees of satisfaction compared to the previous year, I also carried out a specific evaluation, between 6.th and 7.th session, aimed specifically at FC. Below, I will present and discuss the main results, followed by further perspectives on technology-enhanced teaching and learning.

3.1 Student evaluation of the CM course as FC

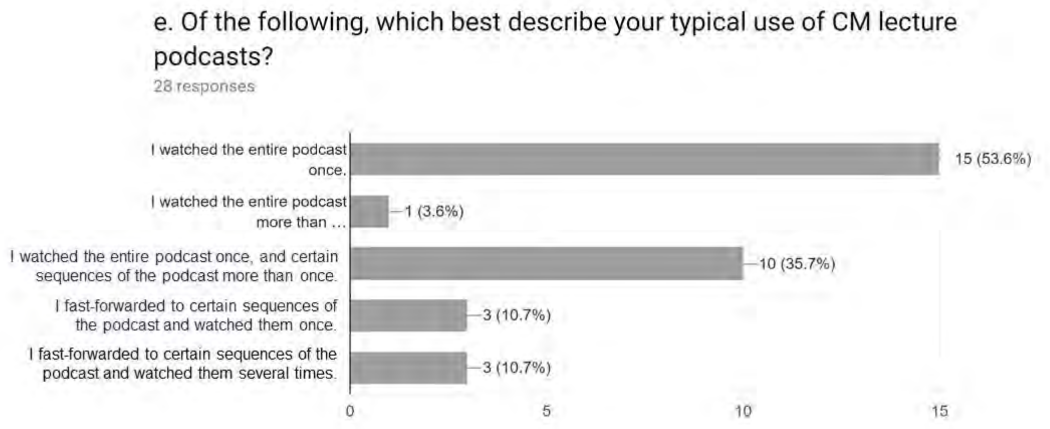
28 students, out of 42 enrolled, completed the online questionnaire on the learning evaluation of the CM course using FC. Initially, the questions focus on issues that could affect the students' experience of FC, such as the newness of the experiment. The newness factor might be significant as video-based instruction was new to 75% of the respondents. Similarly, the students might be impressed by the attention given to the pedagogical design to improve their learning, which also might have affected their overall positive reactions to the instructional incentive (cf. c.)



However, the students exhibit different adoption patterns, when it comes to the number of total podcasts they have watched (cf. d.). Only 4 respondents have watched all podcasts; 6 respondents have watched more than three quarters. The majority of the respondents have watched about half of the video-podcasts, of which 9 have seen more than 50%, and 7 have seen more than 25%. This indicates that their interest has been fluctuating, possibly after the initial novelty had subsided. From the overall conversations in class, it seems that students started relying increasingly on accessing the videos later on, as needed, i.e. as required by their respective project problems and exams.

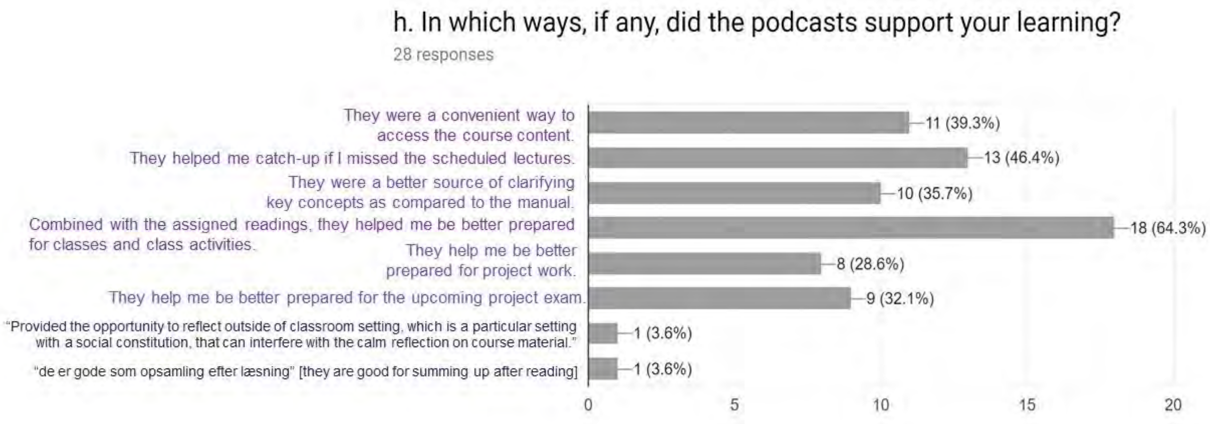


Regarding the manners of use, it appears that the respondents rely on one or more different strategies for watching the digitized lecture presentations (cf. e.).



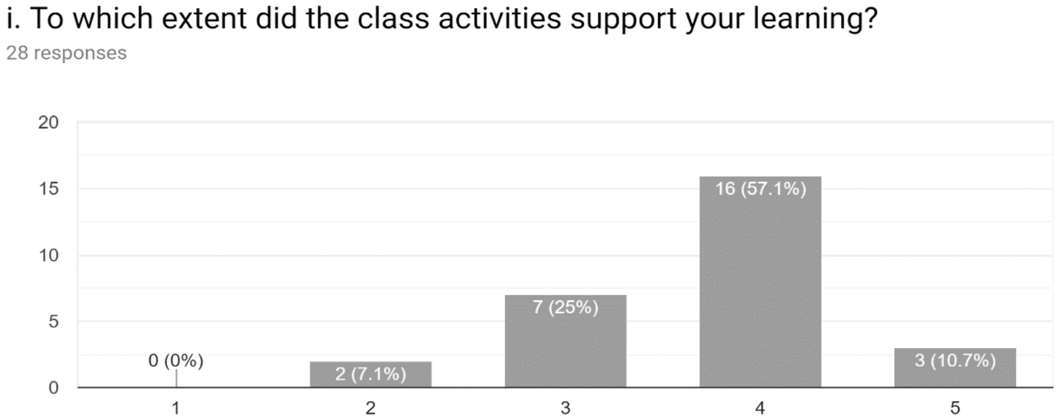
The predominant tendency is that students see the entire podcast once (54%). A relatively large part watch the entire podcasts once, after which they fast-forward to selected sequences (35.7%). A smaller share of the respondents search directly or fast-forward through the podcast, to find specific items, which they watch one or more times (10.7% each). This suggests that students take advantage of the opportunity to orient themselves in the content and revisit difficult or important elements to create or deepen their understanding of the content knowledge.

The following questions inquire into ways in which FC supports the students' learning, according to the expectations set by the FC literature (O'Flaherty & Phillips 2015). The students report that the content video podcasts have supported their learning in various ways (cf. h.). The majority report feeling supported in preparing for the teaching (18). A relatively large proportion also appreciate the possibility of finding the online presentation as to keep up with the teaching in case they miss one or more classes (13).



A considerable share of responses envisage the video presentations as a convenient way to access course content (11) or, significantly, as a better source of understanding difficult concepts than the literature (10). Students also seem to be supported in relation to their project work and project exam (8 and 9 respectively). Some students formulate their own learning outcomes, which relate to the ability to reflect and gain an overview over the subject area, outside class.

Regarding class time, the 8 times 2*45 min., which was to be used for active learning, the impression is that the class activities did support student learning, yet only to a high-to-moderate level, which is less than this author had expected. (cf. i.).



In the privileged situation where the teaching could be devoted to active learning, i.e. discussion, exercises, case-work and reflection, part of the class was still spent on clarifying or explaining specific content as demanded by the students present, which could be related to the uneven preparation pattern. Despite the intentions of application-oriented learning, the content knowledge was a fixed item on the agenda each time. From this teacher's view, it seemed as if the students feared being insufficiently prepared for entering project work; and thus the need to revisit the content before engaging in practical problem solving.

3.2 Discussion of student statements

The evaluation survey contained a number of qualitative questions, for students to formulate their own answers. To the question: "*What difference* does this way of running a course do to your personal learning?" there were 10 enthusiastic answers, e.g.: "*It makes a huge difference! Just that I can always go and see podcasts again, thereby refreshing the things we've learned*."

The more critical answers, however, help sharpen the focus on the relationship between the development and teaching efforts invested vis-avis the actual learning outcomes. For example, when a student says:

> *"Overall, there's not an awful lot I can say about it, other than this occurred to me just another instance of pedagogy which did what it did. Obviously, it added extra prep time for lectures, which is a minor point. Other than that, it provided on the one hand the luxury of freeing up a lot of time in the actual lectures, on the other a disturbance in the usual manner of learning and teaching I'm accustomed to. As such, it tumbled over the cognitive structures I apply when organizing knowledge, which might be problematic since this perhaps has 'uprooted' my focus when studying, and instead thrown me into a huge field where I'm constantly having a feeling of not knowing which foot to stand on - everything is leveled out, so criteria for judging what constitutes proper knowledge and not was difficult. As such, I felt that the literature suddenly was a sort of weird 'add-on', despite knowing that studying literature is important whenever new subject is wished to be known."*

There are several elements, which are consistent with some of the criticisms raised against FC. In particular, I notice the danger of the teacher processed knowledge for student preparation, which appears 'levelled out', and when the students may feel discouraged from studying the subject on their own, and from adopting a critically reflective attitude to knowledge and a more dialectical epistemology.

On the question "*What do you think were the advantages, if any, of this way of running a course*?", some of the known advantages of FC were mentioned, such as: "*It has been nice to be able to hear you [the teacher] explain things and see your slides at the same time on the podcasts before / after reading in the book*"; "*Obviously it is a good 'extra service'*". "*You have the ability to learn more because the podcasts were different from the classes* ". "*The discussions in class were more dynamic, and everyone was prepared more or less* " Or: "*Week and lazy students learn more*".

Digitized content is helpful, but how much does it help and in which way? Arguably, this way of literally 'delivering' knowledge might strengthen the trend towards the commodification of higher education. Regarding possible drawbacks with FC, the students remark that literature is more easily skipped as the content can be more readily accessed via the prerecorded lecture presentations: ”*People slack on reading and miss out on some important stuff* ". Some also express a concern about the overall workload, with both text reading and podcasts, especially if several courses would be run as FC.

Eventually, the students refer to how FC courses can be improved, and here several practical issues are pointed out regarding the length, not more than 10 minutes; and the rigor in presenting the subject matter coherently. A critical and interesting input is given below:

> *”Throw out the strict adherence to literature material when doing the podcasts. Instead try and go about it, like you would do in an actual lecture: "What he's saying here is...", "Did you notice anything faulty about that model?", "Consider this for the lecture: what traditions or assumptions is he leaning up against when saying this?" and the like. This will structure your lesson beforehand by presenting cues in the podcast as to what the student can expect, and consolidates the role of literature without this effect of 'relativization', which has negative consequences for learning.”*

This student calls for a different pedagogical function in the digitized teaching material, other than a neutral "relativizing" presentation of the disciplinary content. The sought-after effect is a sort of digital teaser that stimulates inquiry and imagination in a dialogical fashion by problematizing existing knowledge, which urges students to strengthen their argumentative capacity.

This perspective challenges the dominant teaching paradigm in HE by refusing to accept the primacy of digitized disciplinary content. Rather, technology should be used to fuel a debate as per to how the established knowledge can be challenged, which fosters higher order thinking and learning. The dichotomy in FC between the passive handling of digitized content versus active application in class, or in the field, becomes less significant, whereas the active engagement of students in knowledge creating processes expand across online and class teaching.

3.3 Lessons learnt

The findings in this paper have obvious limitations. They derive mainly from one survey with only two thirds of the students responding. There was no possibility of following up as the course only run in a flipped fashion once, and the findings are not conclusive in terms of the effect of ongoing improvements. Due to structural changes, the course passed on to a new, less experienced teacher, who did not feel confident venturing into new pedagogical approaches. The existing podcasts were mentioned to the coming students as an additional content source, without being actively integrated in the pedagogy. According to the Youtube channel analytics, the number of views appears to have raised slightly; yet, the payback on the substantial efforts employed to develop FC were utterly limited. This situation might be recognizable in many other academic contexts, prone to seizing opportunities for cost reductions, which may involve frequent re-distribution of teaching tasks among permanent and temporary staff. Radical pedagogical transformations require sustained organizational support in a long-term perspective in order to move beyond experimentations to establishing new practices.

Nevertheless, beyond confirming some of the existing challenges with FC (see §2), the findings contribute to intensify the debate on the need for reflexive, critical thinking before subscribing to ready-made formulas for successful pedagogies, such as FC. Technology presents unprecedented opportunities to address pedagogical problems in HE and meet student learning needs, but also unforeseen scenarios that cannot be addressed within existing teaching paradigm, which is substantially based on content transmission; lest we risk reinforcing the dichotomy between knowledge and its application. At the same time, technology represents a window of opportunity to re-think HE pedagogy and should be seized accordingly, as a radical change. Experiments like mine, and similar worldwide might seem isolated. Nevertheless, they accumulate valuable experience, both contextually, at the individual and institutional level, and generically, at the conceptual design level, in this case transcending content-centeredness using technology to support and animate ongoing learning explorations and connect learning across time and space. The experiences so far, have prepared this author for venturing into new experimentations using digital and communication technology to feed inquiry and problem orientation in upcoming teaching and learning designs.

4. Concluding remarks

In spite of the great time and resources invested in producing the 27 video-podcasts and organizing both online and in-class time; and although the students appreciated FC as a helpful incentive, the hoped for increase in the quality of teaching and learning was difficult to determine. The expected raise in higher order thinking and the development of analytical and problem solving skills, as well as enhanced learning capacity in students as they increasingly take charge of their learning, are still wanting. Quite on the contrary, there was a drop in student effort, as knowledge appeared to be readily served, as an 'extra service', by the teacher. In a complex world with many competing demands, the students are welcoming this help. However, it also risks pacifying them and levelling their thinking even more than traditional lectures, unless the focus is more explicitly on active learning and higher order academic skills.

Paradoxically, the intention of getting the content out of the way, risks ending in a veritable cul-de-sac. The content is still the revolving point, both outside-, and in class, selected and processed by a knowledge expert and fixated digitally. The problems and activities in class become subordinate, a sort of add-on, as the standing ground is always there, online. In order for FC to produce the intended effect of innovating HE, I endorse the claim of rethinking the underlying pedagogical design. Similarly, it has been suggested that multiple flips might be needed to convert information into knowledge by the active involvement of the students, using technology to mediate various kinds of flips, as a *continuous dialogue* between the representation and creation of knowledge (Uskokovic 2018). To foster academic skills, the knowledge creation can be flipped over to the students, who can search, find, select and frame knowledge from different sources, with the active participation of fellow students and of the teacher asking in-depth questions and giving feedback and suggestions for further development, in continuous co-creation processes (id.).

An additional way to further develop FC could be to view it as a hybrid learning model, where learning to a greater extent follows the learner, across multiple activity and learning spaces. We live in a time where online and physical activities flow together: *"We are probably the last generation to make any difference between online and offline"* (Floridi, in Jahnke et al. 2016). Technology connects people and connects them to knowledge across various learning and action contexts. Instead of using technology as an advanced textbook, Janke et al. (2016) emphasize the need for new designs for learning and new ways of teaching. There is a need to facilitate *learning walkthroughs*, where the students can easily move between knowledge and application as they become *pro-sumers* and *learnerpreneurs*, i.e. active creators and co-creators of their further learning and progress (id.).

Fluid, rather than flipped classroom could turn the effort of producing static digitized teaching material into a variety of agile elements, with the academic teacher as a learning designer, aware of the need for critical pedagogical assessment of the so-called *affordances* for teaching and learning in an organizational context. Affordances describe the dynamic relationship between the objective qualities of the pedagogical landscape and the subjective ability of the people involved to act herein (Dohn et al.2016). Contrary to affordances in natural environments, various design-based approaches, especially with technology, can help expand the affordability of a situation.

Technology enables unprecedented opportunities to connect knowledge and people, education and application contexts, and to maintain a continuous dialogue and participation in different social spaces. FC could benefit from focusing on *dialogic practices* where students are encouraged, in interactions with each other and with the teachers, to question knowledge and normative discourses, and to participate, to a greater extent, in debates and dialogical knowledge-creating processes (Alexander 2008).

In my upcoming practice as a learning designer, I will accept the invitation to further flip FC and use technology to mediate and enhance dialogic teaching principles revolving around the students' mutual interaction while listening and building on each other's views and thus paving their own way together through a discipline area. I am tempted to use the term 'agile' to represent adaptive ways of using technology as a learning enhancer, but I abstain, out of a concern with getting stuck with technological rather than design considerations.

References

Alexander, R. J. (2008). Towards dialogic teaching: Rethinking classroom talk (4th ed.).
Ash, K. (2012, August 29). Educators evaluate "flipped classrooms". Education Week, 32, s6-8.

Aalborg Universitets Digitaliseringstrategi, Viden for Verden 2016-2021, [in Danish, online], https://www.strategi.aau.dk/digitalAssets/381/381802_030418_aau_digitaliseringsstrategi_web.pdf
Biggs, J. & Tang, C. (2011). Teaching for Quality at University (4th Ed.). New York, NY: Society for Research into Higher Education & Open University Press.
Dohn, N. B., Hansen, J. J., Jensen, J., Johnsen, L., Lauridsen, E., Møller, M. H., & Yepez-Reyes, V. (2016). Digital educational design-process, product, and practice. In Designs for Learning, Fifth International Conference, Copenhagen.
EDUCAUSE Learning Initiative. (2012). 7 things you should know about flipped classrooms. Washington, DC, https://www.rit.edu/academicaffairs/tls/sites/rit.edu.academicaffairs.tls/files/directory/ELI7081-1.pdf
Gnaur, D., & Hüttel, H. (2016), Podcasting for Teaching and Learning in Higher Education, 1. ed. - Open Access ed. Aalborg University Press. Higher Education Practices Series; no. 2.
Gnaur, D., Clausen, J., (2015) "Teaching Smart with Podcasts". In: International Journal of Engineering Education, Vol. 31, No. 2(5), 486-494.
Gnaur, D., & Hüttel, H. (2014) "How A Flipped Learning Environment affects Learning in a Course on Theoretical Computer Science". Advances in Web-Based Learning – ICWL. Proceedings. ed. / Elvira Popescu; Rynson W. H. Lau; Kai Pata; Howard Leung; Mart Laanpere. Vol. 8613 Springer Publishing Co., 219-228.
Hoffman, E. S. (2014). Beyond the Flipped Classroom: Redesigning a Research Methods Course for e3-Instruction. Contemporary Issues in Education Research, 7(1), 51-62.
Jahnke, I., Mårell-Olsson, E., Norqvist, L., Olsson, A. & Norber, A. (2014). Digital didactical designs–reimagining designs for teaching and learning. In ICED 2014: Educational development in a changing World, Stockholm, 15-18.
Johnson, L., Adams Becker, S., Estrada, V., & Freeman, A. (2015). NMC horizon report: 2015 higher education. Austin, Texas: The New Media Consortium.
Jong, M. S. Y. (2019). To flip or not to flip: social science faculty members' concerns about flipping the classroom. Journal of Computing in Higher Education, 1-17.
LaFee, S. (2013). Flipped learning. School Administrator, 3(70), 19-25.
Laurillard, D. (2002). Rethinking university teaching: A conversational framework for the effective use of learning technologies. Routledge.
Laurillard, D. (2013). Teaching as a design science: Building pedagogical patterns for learning and technology. Routledge.
Laurillard, D. (2008). Technology enhanced learning as a tool for pedagogical innovation. Journal of Philosophy of Education, 42(3-4), 521-533.
Linn, R.L. (2000). Assessments and accountability. Educational Researcher,29(2), 4-16.
Linn, R.L. (2001). A century of standardized testing: Controversies and pendulum swings.Educational Assessment,7(1), 29-38.
Marton, F. and Säljö, R. (1997). 'Approaches to learning', in Marton, F. Hounsell, D. andEntwistle, N.J. (eds.),The Experience of Learning. Edinburgh: Scottish Academic Press, 39–58.
Norman, D. A., & Verganti, R. (2014). Incremental and radical innovation: Design research vs. technology and meaning change. Design issues, 30(1), 78-96.
O'Flaherty, J. & Phillips, C. (2015). The use of flipped classrooms in higher education: A scoping review. The internet and higher education, 25, 85-95.
Owston, R., York, D., & Murtha, S. (2013). Student perceptions and achievement in a university blended learning strategic initiative. Internet and Higher Education, 18, 38-46.
Sadaghiani, H. R. (2012). Online prelectures: An alternative to textbook reading assignments. The Physics Teacher, 50(5), 301-303.
Shulman, Lee S. (1987) Knowledge and teaching: Foundations of the New Reform. Harvard Educational Review, 1987, 571(1), p 1-22. Copyright by the President and Fellows of Harvard College.
Shumar, W. (2013). College for sale: A critique of the commodification of higher education. Routledge.
Tucker, C. (2012). Flipped classroom: Beyond the videos, [online], http://catlintucker.com/2012/04/flipped-classroom-beyond-the-videos
Usković, V. (2018). Flipping the flipped: the co-creational classroom. Research and Practice in Technology Enhanced Learning, 13(1), 11.

Using Augmented Reality for Teaching Pupils With Special Educational Needs

Vojtěch Gybas, Kateřina Kostolányová and Libor Klubal
University Of Ostrava, Pedagogical Faculty, Department Of Information and Communication Technologies, Czech Republic
vojtech.gybas@osu.cz
DOI: 10.34190/EEL.19.017

Abstract: Mobile touch devices enable enhanced reality applications. The concepts of virtual reality and augmented reality are often confused and have the same meaning until the beginning of the 21st century. Mobile technology has changed the importance of augmented reality. Its application in mainstream education is already sufficiently described. A great number of authors have tried to define augmented reality. The following is one of the first and widely accepted definitions: "Augmented reality is integration of 3D virtual objects into a 3D real environment in real time" (Azuma, 1997). Similarly, "augmented reality complements the real world with (computer generated) virtual objects so they seem to coexist in the same space as the real world" (Azuma et al., 2011). All the aforementioned definitions have one element in common: interconnecting virtual objects and integrating them into the real world. In contrast to virtual reality, where the generated objects are displayed on an imaging device, augmented reality contains a real-world environment. There are headsets which, on the one hand, are only imaging devices, but on the other create an impression of the real world (Yuen, Yaoyuneyong and Johnson, 2011). Such headsets, however, illustrate a major problem of augmented reality – displaying virtual objects and real-world environments. A mobile touch device is a tablet or a mobile phone with an operating system (Kostolanyova, Klubal, 2016). In a simplified model, a mobile touch device is a personal computer integrated into a single device which does not require any peripheries (a keyboard, mouse or monitor). The obvious advantage of mobile devices is their mobility and integration of more devices (from the augmented reality viewpoint, it is the presence of a video camera). Based on publications from the Web of Science database, a summary analysis by Fombona, Pascual-Sevillano, González-Videgaray (2017) describes the advantages of mobile devices with regard to augmented reality, examining the relationship between the terms augmented reality and m-learning. The analysis proves that the terms are mutually dependent. The paper deals with the specifics of the use of augmented reality in pupils with special educational needs. In particular, the monitoring showed a reduced burden on graphomotorism and a reduction in cognitive stress among these pupils. In this paper we describe the use of application HP Reveal to eliminate the deficit in the abstraction of things, concepts, and subject matter.

Keywords: iPad, moderate mental retardation, special educational needs, HP Reveal

1. Introduction

The first use of the term augmented reality in connection with education dates back to the late 1990s. However, when Moline (1997) mentions it, he talks about virtual reality. The majority of publications between the years 1997 and 2005 are aimed at medicine education. In their study, Rolland, Wright and Kancherla (1997) mention augmented reality in connection with bone anatomy. The terms virtual reality and augmented reality are often interchanged and up until the beginning of the 21st century they had the same meaning. Mobile technology changed the meaning of augmented reality. In his study, Wu et al. (2013) describes the different meanings of the terms virtual reality and augmented reality, presents the advantages of mobile devices and defines technological, pedagogical and educational aspects of using augmented reality in education.

Augmented reality

A great number of authors have tried to define augmented reality. The following is one of the first and widely accepted definitions: "Augmented reality is integration of 3D virtual objects into a 3D real environment in real time" (Azuma, 1997). Similarly, "augmented reality complements *the real world* with (computer generated) virtual objects so they seem to coexist in the same space as the real world" (Azuma et al., 2011). The definition by Dubois, Nigay and Troccaz (2001) mentions augmented reality in connection with an education environment. They define augmented reality as "a way to combine real and virtual environments in order to make carrying out a task in a real world easier". The last definition worth mentioning is the one by Yuen, Yaoyuneyong and Johnson (2011), who argue that augmented reality is "a broad spectrum of technologies which display computer-generated materials, such as text, video or images, integrating them into the real world". This definition was published in a comprehensive study aimed at the use of augmented reality in education.

All the aforementioned definitions have one element in common: interconnecting virtual objects and integrating them into the real world. In contrast to virtual reality, where the generated objects are displayed on an imaging device, augmented reality contains a real-world environment. There are headsets which, on the one hand, are only imaging devices, but on the other create an impression of the real world (Yuen, Yaoyuneyong and Johnson, 2011). Such headsets, however, illustrate a major problem of augmented reality – displaying virtual objects and real-world environments.

2. Mobile touch device

A mobile touch device is a tablet or a mobile phone with an operating system (Kostolanyova, Klubal, 2016). In a simplified model, a mobile touch device is a personal computer integrated into a single device which does not require any peripheries (a keyboard, mouse or monitor). The obvious advantage of mobile devices is their mobility and integration of more devices (from the augmented reality viewpoint, it is the presence of a video camera). Based on publications from the Web of Science database, a summary analysis by Fombona, Pascual-Sevillano, González-Videgaray (2017) describes the advantages of mobile devices with regard to augmented reality, examining the relationship between the terms augmented reality and m-learning. The analysis proves that the terms are mutually dependent.

2.1 Using mobile touch device for teaching pupils with special educational needs

The SAMR (Puentedura, 2014; Klubal, 2014) model is often mentioned when discussing the integration of mobile touch devices into instruction. The SAMR name is created from the initial letters of the Substitution, Augmentation, Modification, and Redefinition words. The model describes the gradual transition to teaching with the support of ICT from the simple replacement of classical materials by their electronic form (substitution) to the state where, thanks to ICT tools, we will make a complete change in the classical concept of teaching, ie we can implement teaching that would not be possible without the use of ICT (ie redefinition). Unfortunately, due to their mental oddities, this model cannot be used when teaching pupils with special educational needs. Therefore, Shulman’s model (1987) was used for implementation of mobile devices into instruction. In the mid-1980s, responding to the critique of the current teacher preparation, Shulman formulated the so-called Pedagogical Content Knowledge (TPCK). He argued that teaching pupils pedagogy and other subjects independently was a mistake; that the professional content should be taught together with methods suitable for teaching a particular curriculum. Shulman’s TPCK connects pedagogy and subject specialization, thus creating a brand new specialization which cannot be achieved by studying the particular disciplines independently. Mischra and Koehler (2006) discuss this issue in more detail. In international publications, an iPad was first mentioned in 2010. Since then, a great number of studies have been published aimed at popularizing the device and explaining why it is suitable for teaching pupils with special educational needs (Koszalka & Ntloedibe-Kuswani, 2010; O’Conell, 2010; Parette, Quesenberry & Blum, 2010).

A combination of pleasant sounds and visual ringtones which go off when the pupil answers correctly not only improves pupils’ motivation, especially those with autistic spectrum disorder (Doenyasa, Şimdi, Özcan, Çataltepe & Birkan, 2014), but also helps fulfill the curriculum plan (Kaur, 2017). In addition to effective pedagogy, an iPad is beneficial for both teachers and pupils (Karney & Maher, 2013). The interactivity of iPad applications helps the user acquire skills in other areas (Kemp, Stephenson & Cooper, 2016).

Interaction through interviews and actions such as guiding children’s fingers or showing them which icons they should tap was beneficial not only for the child, but also for all the observers (Kellems, Rickard & Okray, 2017). An iPad’s interactivity is extremely important (Neumann, 2018). The following authors agree that teachers need to be educated: Wainwright (2013), Aram & Bar-Arm (2016) and Bobnar (2017). Moreover, McMahon and Walker (2014) argue that teachers’ knowledge of iPads is insufficient. Beschorner & Hutchison (2013) and Bigelow (2013) stress that pre-school teachers should be educated enough to be able to help their pupils learn how to write on an iPad. Recent studies on pre-school literacy (Neumann, 2014b; Neumann, Hood & Ford, 2013) used directional language (using the following commands: up, down, around, across) as a strategy for writing letters. As far as writing is concerned, writing on an iPad is easier for pupils and helps improve their visual and sensory learning (Kucirkova, Flewitt & Messer, 2014). Vygotsky’s (1978) “writing in the air” can be applied here as an iPad is a tool which offers a slightly different version of working in a space. When using an iPad, a writing on the display (a digital artifact) can be transformed into a physical artifact on paper, i.e. it is immediately visible and can be immediately printed out. Moreover, an iPad is less demanding in terms of pupils’ eye-hand coordination than other ICT devices and tools. Intuitiveness, mobility and flexibility – these are other factors that can have an impact on pupils' performance in ICT-based instruction.

All the aspects of an individualized approach to mentally retarded pupils can be successfully realized through augmented reality, which, however, has not yet been used for this purpose.

2.2 Guided Access feature

iPads (mobile devices) have the **Guided Access** feature, which helps the pupil stay focused on the task when using an iPad by limiting the device to one application at a time, thus creating a modified environment (Apple, online, 2017). The Guided Access feature helps autistic pupils, pupils with attention disorder and those with mental retardation to better concentrate on the task at hand. This feature allows teachers/parents to make pupils with special educational needs to use a particular application by disabling the Home button, thus helping them to stay fully focused on a task. Moreover, Guided Access also enables teachers/parents to "disable the touch functionality of some parts of the screen", which may come in handy when pupils are starting/finishing a task. The following are the **factors** which can disrupt the use of a mobile touch device and which can be minimized by using the Guided Access feature (Gybas, online, 2017):

- Unwanted operation of an iPad (pressing the Home button by mistake, etc.),
- Unwanted handling of an iPad,
- Pupils not being focused on the application environment,
- Intentional disruption of work.

Technically speaking, with the Guided Access feature on, an iPad will be in the single app mode, i.e. with only one application running. It means that only the selected part of the screen responds to touch commands, i.e. the user can choose what will work and what will not. This iPad feature can be beneficial when using augmented reality for teaching pupils with mental retardation, alongside the other available approaches and applications.

3. HP Reveal

Used in schools all over the world, HP Reveal is one of the most popular and modern augmented reality application. The HP Reveal system combines an application on a local device and cloud storage, to which digital content in the form of video, images or sound is saved. Using a local application, this cloud content is connected to the so-called markers, e.g. pictures in a textbook or posters in the classroom. Therefore, HP Reveal introduces an inventive, entertaining and holistic way of encouraging pupils of all ages to participate in instruction. Since the application was originally titled Aurasma, some literature still refers to not only the application but also to the materials created in it by its original title.

3.1 Aura – augmented reality

An aura is an augmented reality element displayed in the real world through an application in a mobile device. HP Reveal can be used not only to complement objects such as posters, flyers, brochures or books, but also to present augmented reality elements in the classroom. Using a smartphone or other smart devices, one can overlay a real-world image with a sound recording, image or video, thus enhancing the scene displayed on the screen. Since the trigger image (also known as a marker) serves as a web link to particular media, it needs to be unique and permanent. As a result, one will be able to play "auras" locally in one's device or share them with others through the Aurasma data server channels. The main advantage of the HP Reveal tool is that it is easy to use, free and freely available and that it enables users to create their own content. However, it also has disadvantages, e.g. limited data and the fact that the result depends on the skills of the users who create their own content (as in many creative processes).

4. Case study – theoretical frameworks

When teaching pupils with mental retardation, the teacher needs to deal with weak abstraction on the part of the pupils. According to Valenta and Muller (2013), pupils with mental retardation are characterized by slow comprehension and sticking to details. Moreover, such pupils also have an insufficient comparative ability, and both mechanical and logical memory. The thinking process of individuals with mental retardation is too concrete; they are not able to think abstractly and to generalize, making mistakes when analyzing and synthesizing.

Generally, a pupil with moderate mental retardation can be characterized as a pupil with a limited thinking and speaking capacity, with the condition being permanent.

The HP Reveal application can help improve pupils' imagination and abstract thinking.

A qualitative research (based on Hendl, 2005) used both non-participant and structured observation in direct interaction to collect data through **video recordings**, **photography**, **text notes** and **asking the pupils questions** when they were using an iPad and the HP Reveal application. The data were then analyzed and interpreted in a case study. The teacher has an augmented reality-based tool at their disposal, which they can use to interactively explain to their pupils abstract terms and content which are challenging in terms of imagination. The following are the criteria for using an iPad and the HP Reveal application, respectively: no special knowledge or skills are required. All the pupil needs to do is place an iPad over an object (an aura medium, i.e. an augmented reality object) which is then displayed.

4.1 Methodology

Criteria related to the teacher's use of an iPad – the ability to actively use an iPad; the ability to create auras in the HP Reveal application with no outside help.

Realizing the expected outcome based on the Framework Educational Program for Special Primary School – considering the individual needs of pupils, it can be a plethora of objects – objects of daily use, work tools, profession, fauna, flora, etc. Each pupil is different and each pupil perceives differently. Both an iPad and the HP Reveal application were used when realizing the expected outcome "Recognizing and naming different human activities" in the subject "Sensory education" in the educational area "Man and His World", based on the Framework Educational Program for Special Primary School. Pupils find it difficult to visualize different professions and the teacher may not always be able to adequately demonstrate them.

Curriculum content – be able to describe their health problems; know who to go to for help.

Time allocation – 4 hours a week.

Objective – mediate information which is not part of the study material, help the pupils master the use of the HP Reveal application, eliminate problems with abstraction and imagination, broaden their horizons and help them become unafraid of the medical environment.

4.2 HP Reveal in practice

Czech special primary school teachers have a set of textbooks (for the educational area Man and His World) at their disposal. These textbooks teach pupils to correctly name objects, phenomena and situations (We Are Going to School, Septima publishing house). The color illustrations and non-traditional bookbinding (loose leaf or spiral bound textbooks) help pupils meet the objectives of the course in a natural and active manner. These textbooks can also be used in other special schools. They contain pictures depicting different human activities.

Figure 1: Textbook part 1

Figure 2: Textbook part 2

Figure 3: Textbook part 3

In addition to the study material, the teacher also uses an iPad and the HP Reveal application. The teacher actively tries to strengthen the pupils' coordination when they are using the iPad – the pupils need to place the iPad over the selected object in the textbook.

All three volumes of the aforementioned textbook contain markers which the teacher prepared beforehand. The main advantage of the HP Reveal application is the possibility to zoom in on the scanned object, allowing the pupil to see the marker in more detail.

It was clear that the pupils were naturally motivated. They looked forward to seeing what the following marker would look like. All the pupils in the classroom were excited, their eyes sparkled. No lengthy explanation was required as the pupils took an iPad, placed it over the object and waited what was going to appear on the display. They started to communicate with one another to the best of their abilities. They expressed excitement by shaking their arms, making secondary noises, smiling and being restless sitting down. Each pupil had their own iPad, allowing them to scan images in the textbook at their own pace (however, only when the teacher said they could use the iPad).

Therefore, pupils cannot accidentally turn the iPad off, put it to sleep mode or start another application. They are working in the single app mode. In this moment, the teacher becomes a supervisor which would only help the pupils if they were having difficulty placing the iPad over the scanned object.

The teacher talks to the pupils about why it is important to go to the doctor, what body part a particular doctor examines, etc. Some pupils are afraid of the so-called white coats. Afterward, the teacher tells the pupils to use the iPad and the HP Reveal application and the pupils start scanning (with no further instruction required). The following images are displayed: a male doctor, a female doctor and a nurse. Then they scan a different image and watch a video on how a doctor works. This time, they are presented with real-life pictures and video as opposed to the animated pictures in the textbook where they complement the overall graphical design. The teacher used a video where Hurvínek a bedtime story character, guided the pupils through the individual doctor specialties and first aid principles, reacting to the pupils' initial fear of doctors and of going to the hospital.

The markers, which the teacher creates for the future auras, are permanent. If the teacher uses a textbook with identical images, the markers work for each pupil. Within the scope of an interdisciplinary context, the teacher also creates markers for Spelling-Book and Reading Charts. When the pupils come across a thematic image, e.g. a doctor, they can scan the resulting auras.

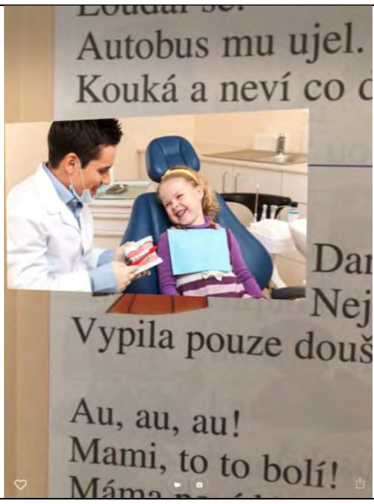


Figure 4: Screen of use of HP Reveal

Figure 5: Screen of use of HP Reveal

5. Conclusion

The **case study** proved that pupil deficiency in knowledge gain can be improved through using the HP Reveal application. The iPad tablets present the curriculum in a different way than the regular, limited, textbooks. Using a mobile touch device, the pupil is presented with a content prepared by their teacher. Even the pupils with fine motor skills disorder can use both the iPad and the HP Reveal application. Moreover, the case study also showed that the aforementioned technology is less demanding in terms of graphomotor skills and eye-hand coordination as the pupils look in one direction and see the result on the display in front of them.

Augmented reality makes it possible to use real-life objects in a school environment (in the existing materials – textbooks), helping pupils with mental retardation improve their imagination and abstraction ability. Future research should be aimed at selecting appropriate augmented reality materials with regard to the pupils' skills.

The **Guided Access feature** has the greatest impact on pupils' self-reliance. This feature can disable the touch functionality of some parts of the screen, thus helping pupils who have trouble concentrating to stay fully focused on a task. The aforementioned iPads have features which other IT devices do not:

- Mobility,
- Compact size,
- Visual keyboard on the desktop,
- Longer battery life,
- Diverse palette of educational applications,
- The ability to adapt to pupils' individual needs,
- Original accessories suitable for special primary school pupils.

References

APPLE: Accessibility. [online]. Cit. dne 29. 11. 2017. Dostupné na <https://www.apple.com/accessibility/>.

Aram, D. & O. CH. Bar-Arm. Mothers helping their preschool children to spell words: A comparison between interactions using the computer vs. pencil and paper. In International Journal of Child-Computer Interaction, Volume 7, 2016, s. 15-21, [on-line]. Cit. dne 30. 11. 2017. Dostupné na <https://doi.org/10.1016/j.ijcci.2016.03.001>.

Azuma, R., Y. Baillot, R. Behringer, S. Feiner, S. Julier, and Blair MacIntyre. "Recent Advances in Augmented Reality." IEEE Computer Graphics and Applications 21, no. 6 (November 2001): 34–47.

Bigelow, E. a C. iWrite: Digital message making practices of young children. Vanderbilt University. 2013, [on-line]. Cit. dne 30. 6. 2019. Dostupné na <http://gradworks.umi. com/35/75/3575558.html>.

Bobnar, A. 5 Ways to get a free iPad for yout special needs child! 2015, [on-line]. Cit. dne 30. 11. 2017. Dostupné na <http://www.wonderbaby.org/articles/ipad-funding-special-needs>.

Beschorner, B. & A. Hutchinson iPads as a literacy teaching tool in early childhood. International Journal of Education in Mathematics, Science and Technology, 1., s. 16–24. 2013.

Doenyas, C., Şimdi, E., Özcan, E. Ç., Çataltepe, Z. & B. Birkan. Autism and tablet computers in Turkey: Teaching picture sequencing skills via a web-based iPad application. In International Journal of Child-Computer Interaction, Volume 2, Issue 1, 2014, s. 60-71, [on-line]. Cit. dne 30. 11. 2017. Dostupné na <https://doi.org/10.1016/j.ijcci.2014.04.002>.

Dubois, Emmanuel, Laurence Nigay, and Jocelyne Troccaz. "Consistency in Augmented Reality Systems." In Engineering for Human-Computer Interaction, edited by Murray Reed Little and Laurence Nigay, 111–22. Lecture Notes in Computer Science 2254. Springer Berlin Heidelberg, 2001. http://link.springer.com/chapter/10.1007/3-540-45348-2_13

Flewitt, R., Kucirkova, N. & D. Messer. Touching the virtual, touching the real: iPads and enabling literacy for students experiencing disability. Australian Journal of Language and Literacy, Vol. 37, No. 2, 2014. [on-line]. Cit. dne 30. 11. 2017. Dostupné na<https://pdfs.semanticscholar.org/6bb6/7ec97fe249d938b8b2b80d5fdab997cdc838.pdf>.

Flewitt, R., Messer, D. & N. Kucirkova. New directions for early literacy in a digital age: the iPad. Journal of Early Childhood Literacy, 2014. [on-line]. Cit. dne 30. 11. 2017. Dostupné na <http://journals.sagepub.com/doi/abs/10.1177/1468798414533560>.

Fombona, J., Pascual-Sevillano, M. -., & González-Videgaray, M. (2017). M-learning and augmented reality: A review of the scientific literature on the WoS repository. Comunicar, 25(52), 63-71. doi:10.3916/C52-2017-06

Garzón, J., Pavón, J., & Baldiris, S. (2017). Augmented reality applications for education: Five directions for future research doi:10.1007/978-3-319-60922-5_31 Retrieved from www.scopus.com

Gellow, E. C. iWrite: Digital message making practices of young children. Vanderbilt University. 2013, [on-line]. Cit. dne 30. 5. 2018. Dostupné na <http://gradworks.umi. com/35/75/3575558.html>.

Gybas, V.: Asistovaný přístup. 2016, [on-line]. Cit. dne 30. 11. 2017. Dostupné na <https://www.ipadvevyuce.cz/?p=2550>

Hendl, J.: Kvalitativní výzkum: základní teorie, metody a aplikace. 2. vyd. Praha: Portál, 2005. 408 s.

Kellems, R.O., Rickard, T. H. & A. D. Okray. iPad Video Prompting to Teach Young Adults With Disabilities Independent Living Skills: A Maintenance Study, 2017, [on-line]. Cit. dne 30. 5. 2018. Dostupné na <http://journals.sagepub.com/doi/abs/10.1177/2165143417719078>.

Kemp, C., Stephenson, J. & M. Cooper. Engaging Preschool Children With Severe and Multiple Disabilities Using Books and iPad Apps, s. 249-266. 2016, [on-line]. Cit. dne 30. 11. 2017. Dostupné na <https://eric.ed.gov/?id=EJ1113520>.

Klubal, Libor, Kostolányová, Katerina. Forms of the Materials Shared Between a Teacher and a Pupil. In: Sánchez, Inmaculada Arnedillo a Pedro Isaías. Proceedings of the 12th International Conference on Mobile Learning 2016. Vilamoura, Algerve, Portugal: Iadis, 2016, s. 4. ISBN 978-989-8533-49-4.

Koszalka, T. A. & G. S. Ntloedibe-Kuswani. Literature on the safe and disruptive learning potential of mobile technologies. Distance Education, 31(2), s. 139-157. 2010.

Kuar, D. Preservice Teachers' Perceptions of Using iPads with Students with Learning Disabilities. The Qualitative Report, 22(9), s. 2428-2436. [on-line]. Cit. dne 30. 11. 2017. Dostupné na <http://nsuworks.nova.edu/tqr/vol22/iss9/10>.

Mishra, P. & M. J. Koehler. What Is Technological Pedagogical Content Knowledge? Contemporary Issues in Technology and Teacher Education. Michigan State University, 9(01), 2009. [on-line]. Cit. dne 30. 11. 2017. Dostupné na <http://www.citejournal.org/volume-9/issue-1-09/general/what-is-technological-pedagogicalcontent-knowledge/>.

Moline, J. (1997). Virtual reality for health care: A survey. Studies in Health Technology and Informatics, 44, 3-34. doi:10.3233/978-1-60750-888-5-3

Müller, O., Valenta, M.: Psychopedie teoretické základy a metodika. 5. rozšířené vydání. Praha: Parta, 2013. 496 s.

Neumann, M. M., Hood, M. & R. Ford. Using environmental print to enhance emergent literacy and print motivation. Reading and Writing: An Interdisciplinary Journal, 26, s. 771–793. 2013, [on-line]. Cit. dne 30. 5. 2018. Dostupné na <http://dx.doi.org/10.1007/s11145-012-9390-7>.

Neumann, M. Using tablets and apps to enhance emergent literacy skills in young children. Michelle School of Education and Professional Studies, Griffith Institute for Educational Research, Griffith University, Australia, 2018. [on-line]. Cit. dne 30. 5. 2018. Dostupné na <https://www.sciencedirect.com/science/article/pii/S0885200616301405>.

Parette, H., P. Quesenberry, A. C. & C. Blum. Missing the boat with technology musage in early child hood settings: A 21st century view of developmentally appropriate practice. Early Childhood Education Journal 37, s. 335–343. 2010.

Puentedura, R. (2014). SAMR and Bloom's Taxonomy: Assembly the Puzzle. Dostupné z: https://www.graphite.org/blog/samr-and-blooms-taxonomy-assembling-the-puzzle

Rolland, J. P., Wright, D. L., & Kancherla, A. R. (1997). Towards a novel augmented-reality tool to visualize dynamic 3-D anatomy. Paper presented at the Studies in Health Technology and Informatics, , 39 337-348. doi:10.3233/978-1-60750-883-0-337 Retrieved from www.scopus.com

Vygostky, L. S. Mind in society: the development of higher psychological processes. Cambridge, MA: Harvard University Presss, 1978.

Wainvright, A. iPads in the classroom are beneficial for kids with disabilities, 2013, [on-line]. Cit. dne 30.11.2017. Dostupné na <https://www.securedgenetworks.com/blog/iPads-in-the-classroom-are-beneficial-for-kids-with-disabilities>.

Wu, H. -. Lee, S. W. -. Chang, H. -., & Liang, J. -. (2013). Current status, opportunities and challenges of augmented reality in education. Computers and Education, 62, 41-49. doi:10.1016/j.compedu.2012.10.024

Yuen, S. a Yuen, Yin a Yaoyuneyong, Gallayanee a Johnson, E. (2011). Augmented Reality: An Overview and Five Directions for AR in Education. Journal of Educational Technology Development and Exchange. 119. 119-140. 10.18785/jetde.0401.10.

The use of Visualisations and Video Productions in Online Game-Based Learning

Heidi Hautopp and Stine Ejsing-Duun
IT, learning and design Lab, Aalborg University, Copenhagen, Denmark
hhau@hum.aau.dk
sed@hum.aau.dk
DOI: 10.34190/EEL.19.094

Abstract: The paper investigates how the use of visualisations and video productions combined with peer-feedback sessions can create exploratory approaches to game design in online teaching. Thus, the paper aims to provide insights into the iterative learning processes of developing games in online game based learning. The empirical data is based on an explorative case study where master students from the international Nordic Visual Studies and Art Education (NoVA) design games as a part of an online game-based learning course. Throughout the course the students were situated at three different universities in Finland, Sweden and Denmark, collaborating cross-cultural across campuses. The purpose of the study was to explore how to establish an online space for joint design inquiry in the context of games for changes across cultural and professional barriers. The data used for analysis is teaching observations, videos of play sessions, students' reflection papers, written and oral evaluation with participants after completion of the course. The analysis is based on different PBL activities; lectures, video tutorials, presentation- and feedback sessions, reflexive exercises and students' self-directed design processes and learning in groups. Game theory and exercises were presented through videos and visuals to support the students' iterative processes of developing games. Analysis of the PBL activities show how teachers' video tutorials relating theoretical game concepts to the students' group work supported their entrance in the game field as well as their design processes. How to balance feedback-related video tutorials and teachers' time for preparation is identified as a relevant issue for further exploration in online game-based teaching. Findings show how the students' visualisations and video productions exemplifying game situations, created a visible reference point for further discussions in the feedback sessions across campuses, which guided the game development. Thus, the combination of inquiry approaches, critical game theory and design processes combined with students' visualisations and video productions indicates interesting connections for bridging gaps between professions, e.g. in art and games.

Keywords: online game-based learning, educational design, students as game designers, visualisations, video productions, higher education

1. Introduction

This paper revolves around an exploratory case study on the use of visualisations and video productions in online game-based learning at Universities, specifically in the master program Nordic Visual studies and Art Education. Our purpose of the study was to explore how to establish an online space for joint design inquiry in the context of games for change across cultural and professional barriers. In a prior research and development project, we have explored the students' design- and learning experiences when taking a pragmatic inquiry approach (Dewey, 1938) in the process of developing communication designs (Ejsing-Duun & Skovbjerg, 2018). During these iterative processes, the students took the role of designers working with different sketching techniques and prototypes (see e.g. Schön, 1983; Twersky & Suwa, 2009). In this way, an essential part of teaching was for students to materialize their ideas and understandings of solutions as well as getting feedback from peers and teachers, when presenting their materialized ideas (Ejsing-Duun & Skovbjerg, 2018).

In the exploratory case study for this paper, the students were also asked to take a pragmatic inquiry approach in the process of developing games and materializing their ideas through iterative design processes. The students had an end goal of developing *games for change*, which invites players to relate to an issue, give them opportunities, awareness and interesting choices about the specific issue. Unlike our prior research project (Ejsing-Duun & Skovbjerg, 2018), the teaching setting for this case study was online, which demanded new ways of creating shared spaces for lectures, peer-to-peer presentations and feedback sessions.

In his book "Teaching in a digital age" (2017), Tony Bates emphasizes the new digital opportunities which he refers to as "rich medias", media which: *"differ in terms of their formats, symbols systems, and cultural values."* (Bates, 2017, p.260). Bates (2017) points out that online teaching can incorporate a range of different media: text, graphics, audio, video, animation and simulations and the use of different media also allows for more individualization and personalization of the learning, better suiting learners with different learning styles and needs. Other studies show how teachers' productions of videos and video tutorials in online settings affect students' engagement and enable a flexible teaching suiting learners with different needs (e.g. Wells, Barry and Spence, 2012; Guo, Kim and Rubin, 2014). Furthermore, video produced in an informal setting and with the teacher's talking head as a part of the video are more engaging than slides alone or high fidelity studio recordings (Guo, Kim and Rubin, 2014, p.2). This exploratory case study will explore both the teachers' and students' use of visualisations and video productions in an online game-based teaching setting and their value in these iterative design processes.

2. Method and case description

The empirical data is based on a 12 week online game-based learning course as a part of Nordic Visual Studies and Art Education (hereafter NoVA). NoVA is a two-year master programme, which educates students in contemporary art and visual culture in order to achieve understanding of Nordic practices and traditions in art education and visual communication. The aim is to provide students with relevant competencies and didactical interaction skills for working in cross-cultural and international educational environments (NoVA Handbook, 2019). Teaching is provided by three Nordic universities; Aalto University in Helsinki, Konstfack in Stockholm, and Aalborg University in Copenhagen and each student will during the master programme be enrolled in the educational programme at two of the universities. The authors of this paper are based as teachers at Aalborg University, Copenhagen.

Due to the geographical distance, the NoVA master programme is based on a combination of e-learning, face-to-face meetings and one cross-campus symposium every semester. Thus, the idea of blended learning is the foundation of NoVA (NoVA handbook, 2019). Furthermore, the NoVA master programme rely on Problem-based learning (PBL) approaches which has a purpose for students to develop the "criticality", that is, emotional, intellectual and practical independence (Savin-Baden, 2003). Moreover, in PBL learning the teachers function as facilitator who organise a learning environment, which involves different activities; e.g. tutorials, students' self-directed learning, presentation and feedback sessions (Newman, 2005; Bateson, 2017). As a part of the NoVA master programme, the use of multimodal approaches; text, images, audio and videos are central elements in the teaching (NoVA handbook, 2019).

This was the context for developing our online game-based learning course (hereafter game course) as a part of the NoVA master programme in autumn 2018. The main focus of the game course was for the students to use games and game elements in order to make changes. Prior to the online course in 2018, the course was held in 2016. As we ask students to take a role as designers when developing games, we also consider our role as educators to be designers of teaching (Sørensen & Levinsen, 2018; Ejsing-Duun & Skovbjerg, 2018). Therefore, the course from 2016 and 2018 can be viewed as two iterations where the teaching has been re-designed based on experiences and where results from this exploratory study will function as inspiration for a new re-design of the course. 15 students attended the game course in 2018 and the data used for analysis is teaching observations, videos of play sessions, students' reflection papers, written and oral evaluation with participants after completion of the course in 2018. Due to the limited data foundation, the purpose of this paper is not to make generalizations about the use of visualisations and video productions in online game-based teaching. Instead, the purpose is to investigate strategies for using visualisations and video productions by both students and teachers in order to establish a joint online design inquiry. Thus, we explore learning potentials and barriers in these online teaching settings.

3. Theoretical perspectives

In this section we will concretise the game content of the game course in relation to online learning at PBL universities as a theoretical foundation for our approach in teaching. Furthermore, we will elaborate our didactical considerations about students as game designers materializing their inquiry processes through visualisations and video productions.

3.1 Critical game design

The purpose of the game course was for the students to investigate the game phenomenon in relation to their background in art and how game elements can spur change by engaging players into certain issues. As mentioned, PBL teaching has the purpose for students to develop 'criticality' (Savin-Baden, 2003) which was also a purpose in the game course with a focus on critical play design (Flanagan, 2013) as one of the starting themes. As Flanagan emphasizes: "*Critical play means to create or occupy play environments and activities that represent one or more questions about aspects of human life.*" (Flanagan, 2013, p.6). Thus, students were encourage to consider game scenarios that could foster questioning and dialogues about issues, which are normally taken for granted (Flanagan, 2013). In line with PBL teaching where content must be ill-structured, open and real-world orientated (Savery, 2006) we framed the course openly asking: "*Games for change!? Let's explore the possibilities of using games and play for change!".* In addition to critical play, the game course also had a focus on *endogenous meaning* of games, where interactive structures in games requires players to struggle towards a goal (Costikyan, 2002). Thus, students were asked to reflect upon the endogenous meaning of their games in relation to the game structures. What builds up a game structures are e.g. rules, goals, challenges, struggles, possibilities of interactions and collaborations between players (Costikyan, 2002). Theory about location based games (Ejsing-Duun, 2011) and how to engage players by making invitation to games (Jensen & Lenskjold, 2004) where also themes presented at the course in order for students to theoretically reflect upon their inquiry processes of developing games.

Prior to a further introduction to the joint online design inquiry, we will elaborate our educational design considerations about students as game designers using visualisations and video productions as a part of the iterative game design processes.

3.2 Educational design - visualisations and video productions as inquiry approaches

The NoVA students typically have a background in art, design and communication, before the join the master programme. Thus, many of the students are familiar with visualisations as a part of their work practices. On the other hand the group of students are not especially familiar with theoretical and methodological frameworks for games. Educational studies show that applying visualisation tools and techniques support design students with an entrance to theoretical fields, because it constitutes a familiar way for the students to explore and make sense of a situation (See e.g. Bang & Gelting, 2015). Additionally visualisations has been discussed as a supporting tool in communicating design ideas and collaborating with others (Twersky & Suwa, 2009). We advocate for drawings, pictures and other symbolic tools are not second-order representations to language, but rather important elements of the human repertoire for meaning-making and for the building up of a social memory relevant for specific practices (Ivarsson, Linderoth & Säljö, 2009). Pink (2007) elaborate how researchers can use photographs as important ways to document experiences and how photos becomes concrete reference points in dialogues about the experiences afterwards. Thus, we consider the use of visualisations and photos as familiar symbolic tools for students to use when entering the game field as well as investigating and presenting their design ideas.

As mentioned in the introduction, our point of departure for the game course, is for the students to take a pragmatic approach (Ejsing-Duun & Skovbjerg, 2018) when developing games. This approach is based on John Dewey's (1938) concept of *inquiry*. Dewey proposes that 'doing' are central to understanding how we think and learn by reflecting on our practices (Dewey, 1938). Donald Schön (1983) brings Dewey's thinking into professional practice by creating language that makes it possible for designers to make their knowledge of their own practice visible. By using visualisations, students can externalize tentative and imprecise ideas in *sketches* (Twerky & Suwa, 2009) going into a *conversation with materials* and with peers (Schön, 1983) which can lead to refinements of their designs.

As facilitators of the teaching (Newman, 2005) we are obligated to create a learning environment for inquiry processes and dialogues. Other educational research has focused on organising learning environments which place the *students as learning designers* where the teaching scaffold students' subject-related inquiry, agency, reflection and learning (Sørensen & Levinsen, 2018). In the game course the students was encouraged to take the role as learning designers when designing games with a specific purpose and target group. In order to scaffold the students' subject related inquiry (Sørensen & Levinsen, 2018) we organised exercises where students firstly took the role as gamers, experiencing different digital games and location based games. Secondly, the students was encouraged to take the role as game designers using their own personal game experiences in the collaborative process of developing the game. This approach was inspired by autoethnography where personal experiences are used to understand different cultural phenomenons (Ellis, Adams & Borchner, 2011), in this case games.

When the teaching is online based, we will further explore how students' video productions can expand the time frame of the students design ideas in addition to their more static visualisations and photos. Specifically, in the students' final iteration of their game design exemplifying the game experiences and narrative of the game, still getting feedback on their design idea. Based on prior studies, we advocate for video sketching techniques (Ørngreen, Henningsen, Gundersen and Hautopp, 2017) where the tentative and unfinished 'sketchy' feeling of the materials (Twersky & Suwa, 2009) are still in focus. Thus, the learning *process* of making video productions are central to developing the game design with a less focus on making aesthetic video productions (Ørngreen et al, 2017). As we focus on students using different media in their inquiry processes, there is also an increasing focus on teachers using visuals and videos when designing online teaching (McKeachie & Svinicki, 2006; Bates, 2017). In order to 'walk the talk', we also engaged in a iterative process exploring the use of visualisations and video productions as a central part of the online teaching with an iterative focus on process over product (Guo, Kim and Rubin, 2014; Ørngreen et al, 2017).

Throughout the analysis, we will present and discuss how visualisations and video productions were applied by both teachers and students in order to create a joint online space for game design inquiry.

4. Analysis of game course

The analysis can be seen as a retrospect on the joint inquiry processes, which unfolded during the game course. Based on the initial introduction of the game course, the students were presented for the main task of developing a *game for change* that they should design through iterative activities during the 12 week course. The expected learning outcome was for the students to be able to develop a game informed by game theory and refined through game test and peer-feedback. After the initial phase, the students grouped in 2-4 persons based on common interests and started developing their game.

As facilitators of the online learning environment (Newman, 2005) we structured the teaching in different activities;

- Online meetings: lectures, video tutorials, presentation- and feedback sessions
- Reflexive exercises
- Students' self-directed design processes and learning in groups

The analysis below is organized in relation to the different PBL activities in the course. Under each activity, we will elaborate and discuss examples of students' and teachers' strategies when using visualisations and video productions during the course.

4.1 Online meetings: Lectures, video tutorials, presentation- and feedback sessions

The course was organised with one joint online meeting pr. week, each revolving around a specific theme such as; *1) Critical Play - Games and activism, 2) Understanding games, 3) Framing, Games in place and space, 4) Making an invitation - participation.* As we started the online course, we planned the online meetings to last for 2 hours starting with 20-30 minutes lectures of relevant concepts from the specific theme followed by feedback sessions between the students. In pace with the development of the students' games, we wanted to make space for more joint inquiry and dialogue in the feedback sessions. Thus, we redesigned the online meetings with feedback sessions in smaller groups and placing the lectures in video tutorials for students to see in between the online meetings. According to McKeachie and Svinicki (2006, p.58) lecturing is best used for summarizing and adapting material to the interests of a particular group, initially helping students discover key concepts, principles and ideas within a specific topic. In our case, we used the video tutorials to relate the themes and theoretical game concepts of the week to the students' own work with designing games. We prioritized concrete examples for the students to act upon (Dewey, 1938). Thus, the videos were developed in between the weekly meetings adapting to the latest online dialogues and feedback sessions. We used simply video recording tools, e.g. screen recordings (Camtasia and Screencast-o-matic) with a teacher's talking head (Guo, Kim and Rubin, 2014) or powerpoint recordings in one-take, in order to remain the tentative and imprecise 'sketchy' feeling in the videos (Ørngreen et al., 2017). The advantage of this approach to video tutorials was that the students generally had the experiences of the videos as relevant and meaningful in relation to their work in the course. In their written evaluations, all students have expressed appreciation of the video tutorials. A student comments: *"The videos were so helpful! It was great to be able to go into the reading knowing a bit about what the context was, rather than grappling to understand it. I appreciated the main points and concepts as well, as I was able to get more from the readings with the videos."* In this way, the students used the video tutorials in relation to their readings and design processes in their groups. Another student comments: "*I really appreciate that there were videos in advance to see and prepare for upcoming online lesson. It helped much to concentrate* *on specific topic* (…) *and your feedback about our game design processes was also very helpful. I think these preparation videos with examples (!!) are great."* The disadvantage of this approach to making videos is that it can be time consuming to produce while the video tutorials cannot be reused for next semester, when mentioning specific student projects in the videos, which will be different the next year. In the oral evaluation after the course, some students proposed that the videos should be 5-10 minutes instead of 20 minutes, which also could have the effect of being less time consuming for the teachers to produce.

As a central part of the online meetings, students were asked to give a 5-7 minutes presentations of their game design which they have worked with in relation to the specific game theme of the week. Another group acted as opponent to the presentation giving feedback on the game design. A student comments on the role as opponent: *"I value peer review. It's good to learn how to communicate both compliments and critical points."* Several students mentioned the benefits of feedback for their design processes: "*Giving presentation was essential! That way one had to formulate thoughts into a brief space of slides and then somehow share what one was passionate about."* The student further elaborates*: "Of course this was also not the first online course so that made a big difference for me having learned and understood the platform and technologies."* Other students also appreciated the feedback sessions as very relevant for the design processes, but mentioned online experiences as a factor in the process: *"Giving online presentations and being opponents all in all is good for the design processes and in this course it worked perfect. Personally, it was a bit hard due to lack of experience in this kind of online learning environment."* These findings point to learning potentials for the students in the feedback sessions both in the role of presenter and opponent, and at the same time it is central to get experiences of these activities in order for students to feel comfortable in the online learning environments.

4.2 Reflexive exercises

In order to encourage students to activate relevant prior knowledge about games and art (Newmann, 2005) as well as engaging in new game experiences, we structured reflexive exercises in between the online meetings for the students to act as gamers as well as game designers (Levinsen & Sørensen, 2018). The reflexive exercises were especially target the different themes of the online meetings and requested the students to take an autoethnographic approach with focus on the personal experience of playing the game (Ellis, Bochner & Adams, 2011). Example of activities are; 1) Present game experiences and post questions for debate in an online forum; 2) Make a video screen recording playing a self-chosen game in relation to the theme and theoretical concepts 3) Make a dot.walk in relation to the theme *games in place and space* as an example of a location-based games. The dot.walk (Medienkunstnetz, n.d) is a walk where the purpose was to be guided in the city by some simple instructions (turn left 1st street, turn right second street; turn left third street). The walk was framed to take 10 minutes and the students was guided to document their walk by taking five photo, reflect upon their experiences and subsequently adjust the instructions for the game in order to redesign it. Furthermore, the students were ask to make a two page reflection paper for each online meeting reflecting both the exercise, the game theory and the group work on developing games. The individual exercises was a supplement to the students' group work and the purpose was for the students to embed the game concepts in relation to different activities and through these exercises strengthen their entrance in the game field.

4.3 Students self-directed design processes and learning in groups

In retrospect, the individual exercises also functioned as shared inquiry spaces for the students to combine their interests in art and photographs with the purpose of designing games. Thus, the exercises lay a foundation for the students' self-directed learning in groups. For example, after a walk in the subway in Stockholm, a group of students got inspired to make their *game for change* with a focus on womens' period. From the subway they had taken photographs of graphic artist, Liv Strömquist's enlarged sketches of women having their period, some of them entitled: "*I'm alright (I'm only bleeding)".* This exhibition has created debate (Hunt, 2017) and in their presentation, the students used their pictures to make a critical stand in line with the artist about taboos revolving women's periods. The students used this inspirational walk to foster ideas on to how to questioning normative assumptions of women's period through a critical game design (Flanagan, 2013). During their game development the students made their own visualisations inspired by the originals (see figure 1) which they incorporated as a part of their game design.

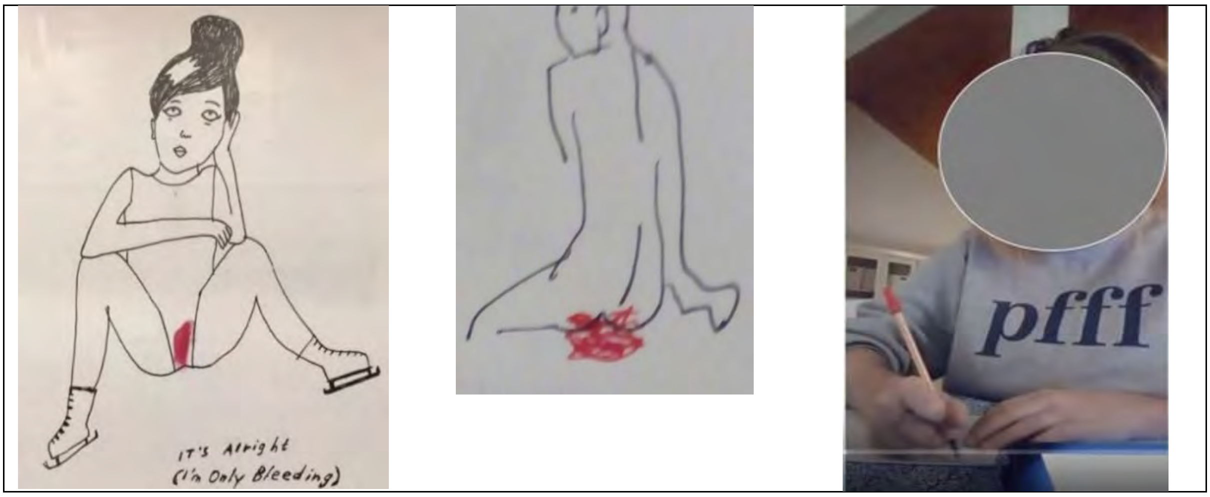


Figure 1: Sketch by Liv Strömquist, a student visualisation and a play session from video productions

In their final presentation, the "Period game" group produced a video showing a player engaging in their game which had been designed as an app that provides scenarios exemplifying issues related to menstruations. The app was made as a paper prototype and one student acted as the player in the video, talking about her choices (see fig. 1), when she was met with challenging question in the app (Costikyan, 2002). The player took the role as a fictive character, a British Female, 16 years old from a low socio-economic background. Related to facts about how British teenagers cannot afford menstrual products due to high costs, the character is placed within dilemmas such as: "*Your period had started this Tuesday morning. But your parents did have enough money this month for period pads and are too tight in their budget to give you some for the upcoming days. School started in one hour. What do you do?".* Throughout the game, the player had to make decisions in relation to economic, health and personal issues about menstruations. The video productions made the struggle in the game visible (Costikyan, 2002) which was used as a reference point for the students to discuss different perspectives on women's period in the feedback session (Flanagan, 2013; and teaching observations).

Other students started their project when they got inspired from seeing different ways of doing the reflexive exercises, e.g. on making a video screen recording of a self-chosen game. Here one student has chosen to record herself playing a digital game about cultural differences, where she reflected upon how games can raise players' attention in relation to their own stereotyping of other groups. Together with three other students, she formed a group where they started an inquiry process about how a game can foster inviting dialogues and interactions around cultural issues (Flanagan, 2013; Costikyan, 2002). In the beginning of their design process, the students were keen on making an app as their final game design, but after their second round of peer-feedback they changed their idea. The students redesigned their initial idea to a board game also embracing social aspects of the game to a greater extent. In their final video presentation of their game "Cultural awareness", the students showed the game play by exemplifying different game situations. The students showed the play situations by starting with a zoom on the specific game card, which invited participants into a dialogue about cultural items and dilemmas (Flanagan, 2013).

Figure 2: Play situations starting with a zoom on specific game cards

Green game cards represented different cultural symbols which meaning players ought to write down and afterwards explain their motive for their guess in plenum. Afterwards, the players negotiate the individual score of one to three points in relation to their answers. In case of disagreement, the presenter of the question has the final word. In a new game situation, one player draw a blue card from the pile of cards and reads aloud: "*Western poet create his pen name using Chinese character" Cultural appropriation or inspiration*"? The players now have to decide for themselves how they will characterize the action of the poet and choose between *cultural appropriation or inspiration* while selecting a yellow card representing their choice. Afterwards, players reveal their choice by turning the yellow card, which leads to a conversation about the background for their choices. In their final video productions, the game narrative and endogenous meaning (Costikyan, 2002) of the cultural dilemmas as context dependent and negotiable became visible in the students' game structure focusing on dialogues and joint negotiation about scores.

5. Discussion

The analysis has showed how teachers and students used visualisations and video productions as a part of an online shared inquiry space, some students with more game- and online experiences than others. Some students expressed both before and after the game course that they are not particularly passionate about games. Despite the lack of interest in games, they found some personal focus in the course, e.g. a politically interest in the game culture or an interest in the exploratory approaches and theory presented at the course: "*The texts where many and very interesting and I was amazed by the text on autoethnography. There I saw that the theory was not only about games but about the research approach of ethnographers exploring a certain field and culture within academia approach*". The fact that we combined the academic inquiry approaches with visualisations and video productions as methods familiar to the students (Bang & Gelting, 2015) can be an explanation of the appreciation of the course despite the lack of interest in games. As another student expressed, her understanding of games was wider after the course which she related to her profession as an art teacher: "*In artistic creativity - when designing workshops or learning class, now I could include different approaches* (…) *Also when thinking about community based art projects, I will definitely remember about games as part of activism"*. This quote exemplifies, how *games for changes* are not just about the specific games, but also about the approaches embedded in the game design, when inviting participants to play and take active part in critical issues. The combination of inquiry approaches, critical game theory and design processes combined with students' visualisations and video productions indicates interesting connections for bridging gaps between professions, e.g. in art and games. These combinations should be further explored in later research studies.

6. Conclusion

This paper is an empirical example on the establishment of an online space for joint design inquiry in the context of games for change across cultural and professional barriers. The study focused on incorporating teachers' and students' visualisations and video productions as central part of creating a shared online space across the three campuses. Analysis of PBL activities showed how teachers' video tutorials relating theoretical game concepts to the students' group work supported their entrance in the game field as well as their design processes. How to balance feedback-related video tutorials and teachers' time for preparation is identified as a relevant issue for further exploration in online game-based teaching. Students' different strategies of using visualisations and video productions in reflexive exercises and design processes made the game experiences and narrative visible for students across campus, which enabled further discussions in the feedback sessions and supported the joint inquiry processes.

References

Bang, A. L., and Gelting, A. G. (2015) "Designerly Ways to Theoretical Insight: Visualisation as a means to explore, discuss and understand design theory", *Design and Technology Education: An International Journal 20.1.*

Bates, T. (2017) *Teaching in the digital age: Guidelines for designing teaching and learning.* Retrieved 12th of July 2019 from*: https://opentextbc.ca/teachinginadigitalage/*

Costikyan, G. (2002) "I have no words & I must design: toward a critical vocabulary for games." *In Proceedings of the computer games and digital cultures conference, Finland.*

Ellis, C., Adams, T. E., and Bochner, A. P. (2011) "Autoethnography: An Overview. *Forum: Qualitative Social Research*, *12*(1), pp 273-290

Dewey, J. (1938) *Logic: The Theory of Inquiry.* New York: Holt, Rinehardt and Winston

Ejsing-Duun, S. (2011). *Location-based games: from screen to street*. PhD dissertation

Ejsing-Duun, S., & Skovbjerg, H. M. (2018) Design as a Mode of Inquiry in Design Pedagogy and Design Thinking. *International Journal of Art and Design Education*. https://doi.org/10.1111/jade.12214

Guo, P. J., Kim, J. and Rubin, J. (2014) How Video Production Affects Student Engagement: An Empirical Study of MOOC Videos*. In Proceedings of the SIGCHI Conference* (10 pages)

Hunt, E. (2017). “Enjoy menstruation, even on the subway: Stockholm art sparks row”. *The Guardian, international addition.* Retrieved 12th of July 2019 from: https://www.theguardian.com/cities/2017/nov/02/enjoy-menstruation-subway-stockholm-art-row-liv-stromquist

Ivarsson, J., Linderoth, J. and Säljö, R. (2009) “Representations in practices. A sociocultural approach to multimodality in reasoning.” Routledge, pp 201-212

Jensen, R. and Lenskjold, T. (2004) "Designing for social friction: Exploring ubiquitous computing as means of cultural interventions in urban space." Web Proceedings of CADE’04 (2004)

McKeachie,W. and Svinicki, M. (2006) *McKeachie’s Teaching Tips: Strategies, Research and Theory for College and University Teachers* Boston/New York: Houghton Mifflin

Medienkunstnetz (n.d) .WALK. Retrieved 12th of July 2019 from: http://www.medienkunstnetz.de/works/dot-walk/

Newmann, M. (2005) “Problem Based Learning: An introduction and overview of the key features of the approach”, Journal of Veterinary Medical Education (February) pp 12-20

NoVA Handbook (2019) NoVA Master Program Guidelines. Online access with login – Retrieved 12th of July: http://nova-master.com/login/?redirect_to=http%3A%2F%2Fnova-master.com%2Ffor_students%2Fhandbook%2F

Pink, S. (2007) *Doing Visual Ethnography.* (2. ed.) SAGE Publications

Savery, J. R. (2006) Overview of Problem-based learning: Definitions and distinctions.*Interdisciplinary Journal of Problem-based Learning*, 1(1), 9–20.

Savin-Baden, M. (2003) *Facilitating problem-based learning - Illuminating perspectives*. Philadelphia, PA: McGraw - Hill Education.

Schön, D. A. (1983) *The reflective practitioner: How professionals think in action*. London, UK: Temple

Sørensen, B. H. & Levinsen (2018) “Teachers’ Learning Design Practice for Students as Learning Designers”. Proceedings of the 6th International Conference on Designs for Learning 23-25 maj 2018, Bergen Norway

Twersky, B., & Suwa, M. (2009). Thinking with sketches. In: Markmann, A., & Wood, K. (eds.), *Tools for innovation*. Oxford: Oxford Scholarship Online.

Wells, J., Barry, R. M. and Spence, A. (2012) Using video tutorials as a carrot-and-stick approach to learning, IEEE transactions on education, vol. 55, no. 4, p. 453-458.

Ørngreen, R., Henningsen, B., Gundersen, P. B., and Hautopp, H. (2017) The Learning Potential of Video Sketching. I D. A. Mesquita , & D. P. Peres (red.), *Proceedings of the 16th European Conference on e-learning ECEL 2017: ISCAP Porto, Portugal, 26-27 October 2017* (p. 422-430). Reading, UK: Academic Conferences and Publishing International. Academic Bookshop Proceedings Series

Methodology for Developing Algorithmic Thinking in Pre-school Education

Tatiana Havlásková, Zuzana Homanová, Kateřina Kostolányová and Zdeněk Barteček
Department of Information and Communication Technologies, Ostrava, Czech Republic
tatiana.havlaskova@osu.cz
zuzana.homanova@osu.cz
katerina.kostolanyova@osu.cz
zbartecek@gmail.com
DOI: 10.34190/EEL.19.027

Abstract: Pre-school age is the most crucial and sensitive period in a child's life, a period of their psychological development. It is at this age that a child's personality develops. And people who, both consciously and unconsciously, participate in their educational process play an important role in a child's formative years. Children at this age learn a lot on their own – by imitating, playing, exploring and simply by being curious. However, a tutor (a parent or a teacher) is still the one who should support and motivate children, helping them develop competencies they will need in school. Pre-school children learn a lot of new information, trying to develop key competencies such as learning, communication, civics, and problem-solving skills. Pre-school children see and understand the world differently than adults, they perceive facts in a specific way. That is why the teacher can help children develop the aforementioned competencies in a natural way. As far as developing the problem-solving competency is concerned, there are additional possibilities to do so. People face problems, which need to be solved quickly and effectively, every day (at work, in personal life). That is why the step-by-step approach to problem solving should be implemented into pre-school education. Therefore, it is extremely important to map children's thought process when solving a problem (finding new and non-standard solutions) and expand these findings using appropriate methods. Dividing a problem into smaller parts; proceeding step by step, trying to find the most effective solution – all that helps develop algorithmic thinking. The development of abstract and logical thinking, spatial orientation and pre-mathematic concepts is equally important. Digital technology – from interactive whiteboards to tablets to robotic toys – can be a useful didactic aid. The toy is in general meaning an object that supports basic childhood needs or activity – game. Robotic toy - Bee Bot - is a very simple robot that needs to be programmed. The program is created by pressing the basic buttons on the back of the toy and storing it in the robot's memory. The next command starts. The robot then executes a sequence of commands. Creating a program (for example, by tapping the free buttons with the intention of knowing what a toy can do) is different from creating an algorithm. Creating an algorithm is a sequence of commands that lead to a goal to solve a particular problem. To support the development of child's algorithmic skills, it is necessary to familiarize children with the types of tasks: problem situations that can be solved, for example, by creating a Bee-bot robot program. Problem-solving skills, logical thinking, creativity and originality are the most appreciated skills today. Therefore, starting to develop these skills as early as kindergarten is a logical conclusion.

Keywords: digital competencies, algorithmic thinking, activities, pre-school education, digital technology

1. Pre-school age

Kindergarten is where a child meets other children of their age for the first time and where they encounter situations that require socialization and adaption. Kindergarten is where children acquire basic skills, learn key competencies and are educated. Pre-primary education is targeted action aimed at helping pre-school children develop their student skills and competencies. Moreover, pre-primary education is part of the education process, which should help children succeed not only in their future educational endeavors but also in life (Opravilová, 2016).

Pre-school children's development is extremely versatile. Their motor skills (coordination, agility, balance) are improving all the time. And so do their drawing and talking skills (which help them better understand themselves). Around age 4, children's cognitive development moves from the preconceptual stage to the intuitive stage, i.e. they begin to think using holistic concepts (Langmeier, Krejčířová, 2006).

1.1 Abstract thinking

Most sources define abstract thinking as theoretical thinking used to solve theoretical tasks based on terms and symbols, i.e. something that cannot be imagined (e.g. equations, etc.). A child's thinking about the problem, creating an algorithm in their mind and generalizing the solution is abstraction which is essential for solving problems.

1.2 Pre-mathematical thinking

Mathematical thinking (numerical mathematics) is basically the ability to work with numbers and basic numerical operations. Numerical tasks do not always have to be based on finding or deriving a complex principle. The main task is to find a solution. Numerical mathematics uses different kinds of ciphers, symbols instead of numbers, word problems, series of numbers, etc. (Fořtíková, 2014). Pre-school children are already familiar with numbers. However, they have yet to understand their meaning. Even older children have difficulty understanding relations between numbers and their relative numerical significance (sometimes five can be more and other times less). Children need to understand that the result does not depend on what we count, i.e. that the result is always the same (it does not matter whether it is apples, pears, etc.) – they need to understand numeric equality (Vágnerová, 2012).

1.3 Logical thinking

Logical thinking of pre-school children is specific. Logic can be defined as a set of principles related to thinking and knowledge acquisition. Basically, it is based on finding the path which leads to the correct answer (i.e. to solving a problem). The following tasks are used to aid the development of logical thinking: which of the following does not belong to the group, logical pairs, relations between symbols, riddles, quizzes and codes (Fořtíková, 2014).

1.4 Problem-Solving

The problem-solving competence is vital to computational thinking. A mark of intelligence, it is a natural human trait. Everyone solves problems all the time; they need to solve problems and solve them correctly. When searching for a solution, we often use our experience and all our skills (i.e. we make full use of all the aforementioned areas). As far as pre-school education is concerned, problem solving needs to be divided into two parts (Vágnerová, 2012):

- Defining a problem and its interpretation – in order to be able to solve a problem, one needs to understand its essence. A pre-school child often pays attention to unimportant details which prevents them from understanding the situation and solving the problem. The so-called scripts (i.e. knowing how particular situations are related) can be extremely helpful. Children know what to do in a particular situation and use this knowledge to solve the problem.
- Finding correct solutions and their realization – when it comes to pre-school children, creating a systematic plan is difficult. Their plans are often situational and difficult to realize. These unrealistic solutions result from children's optimistic self-assessment, i.e. they think that they can do more than they are capable of. Planning is basically applying one's knowledge, e.g. a script.

1.5 Algorithmic thinking

Strategy for Education Policy of the Czech Republic Until 2020 defines algorithmic thinking as a way of thinking using computational strategies to solve problems, including complex and vague problems. It helps children develop their ability to analyze, synthetize, generalize and search for appropriate problem-solving strategies and verify them.

In their paper (2018), Prextová, Homanová and Kostolányová argue that pre-school children can develop their algorithmic thinking in a natural way (through didactic games). Children encounter activities that are based on regularity, repetition and the sequence of steps every day, e.g. brushing one's teeth in the morning/evening, everyday rituals such as getting up, putting one's clothes on, etc. Children need to realize that every activity has a specific sequence of steps (we always know which step will follow).

2. Information and communication technologies in pre-primary education

In her paper (2015), Splavcová mentions the use of information and communication technology (ICT) in connection with psychomotor development as it is extremely important to be familiar with a pre-school child's mental development. The teacher needs to achieve a clearly defined educational goal. Moreover, it is also important to pay attention to how much time a child spends with technology. On the one hand, there are many technologies that have a positive effect on a child, e.g. television, the Internet, books as well as the often-criticized computer games. They provide access to useful information, knowledge, positive examples, social patterns, opinions, experience and emotion which otherwise children would not have access to. On the other hand, these technologies are often viewed as one-sided (the fact that it turns children into passive consumers). The excessive use of digital technology prevents children from developing their motor, manual and social skills (Mertin, Gillernová, 2010).

The following are ICT categories that can be found in kindergarten (Božik, 2018):

- Hardware equipment – when implementing hardware or technological equipment, one should know exactly what goals they are trying to achieve, how it will be used (by teachers), whether or not it will be used in accordance with the School Educational Program and whether or not the employees are digitally literate. This category is further divided into the following sub-categories:
- *Desktop computers – used in administration or for projection purposes. If a computer is to be used as an interactive and multimedia device, it should be operated by a teacher*
- *Projection and interactive technology – interactive whiteboard*
- *Interactive devices that allow projection onto the floor*
- *Touchscreen devices*
- *Robotic toys*
- *Tablets*
- Software equipment – enhances standard pre-school education. It enables children to learn about letters, numbers, counting and develop their logical and analytical skills in a playful and effective way. Moreover, children also learn how to use a computer. Software equipment can be divided according to whether the license is free or not:
- *Commercial educational applications*
- *Open-source and free PC applications*

In order to be able to use ICT in kindergarten instruction, teachers need to be familiar with it. If the teacher is not able to use technology in an effective manner, they cannot possibly incorporate computational and algorithmic elements into instruction. That is why the TPCK model should be mentioned. In the beginning, there was Shulman's theory that defined the so-called PCK (Pedagogical Content Knowledge). It is based on the notion that professional content should be taught together with methods suitable for teaching a particular curriculum. The development of technology made this model popular. Punya Mishra and Matthew J. Koehler expanded it by adding a technological aspect, thus creating TPCK (Technological Pedagogical Content Knowledge) (Brdlička, 2009). The model defines today's teacher who should not only be an expert in their field, but who should also use appropriate didactic and methodical approaches and be able to incorporate technological elements into them.

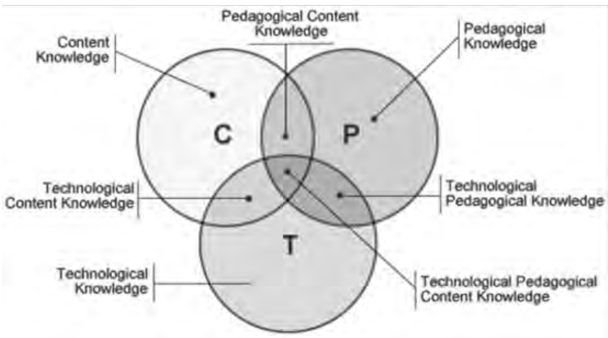


Figure 1: TPCK model (Brdička, 2009)

3. Implementing Bee-Bot into pre-primary education

Bee-Bot is a programmable robotic toy, an interactive digital tool for developing logical thinking, spatial imagination, planning and pre-mathematical concepts. It appears to be a perfect tool for developing computational thinking and basics of programming, informatics and mathematics (Infra, 2010).

In order to make implementation of robotic toy-based activities into kindergarten instruction as easy as possible, the following methodology has been created, which contains a step-by-step description of the individual stages of implementation. The instruction concept was divided into 5 stages to make the education process easier to follow and preparation more effective.

Table 1: Bee-Bot methodology information

Title:	Developing algorithmic thinking with the use of Bee-Bot
Time allocation:	20 hours
Goal:	The goal is to determine children's level of algorithmic thinking and problem-solving skills, develop their algorithmic thinking and problem-solving skills, develop logical and abstract thinking, develop their imagination, planning, pre-mathematical operations, spatial orientation and then determine how much their skills have improved. Bee-Bot (robotic toy)-based activities will help achieve the aforementioned goals.
Aids:	Bee-Bot, card mat, created images, objects (toys)

3.1 Stage 1 – Becoming familiar with Bee-Bot

This stage is primarily aimed at the teacher. The Bee-Bot (Figure 2) works by remembering and storing individual steps/commands in the order chosen by the user. Children are immediately faced with abstraction as the toy does not have a display or screen on which they could see the selected commands. Therefore, it is important to plan, set and remember the individual commands in advance.

Figure 2: Bee-Bot

The upward arrow allows us to make the bee move forward by 15 centimeters (forward means in the direction of the bee's eyes; the bee only moves in the direction of its head). The downward arrow works the same way as the upward arrow. It allows us to make the bee move one step backward (backward means in the direction of the bee's "buttocks"). The right arrow makes the bee turn 90 degrees to the right. By turning, the bee realizes one step without changing its position. The left arrow works the same way as the right one. It makes the bee turn 90 degrees to the left. The blue "X" button is used to delete the commands stored in the bee's memory, i.e. the bee will carry out only the current commands, and not the past ones. It is recommended to erase the bee's memory every time one enters new commands. The "II" button is used to stop the toy during the execution of a command (it does not move, turn or go backward, but stays in its current position for the duration of one command). It is used when one needs to stop the bee for exactly one command. The green "GO" button starts the bee and makes it execute the proposed sequence of commands (this button is used when one has entered all the commands that will lead the bee to the finish line).

The teacher should introduce the bee to the children only when they are familiar with its functions. Since the toy is new, it will spark children's interest and keep them motivated. The teacher should use this fact to maintain their interest.

Example: To children, the bee can be a new friend that wants to play with them and can do a lot of things that it would like to teach them. Children can also name the bee (which, however, is not necessary). The teacher tells the children that the bee can move, turn and make sounds.

3.2 Stage 2 – Becoming familiar with Bee-Bot's functions

The children have already been introduced to the bee. Now it is time for the teacher to explain what each button does. The teacher should divide the children into groups of 3 to 5 (children of the same age). The children should sit in a semicircle close to the teacher when they explain them what the upward arrow, etc. does. The instruction should be short and to the point. Moreover, the teacher should demonstrate each step to help the children remember it. The teacher should repeat the instruction 2 or 3 times.

3.3 Stage 3 – Practice

The children know how the bee works and now they should try to use it. Depending on the number of bees, the teacher hands the toys to the children for them to try it out. The teacher monitors the children and provides help if needed. During this stage the children try how the bee works.

3.4 Stage 4 – First real task, Use of card mat

After practice, the teacher should first calm children down and then float the idea of a task that they will have to solve (in simple terms).

Example: Children should try to solve the task by themselves, without any outside help. The assigned task should be simple, e.g. move the bee one step forward (X, ↑, GO). Then they should try to move the bee two steps forward (X, ↑, ↑, GO), then three steps forward + make it turn (X, ↑, ↑, ↑, →, GO), etc.

The teacher should also use a card mat that looks like a chessboard (Figure 3). The card mat consists of 15x15cm squares. However, it is entirely up to the teacher how many squares there will be. The card mat will help children understand the word "step" as one step corresponds to one square on the mat. The teacher can create obstacles and/or stops on the bee's way, making it the task a little more difficult for children.

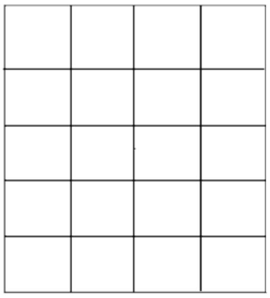


Figure 3: Card mat

3.5 Stage 5 – Increasing difficulty and completing complex tasks

In this stage children should be able to complete even the more difficult tasks (using a card mat).

Example: On the card mat the teacher places obstacles, objects that represent obstructions along the route (e.g. toys, images that can be placed anywhere on the card mat). The teacher determines both the point from which the bee starts and the point which it should reach, including the objects which it should touch/avoid along the way. The teacher should be gradually increasing the difficulty of tasks (as children's level increases). Children's first task could be to make the bee pick up three flowers along the way, regardless of the number of steps. There are multiple ways to reach the finish line – it is up to children which one they choose.

In the final stage, children should be able to make the bee go from start to finish, following a predefined algorithm and instructions. If the teacher wants to make the task more difficult, they can have the children make the bee return back to the starting point (the same way, another way, a shorter way, etc.).

Note: The teacher should carefully monitor and document children's progress in order to be able to evaluate and compare their acquired knowledge. In doing so, the teacher should focus on the important things such as creativity, unusual solutions, interesting ideas, etc.

4. Verifying the methodology in practice

After consultation with the teacher, the methodology was verified in kindergarten instruction (in a natural way, i.e. not to disrupt children's schedule) (Figure 4). Days dedicated to Bee Bot-related activities were named *"Days with a magical bee – developing algorithmic thinking"*. First of all, the children were divided into groups of 1 to 3 based on their age and estimated level of knowledge and skills. The Bee Bot-based instruction took place in a separate room (called a "playroom"). The rest of the children stayed with the teacher in the classroom. The authors worked with 16 children aged 3 to 6 divided into 7 groups. The results were as follows:

- **Group 1 (2 children, 5 and 6 years old)**

In this group, the authors tried to apply the entire methodology (i.e. all five stages), making children solve more difficult problems. The oldest of all groups, these children were posting good results from the start and further improved their skills over time. The children managed to make the bee go from start to finish (at the opposite end of the card mat), using 12 to 15 steps and several turns. The activities were created to make the children start from opposite ends (their task was to reach finish without colliding with the other one's bee). The children were successful in both cases, completing a complex task. The children were not the only ones who found the activities interesting. The teachers, too, were satisfied with the results. As far as the children's input and output skills are concerned, they managed to solve a complex task, developing their algorithmic thinking in the process.

- **Group 2 (3 children, 5 years old)**

In this group, too, the authors tried to go through the methodology's five stages. The children made significant progress (particularly in thinking about a problem). In the final stage, the children had to solve more difficult problems. Two out of the three children managed to guide the bee from one point to another (using cards with arrows on them), including checkpoints, turns and shifts. These two children solved a complex task. The third one needs more practice and individual help.

- **Group 3 (3 children, 4 and 5 years old)**

In this group, the authors wanted to expand the children's knowledge about the sequence of steps, planning and practical application. The children in this group should be able to understand the sequence of steps, how to make the bee turn and shift. However, to be able to make the bee go across the entire card mat, they will need more practice. At the beginning, the children had zero knowledge and minimum skills. At the end, however, they were able to plan, solve a problem, understand the sequence and move the bee by 3 to 6 steps, including turning. As far as the methodology is concerned, the children reached Stage 4.

- **Group 4 (1 child, 4 years old)**

The child became familiar with the sequence of steps, planning and realization. They were able to make the bee turn and shift. At the beginning, the child had already begun to understand the meaning of individual steps. It was in Stage 5 where problems occurred. The child did not complete the task – they could not make the bee turn at the right square and make it move in the correct direction (they were not able to calculate the correct number of steps). The child was able to evaluate, plan and make the bee move to a particular spot (however, not across the entire card mat). Nevertheless, the child made significant progress, i.e. they developed their algorithmic thinking.

- **Group 5 (3 children, 4 years old)**

In this group, the methodology stopped at Stage 4 (moreover, it had to be repeated multiple times). All three children developed their algorithmic thinking as they had very little knowledge at the beginning. One of the children was better than the other two, having understood the process of planning, the sequence of steps, the highest level of abstraction, the problem-solving process and creation of an algorithm. This child was the best of the three at using the bee (the greatest number of steps, including turning).

- **Group 6 (2 children, 3 years old) & Group 7 (2 children, 3 years old)**

In this group, the authors intended to develop the children's spatial orientation and basic algorithmic skills. They succeeded. The children were able to name the directions and make the bee move in the required direction – forward, backward, to the right, to the left. Moreover, they were also able to make the bee turn, some of the children were almost able to make the bee turn by 360 degrees. The children in both groups made significant progress. However, neither group was able to move past Stage 4 (basic commands and instructions in particular). Requirements on these children should not be as high, they should use the bee for a longer period of time, working on their own or with a little help from the teacher.

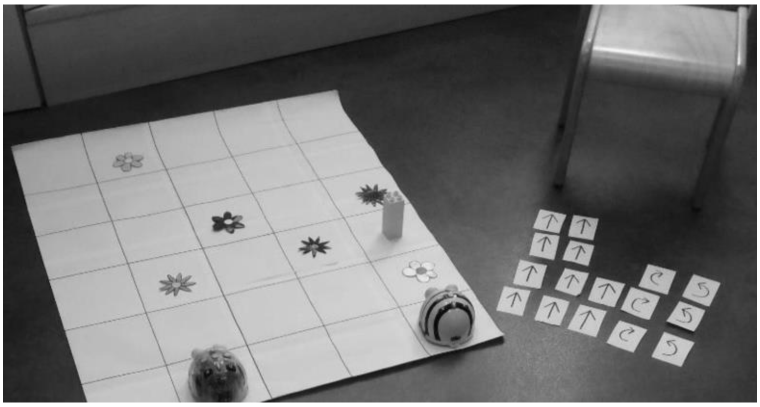


Figure 4: Verification in kindergarten

5. Conclusion

The paper was aimed at introducing one of the methods of developing algorithmic thinking in pre-primary education – the robotic toy Bee-Bot. The toy was used in accordance with the proposed methodology and activities. The documentation proves that a development process based on the methodology can be realized. Problems occurred only in groups with 3-year-old children, for whom the methodology was too difficult. The authors determined that while the methodology was not suitable for 3-year-old children, the bee itself was (the bee is designed for 3-year-old children – according to the manufacturer, the minimum recommended age is 3). When using the bee, children's progress should be considered. Moreover, the teacher should provide as much help as needed and assign easy tasks. A child should also be able to play with the bee on their own (either on the card mat or on the carpet, floor, etc.).

Children aged 4 and older were able to achieve goals stated in the methodology. Based on the methodology, the activities were divided into stages according to the level of difficulty, with the highest level being Stage 5 where the children had to solve complex tasks.

The proposed methodology can help teachers implement activities aimed at developing algorithmic, logical and abstract thinking and problem-solving skills in a natural way (i.e. create a game-like atmosphere, while working systematically towards a desired goal).

References

Božik, R. (2018) "Podpora využití ICT v práci učitele MŠ", [online], www.utb.cz/fhs/struktura/studijni-opory-ums

Brdička, B. (2009) "Integrace technologií podle modelu TPCK", [online], https://spomocnik.rvp.cz/clanek/10641/INTEGRACE-TECHNOLOGII-PODLE-MODELU-TPCK.html. ISSN 1802-4785.

Fořtíková, J. (2014) *Rozvoj rozumových schopností u dětí v MŠ: pracovní listy pro předškolní děti*, Portál, Praha.

Infra (2010) "NOVINKA – robotická včelka BEE-BOT", [online], www.infracz.cz/ze-spolecnosti/novinka-roboticka-vcelka-bee-bot/

Langmeier, J. and Krejčířová, H. (2006) *Vývojová psychologie*, Grada, Praha.

Mertin, V. and Gillernová, I. (2010). *Psychologie pro učitelky mateřské školy*, Portál, Praha.

MŠMT (2014) "Strategie digitálního vzdělávání do roku 2020", [online], www.msmt.cz/file/34429/

Opravilová, E. (2016) *Preprimární pedagogika*, Grada, Praha.

Prextová T., Homanová Z. and Kostolányová K. (2018) "Activities for Developing Explain Computational Thinking", *Proceedings of the 17th European Conference on e-Learning*, November, pp 474-480.

Vágnerová, M. (2012) *Vývojová psychologie: dětství a dospívání*, Karolinum, Praha.

Online Learning of Reflective Journal Writing in Tertiary Education

Karl Holm, Jovita Yeung, Mimi Yu, Rodney Ho, Yvonne Loong and Felix Chao
The Independent Learning Centre (ILC), The Chinese University of Hong Kong (CUHK), Hong Kong SAR, China
karl.holm@cuhk.edu.hk
joviel@connect.hku.hk
mimi.yu@cuhk.edu.hk
rodneyho@cuhk.edu.hk
loongycw@cuhk.edu.hk
felixchao@cuhk.edu.hk
DOI: 10.34190/EEL.19.042

Abstract: Reflective journal writing is an important genre of academic writing in which students are not only asked to think critically about any given experience, topic, or question, but also to be able to monitor their own development as learners. Here, we present and evaluate an English language micro-module for self-directed learning of reflective journal writing skills aimed specifically at students taking the compulsory General Education courses given to all students at CUHK. This micro-module is complementary to Chinese language versions and supports regular workshops. In the design of this platform, we have tried to reach multiple aims: for example, while we suggest a linear progress throughout the module, we also provide several points of entry in order to satisfy different learning needs and individual preferences. Furthermore, we provide multiple types of exercises and checkpoints generated from authentic student texts in order for the students to monitor their progress. In terms of content, we found it important not only to explain in detail the process of reflective thinking, but also to exemplify and practice the language features of reflective journal writing. Thus, we include detailed sections on how to analyse writing prompts, generate ideas and arguments, and finally outline and compose the writing. Therefore, we believe that core parts of this micro-module are also useful for learning and practicing general academic writing. During the academic year of 2018-19, student feedback questionnaires and pilot focus group studies have been used to evaluate the potential benefits from using the micro-module as a complement to regular workshops. To date, access rates and feedback response suggest that students find the online interface and content practical and meaningful. Furthermore, initial analyses of results indicate that the micro-module enables independent and mobile learning with increased and deeper content than a single workshop can provide.

Keywords: reflective thinking, reflective journal writing, online learning, mobile, micro-module

1. Background

The web-based platform "General Education Reflective Journal Micro-Module" (GERJMM) was developed by The Independent Learning Centre (ILC) at The Chinese University of Hong Kong (CUHK), in collaboration with the General Education Foundation Programme (GE) of the CUHK. The platform is part of a project titled "Micro-modules of Reflective Journal Writing for University General Education Foundation Programme", funded by the Teaching Development and Language Enhancement Grant (TDLEG#4170501) for the 2016-19 triennium. The GERJMM is an English Language, tailor-made online learning platform specifically developed to guide and support reflective journal writing in the credit-bearing compulsory courses: "UGFH 1000 In Dialogue with Humanity" and "UGFN 1000 In Dialogue with Nature" for all undergraduates at CUHK.

The General Education Foundation Programme of CUHK aims to provide a balanced education for undergraduate students (CUHK University General Education, 2019). Students are prepared to be lifelong learners and global citizens with the intellectual capacity for understanding important knowledge, ideas, and values, of humanity in our modern world through engaging in active reflections on perennial issues. As a cornerstone of university education and personal development, two GE courses are offered to first year and second year students. "In Dialogue with Humanity" includes significant works of religion, moral philosophy, and political philosophy prompting students to explore the classics that have shaped humanity's self-understanding and visions of a good life and society. Meanwhile, "In Dialogue with Nature" features an intellectual journey of investigating the major discoveries of Western science, the human mind and cognition and ultimately, reflecting on the limitation of scientific knowledge (CUHK University General Education, 2019). Overall, both courses share a mutual goal to extend students' curiosity of the world around them, to promote a habit of reading critically, and develop attitudes that are compatible with independent learning.

Over the years, GE tutors have observed that students often struggle with the unique characteristics and requirements of reflective journals. Despite being a form of academic writing that involves citation of literature and theory, reflective journals have a personal nature through inviting learners to explore their values, attitudes, and beliefs. It is this special combination of the impersonal and personal that students find most challenging to express. As reflective journals are part of the assessment in General Education, the GERJMM was developed in order to guide our students in reflective writing, and to become more reflective individuals in everyday life.

Several reviews and meta-analyses have attempted to summarise the potential benefits, as well as pitfalls, of online learning in tertiary education; for comprehensive examples from recent years see Clark and Mayer (2016), Sun and Chen (2016), Wu (2015), and Wallace (2003). Some of these studies focus on particular aspects of the perceived benefits of online - or e-Learning, such as the increased ability among students of self-regulated learning (Broadbent and Poon, 2015; Lee et al., 2017), and the use of exemplars, that is students' texts, as a means of efficient feedback (Carter *et al.*, 2018). From these overviews, it would appear that a common drawback of online-, or distance learning, is the reduced teacher presence. The teacher still has an important role in both group and individual feedback responses and in managing the flow of content through exercises and assignments (Wallace, 2003). Although we have as yet to develop an efficient procedure for continuous and direct feedback responses to our students individual needs, it should be noted that the GERJMM has been developed as an additional support to our regular workshops and lectures; thus, the platform is not designed to be a stand-alone tool for learning reflective journal writing. On the other hand, important benefits reported from these studies on online learning include the increased access to learning and training, the improved cost effectiveness of teaching resources, improved mobility and the allowing of adjustments to subject and content need (Moore and Kearsley, 2012; Finch and Jacobs, 2012). In our design of GERJMM we have strived to incorporate the results of empirical research on online learning from several of these sources. Although or data set is as yet comparatively small, we will also attempt to present our own preliminary findings in terms of reporting on students' feedback on the potential benefits of the use of the GERJMM online micro-module.

2. Content and learning tools of the GERJMM

Through incorporating the course curriculum of GE, in addition to students' different levels of written English and their individual learning styles, the GERJMM aimed to supplement regular classroom teaching and supportive reflective writing workshops organized by the ILC. The online learning platform offers detailed explanation on reflective writing and also provides interactive exercises to encourage knowledge consolidation and self-directed learning.

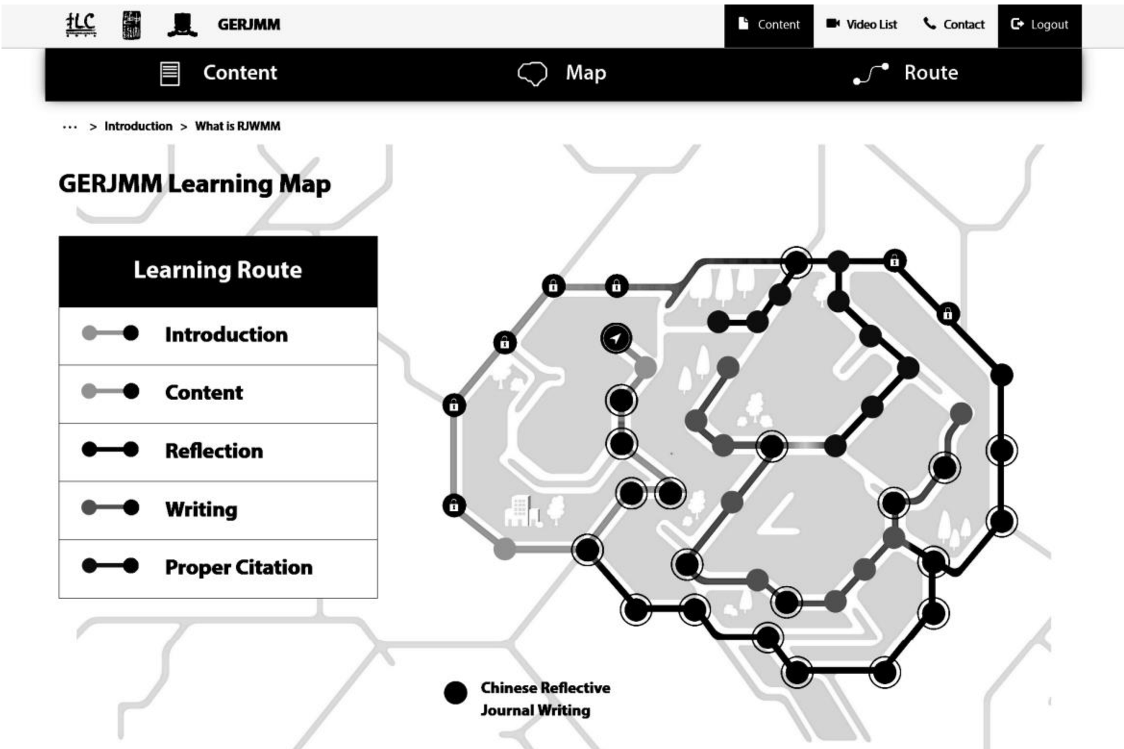


Figure 1: GERJMM learning map

There are four main routes (or sections) on the platform – Content, Reflection, Writing, and Proper Citation (Fig. 1). A link is available to students to access the Chinese Reflective Journal micro-module, which is independent of the English version in this paper. One of the key features of the micro-module is the freedom to progress at a personalized pace according to the learner's needs. As there is no specific order of completion, students are free to select which route fits their learning needs and interest at any given moment in their learning process. This design promotes flexibility in the learning process and encourages students to develop as self-independent learners.

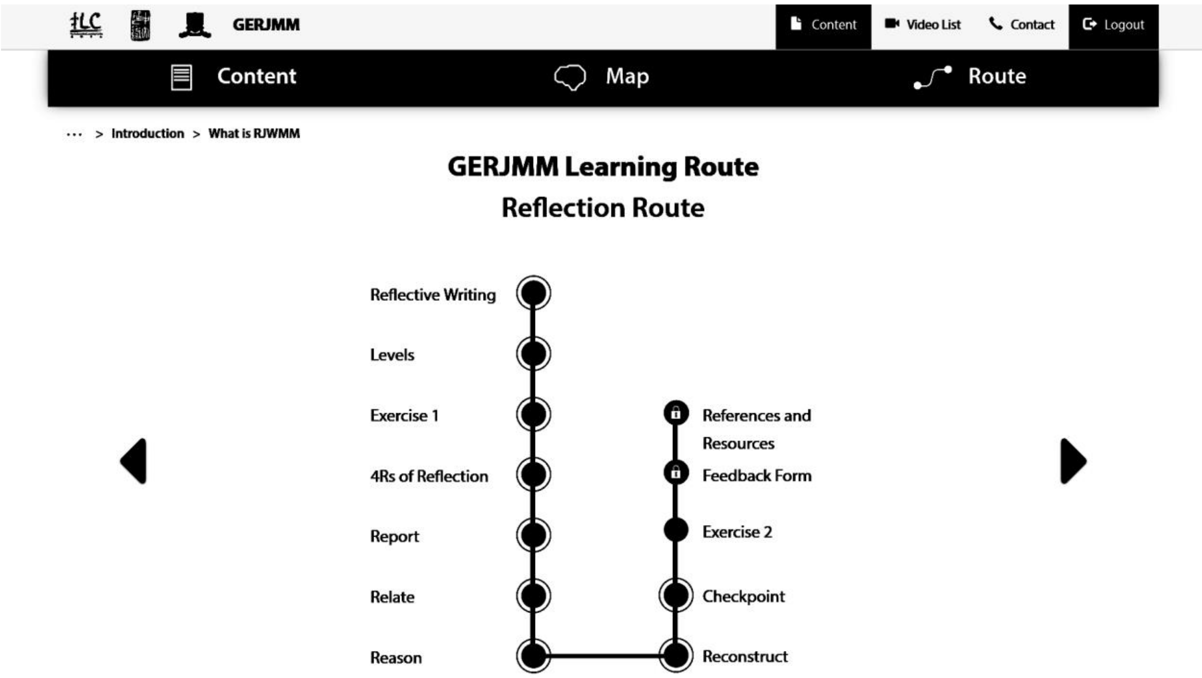


Figure 2: An example of a learning route

By clicking on the top right-hand corner of the page, a brief overview of the route's contents is available for preview. Students are also able to click on specific exercises or learning points on the route for easy access or review. To help learners keep track of their learning progress, a tracking function is provided. A darker circle around a certain activity or lesson indicates completion, as shown in Figure 2.

2.1 The Content route

The Content route is designed to support students in generating content for their reflective journals through introducing brainstorming methods and information organization. Using a sample essay question, the section guides students through the process of understanding the aim of the question, brainstorming ideas, and critically selecting them.

2.2 The Reflection route

The next route, Reflection, aims to equip students with reflective skills through introducing the 4Rs Model of Reflective Thinking: (1) reporting, (2) relating, (3) reasoning, and (4) reconstructing (QUT Citewrite, 2010). Although there is no specific order of completion for the majority of the platform, the 4Rs Model of Reflective Thinking and exercises must be completed in sequential order to ensure students are able to build on the concepts introduced in each step and have a solid understanding of the reflective model.

2.3 The Writing route

Students often enter CUHK with differing levels of English and those with a weaker grasp of the language may find it difficult to express their ideas coherently. The Writing route is designed to counter the linguistic barrier and induct students to the common rules of reflective journal writing. Compared to the first two routes, the Writing route is more generic in nature and encompasses basic academic essay writing skills, such as guidance on essay structure and proper diction, with the aim of aiding students in presenting their reflective ideas in words.

2.4 The Proper Citation route

Last but not the least, Proper Citation explains different situations of plagiarism to raise students' awareness about possible forms of academic dishonesty and also revisits information about proper MLA citation.

3. Learning tools

Taking into account individual learning preferences of students, various learning tools are available in the GERJMM, such as interactive exercises, video lists, and progress checks. Interactive exercises encourage student engagement in the learning process through mini-games such as mix-and-match, connect-the-dots, and information search. Immediate feedback is provided to help learners identify and rectify mistakes. Students are also able to receive hints if they are stuck on a particular question or activity.

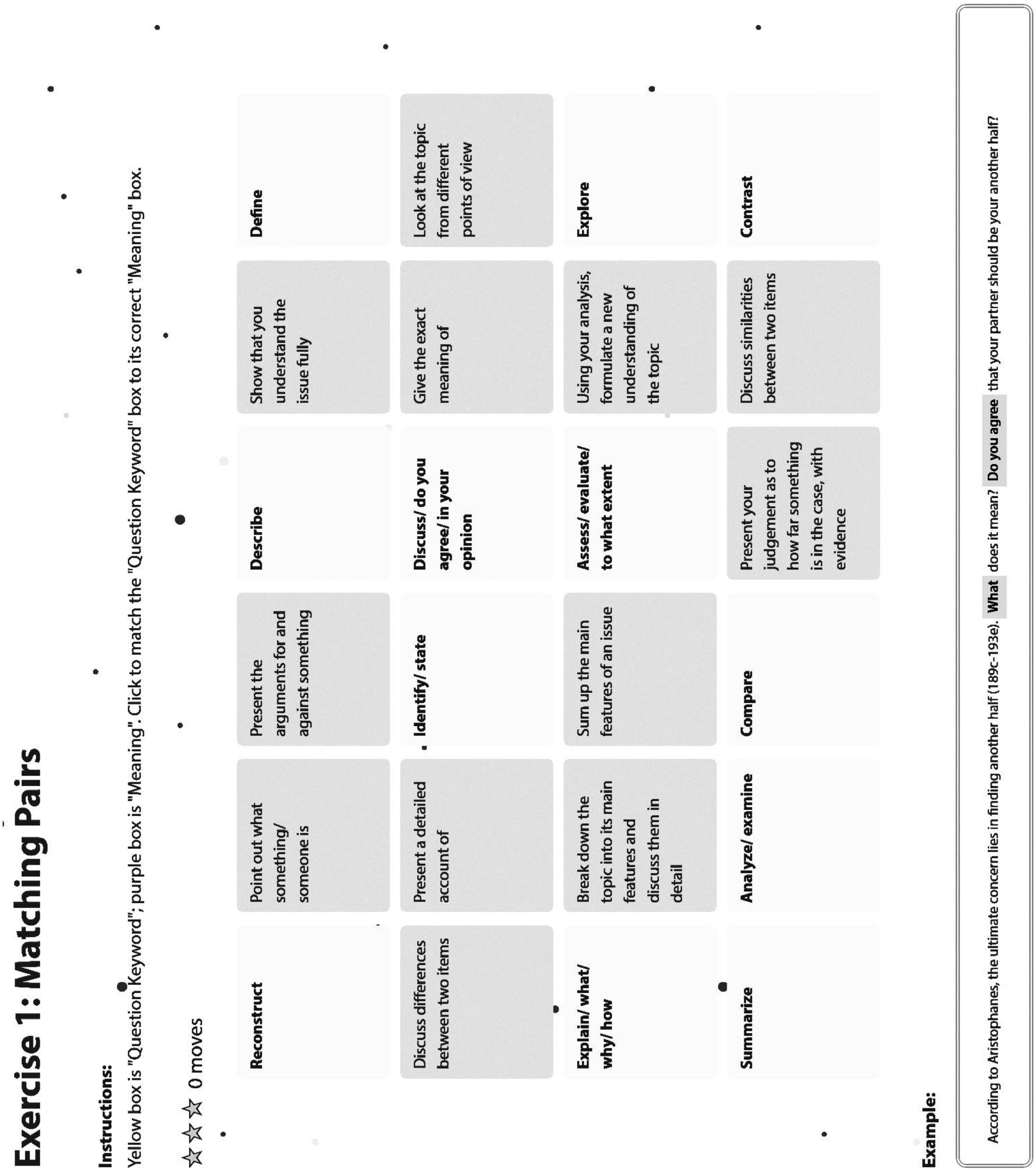


Figure 3: An exercise example

Figure 3 shows an example of a mix-and-match exercise in the micro-module. This exercise was specifically designed to help students consolidate knowledge of various question words introduced in the previous chapter. Exercises and checkpoints are present after the introduction of a new concept as they have been shown to promote information consolidation, reconstruction, and assimilation in learners (Woodberry & Aldrich, 2000).

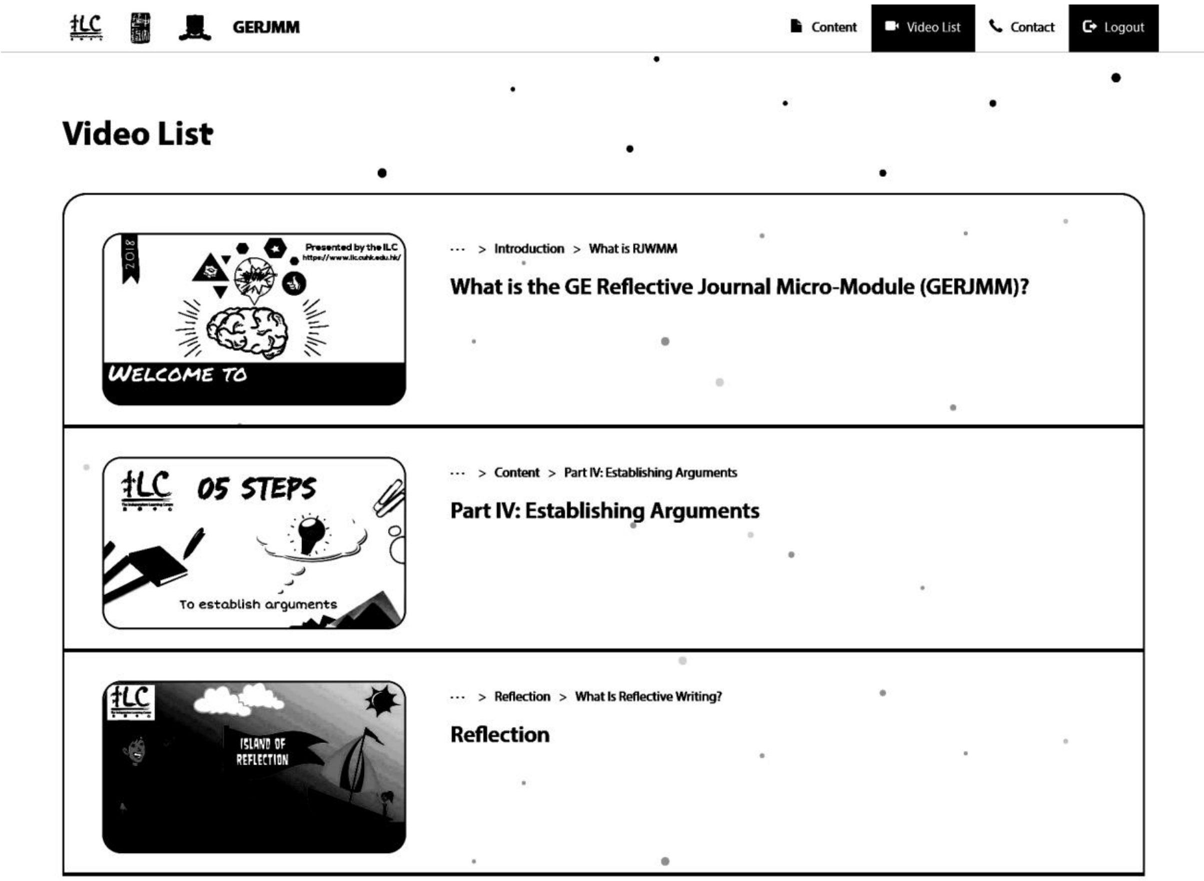


Figure 4: Part of the video list

To reflect the growing trend of media in education, animated videos are included in the GERJMM to explain difficult and tedious concepts in a colourful and entertaining way. As shown in figure 4, link to a video list is provided on the hot bar and it allows students to conveniently learn or revise specific concepts without having to go through the route in search of a certain video.

4. Preliminary findings

The GERJMM was first introduced in the autumn semester of 2018, and here we present data from the first two semesters (autumn 2018 and spring 2019) that the micro-module has been freely accessible to the GE students. Prior to the micro-module's official launch, an orientation about the aims, design, and functions were introduced to the General Education teachers in the summer. Teachers were requested to promote the GERJMM to their students as an optional tool for independent learning during the GE course.

A total of 809 students accessed the GERJMM in the first year of its launch. This reflects a larger number of students, approximately 700 students actually taking the English version of the two GE courses. This can probably be explained by the fact that students have been encouraged to access and use both the Chinese and English versions of these micro-modules regardless if they are enrolled in the English or Chinese classes in order to find the support that best reflects their needs. Among the 809 students, 129 had a completion rate of 100%, that is, they finished all parts of the micro-module. This drops to 25 and 28 students in the completion rate interval of 75-99%, and 50-74%, respectively. A majority of students, 627 finished less than 50% of the micro-module.

Two types of quantitative feedback students were collected. Firstly, each section, or route, of the micro-module included a content specific set of feedback questions for that route. The feedback response per section was recorded on a 1-6 band scale (Strongly disagree to Strongly agree) measuring to what extent the students found the content of each route useful to their reflective learning needs. Overall, the outcome here was generally positive with means ranging from 4.6 to 4.8 for the usefulness of content of the four different sections (the Introductory route had no feedback questions). The number of responses for the different routes ranged from 58 to 93 for the four different sections.

Secondly, we also collected feedback responses via mail at the end of the semester. These questions sought to collect responses on the usefulness of the micro-module as such for independent learning, and as a complement to regular teacher-lead workshops and classes. The number of collected responses were here lower, totalling 53 collected responses over the year. Questions addressed all features of the micro-module, including its design, content, the basic explanation of reflective thinking concepts, videos, exercises, writing support, the usefulness of self-help material, and finally self-learning. Again, although no question stood out, the overall result was positive with a mean ranging from 4.2 to 4.5 on a 1-6 band scale (Strongly disagree to Strongly agree).

In addition to the above, qualitative feedback was also collected via open-ended questions embedded in the surveys and from a pilot focus group interview. To test the feasibility and effectiveness of data collection from focus group discussions, a pilot focus group was organized and two students who had accessed the GERJMM in the spring semester of 2019 were randomly chosen and invited to attend. Based on both the quantitative and qualitative feedback obtained, three significant themes emerged.

4.1 Improved understanding of reflective journal writing

The primary aim of the GERJMM is to assist students in their GE reflective journal writing. In previous years, GE teachers have discovered that Year 1 students do not have sufficient knowledge of the definition and requirements of reflective journal writing. As a solid understanding is crucial to planning and writing a good reflective journal, it is important for the GERJMM to explain the unique criteria of reflective journal writing, and also differentiate between other forms of informal and academic writing (Clarke, 2004).

Findings show that the GERJMM is able to improve students' understanding of reflective journal writing. Over 90% of students surveyed after the completion of the GERJMM agree that "the content of the micro-module familiarizes me with the basic requirements of reflective journal writing". Prior to accessing the GERJMM, students mistakenly believe that reflective journals are akin to essay writing in secondary school. However, after completing the micro-module, they are more familiar with the unique requirements of reflective journal writing. This sentiment is well-summarized by a focus group participant:

> *"After finishing the [GERJMM], I think this reflective journal [writing] is more focused on critical thinking and analytical thinking, it is not the same as I expected before."*

After accessing the GERJMM, students are able to identify and understand the special requirements of reflective journal writing, which is the first and foremost step to producing quality work, not only in the GE courses, but in other subjects that require reflective thinking and writing.

4.2 Catering to individual learning needs

The flexible design of the GERJMM allows students to learn at their own pace according to their personal learning needs. More than 90% of students responded positively to the statement "The micro-module introduces various kinds of self-help material to encourage me to self-learn reflective writing". A student in the focus group noted that he had only accessed the *Citation and Avoiding Plagiarism* route because he only needed assistance in referencing and formatting. The flexibility in content and the liberty to access various routes of the micro-module without a specific order or timeframe enables students to cater to the problems they encounter in reflective journal writing (Chen, 2003). This promotes a shift from teacher-centred learning to student-centred as the learning experience becomes context-sensitive and focuses more on generic skills (e.g., thinking, problem-solving) opposed to the passive reception of knowledge. Being an online learning platform, the GERJMM offers full liberty to students to decide when and where they would like to learn. Students can access the micro-module on their tablets and phones in any place at any time. As one learner commented that every student has a busy schedule and they may have limited time to handle their academic enquiries, so the micro-module provides a quick and simple solution to the problems they may encounter in reflective journal writing. In short, the GERJMM caters to individual student learning needs by providing great flexibility in content, time, and space for learning.

4.3 Springboard for further enquiry

While the GERJMM aims to introduce reflective journal writing, improve students' writing skills, and guide learners through the basic requirements of MLA citation, there is always a limitation to the amount of content included. As a result, there are times when the information provided may not be sufficient enough to meet students' learning needs (Sheard & Lynch, 2003). This shortcoming is well-illustrated by a focus group participant:

> *"Sometimes, my problem is not because of these elements. It may be a logical flaw or something, which [the GERJMM] might not help me that much. But as a starting point, this is good."*

Despite the shortcomings of a limitation to the depth of information provided, the GERJMM serves as a "springboard" for students to consider and raise questions that may be answered by their GE teachers in class. In short, the micro-module may be considered a quick and convenient solution to students with simple and common problems, such as brainstorming or essay formatting; it may also be a starting point for students who encounter more difficult questions as they access the micro-module to seek further clarification from course teachers. All in all, the GERJMM is a self-learning tool that encourages students to take responsibility of their learning progress and find answers to the questions they raise.

5. In conclusion

To summarise, the General Education Reflective Journal Micro-Module (GERJMM) appears to support the GE students in terms of enabling independent and mobile learning with increased and deeper content than a single workshop can provide. To date, access- and completion rates, as well as feedback response suggest that students find the interface and content practical and meaningful. Based on a more detailed analysis of the feedback response, we intend to adjust both content and web interface for the next academic year. These micro-modules are an ongoing collaboration with the General Education Teaching Staff from which we will continue to gather suggestions on improvement that suits our GE students' needs.

References

Broadbent, J & Poon, W.L. (2015). Self-regulated learning strategies & academic achievement in online higher education learning environments: A systematic review. *Internet and Higher Education*, 27, 1-13.

Carter, R., Salamonson, Y., Ramjan, L.M., Halcomb, E. (2018). Students Use of Exemplars to Support Academic Writing in Higher Education: An integrated review. *Nurse Education Today*, 65, 87-93.

Chen, D. (2003). Uncovering the provisos behind flexible learning. *Journal of Educational Technology and Society, 6*(2), 25-30.

Clark, R & Mayer, R. (2016*). e-learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning*. 4th ed. Wiley.

Clarke, M. (2004). Reflection: Journals and reflective questions: A strategy for professional learning. *Australian Journal of Teacher Education, 29*(2), 1-14.

CUHK Independent Learning Centre. (2018). "*GE Reflective Journal Micro - Module (GERJMM)",* [online], CUHK, http://www.ilc.cuhk.edu.hk/go/GERJMM.

CUHK University General Education. (2019). "*Curriculum design"*, [online], CUHK, http://www5.cuhk.edu.hk/oge/index.php/en/programme/curriculum-design.

Finch, D., & Jacobs, K. (2012). Online education: Best practices to promote learning. *Proceedings of the Human Factors and Ergonomics 56th Annual Meeting.*

Lee, C., Yeung, A.S., Ip, T. (2017). University English Language Learners' Readiness to Use Computer Technology for Self-directed Learning. *System*, 67, 99-2010.

Moore, M., & Kearsley, G. (2012). *Distance education: A systems view of online learning*. 3rd ed. Wadsworth.

QUT Citewrite. (2010). "*The 4Rs model of reflective thinking"*, [online], QUT https://www.citewrite.qut.edu.au/write/4Rs-for-students-page1-v1.5.pdf.

Sheard, J., & Lynch, J. (2003). Accommodating learner diversity in web-based learning environments: Imperatives for future developments. *International Journal of Computer Processing of Oriental Languages, 16*(4), 243-60.

Sun, A & Chen, X. (2016). Online Education and Its Effective Practice: A Research Review. *Journal of Information Technology Education Research*, 15, 157-190.

Wallace, R. (2003). Online Learning in Higher Education: a review of research on interaction among teachers and students. *Education, Communication & Information*, 3(2), 241-280.

Woodberry, R. D., & Aldrich, H. E. (2000). Planning and running effective classroom-based exercises. *Teaching Sociology, 28*(3), 241-48.

Wu, D. (2015). *Online Learning in Postsecondary Education: A Review of the Empirical Literature (2013-2014).* ITHAKA S+R, DOI: https://doi.org/10.18665/sr.221027

Using H5P Interactive Teaching Aids to Solve Problems

Zuzana Homanova, Tatiana Prextova, Daniel Tran and Katerina Kostolanyova
University of Ostrava, Ostrava, Czech Republic City
zuzana.homanova@osu.cz
tatiana.prextova@osu.cz
daniel.tran@osu.cz
katerina.kostolanyova@osu.cz
DOI: 10.34190/EEL.19.052

Abstract: Students' key competencies are considered an important part of the 21st-century skill set. These competencies allow the student to succeed now as well as in the future, on both personal and professional levels. Students should be encouraged to develop their problem-solving skills. In order to master this competency, students need to use not only knowledge from different fields, but also their cognitive, analytical, decision-making and communication skills. Interactive teaching aids can be used for this purpose in all educational areas and different school types. Featuring interactivity and various multimedia elements, these aids allow students to engage multiple senses at the same time. That is what makes these innovative teaching aids effective and therefore popular. The H5P language allows for the creation of new interactive teaching aids. Moreover, thanks to the native display of multimedia content in the web environment, it also allows for the use of the original source. The paper is aimed at using H5P interactive tasks to help elementary school students develop their problem-solving skills. It includes practical examples of H5P tasks such as Branching Scenario or Drag and Drop which can encourage activity and curiosity, thus helping students find a way to solve a problem. It explains how each task can be used in instruction as well as what is required to create the particular task. Particular attention is paid to feedback, which consolidates knowledge. The tasks presented in the paper should be available to those who participate in education.

Keywords: H5P, problem-solving competence, problem-solving tasks, interactivity

1. Introduction

The aim of modern education is to equip students with key competencies appropriate for their level and so prepare them for further education and employment in society. Problem-solving competency is one of the key competencies, often referred to as the higher order skill or cross curricular one – exceeding the problem of just one discipline. This competence is very important for students as it prepares them for the future where they will face number of real problems. The aim is for a student to develop not only cognitive and analytical skills, which support the development of the ability to interpret and understand problems, but also the ability to solve problems and find a path that leads to a solution. This issue is currently often discussed. According to OECD, the ability to solve problems is 'at a time when society, the environment and technology are constantly evolving and changing, considered to be a competitive advantage for the individual' (Palečková et al, 2014, p 6). Therefore, to solve problems, it is necessary to build on the acquired knowledge and skills, reorganize them and link them with new information; fill the gaps in one's knowledge with observation and examination of the problem situation (ibid.). Another important component of problem-solving skills is creative and critical thinking.

Principles of so-called computational thinking can also be applied in solving problems, that is, focusing on the description of the problem, it's analysis and finding effective solutions (Informatics thinking 2018). Problem-solving is also one of the sub-areas of digital literacy. At present, this issue is very topical in the Czech Republic.

Dostál (2015, p. 52) argues that "in order for the students to be able to solve a complex problem, they need to learn how to solve the individual parts of a problem in a creative way (they need to learn to understand the problem, find evidence, make conclusions based on facts, make assumptions, verify the solution, etc.). In order to be able to develop this skill, the student needs to be confronted with the problem – they need to solve the problem on their own. Problem-based tasks can help develop the problem-solving competency. According to Češková (2016), the problem-solving competency can be developed through the problem-based tasks that require a situational approach (i.e. apart from the problem itself, one needs to be aware of circumstances that affect the situation). Many authors see problem-based tasks as a catalyst for learning processes at all stages of instruction – motivation, acquisition, practice, application, evaluation (Knecht 2014; Müller and Helmke 2008). Authors prefer the so-called complex tasks, in which tasks are organized according to the level of difficulty (i.e. from simple to difficult, from algorithmic to creative, etc.). The PISA (Program for International Student Assessment) tests contain complex tasks.

The PISA (*Program for International Student Assessment*) regularly surveys the levels of 15-year-old students in a number of different areas of interest. These areas are presently the focus of attention of The Organization for Economic Co-operation and Development (OECD); problem-solving being one of them (the team problem-solving area has been surveyed since 2015).

Even though complex problem-based tasks are included in the existing as well as planned study materials, it is still not enough. It is mainly because their preparation is time consuming (Havlova et al 2010). That is why it is necessary to find and analyze available resources that would make it easier to create problem-based tasks.

2. Definition of terms: problem-solving, key competencies to solving problems

In general, competency can be defined as the application of what one knows and is able do to solve a particular task or problem in everyday life. In *The Nature of Problem Solving* Csapó et al (2017, p 15) define problem-solving as

> *"one of the key competencies humans need in a world full of changes, uncertainty and surprise". PISA (Palečková 2014, p 7) defines the ability to solve problems as 'utilizing an individual's cognitive skills to understand a problem and to solve it, despite the solution not being immediately apparent. It also includes an individual's willingness to deal with such situations so that he can develop his own potential as a constructive and contemplative citizen".*

In the Czech Republic, the key competencies are defined by the Framework Educational Program for Basic Education (MŠMT 2017, p 10) which defines them as "*a summary of knowledge, skills, abilities, attitudes and values important for the personal development and employment of each member of society*". Problem-solving competency is one of the sub-competencies that this strategic national document defines. Based on this conceptual framework, a student should manage these activities by the end of elementary education (MŠMT 2017):

- perceives the most diverse problem situations in school and out of school; recognizes and understands problems; considers discrepancies and their causes; considers and plans ways to address/solve problems based on his or her own reasoning and experience;
- seeks for information suitable for solving problems; identifies identical, similar and different features of pieces of information; makes use of acquired knowledge to discover/identify various ways to solve problems; is not discouraged by any failure and persistently seeks the best solution to the problem;
- addresses problems independently; chooses suitable ways to solve problems; uses logical, mathematical and empirical methods to address/solve problems;
- tests practically the adequacy of approaches to problem solving and applies proven methods when addressing similar or new problems; monitors his or her own progress in tackling problems;
- thinks critically; makes prudent decisions and is able to defend them; is aware of the responsibility for his or her own decisions; evaluates the outcomes of his or her decisions.

As a rule, these partial competencies cannot be build independently, as they are only gaining importance in the context of other components (Klíčové kompetence v základním vzdělávání 2007, p 25). Methodological guide *Klíčové kompetence ve výuce na základní škole a gymnáziu* (2011) provides examples of specific teaching situations from several educational fields to support the development of key competencies. An example of developing problem-solving competency is described in Table 1.

Table 1: Examples of educational situations from selected educational fields (based on Hesová et al 2011)

Field/Topical subarea	Example of level development	Example questions
Czech language and literature: Reading a literary work Leading a student to instructive and active reading	Formulating and deriving opinions about the work; data interpretation; creating a graphical record of answers to questions	What are the typical features of the author's style? Is the atmosphere of the time period reflected in the work?
Mathematics and its application Geometric tasks Awareness of the direct connection between mathematical theory and practical application	Problem analysis; solution planning, for example using visual representation of the problem; systematic approach to solving the problem	Have we ever encountered a similar problem before? Will an image help us? What do we already know and can start from? What is our goal?

The concept of key competencies varies from country to country with each country setting its own core competencies. Some countries (e.g. the UK) do not directly integrate problem-solving among their key competencies. However, problem-solving is an integral part of Information and Communication Technology instruction and therefore most countries encounter this competence (Kocourková and Pastorová 2011).

Problem-solving competencies are also associated with the following skills (Šlejšková and Gošová 2011):

- The ability of being open to learning new and original practices;
- The ability of seeking and finding alternatives;
- The ability to make decisions;
- The ability to implement solutions;
- The ability to communicate.

2.1 Problem-solving approaches

Various forms of teaching, such as problem-solving teaching or research-based teaching, are used to support the development of the desired competency in educational activities. Problem-solving teaching is a method that facilitates development of one's creative abilities through natural activation (Kwan in Chlupáč 2008, p 74). As Chlupáč (2008, p 76) states "*when a student solves problems in the process of learning, it leads to a situation in which he is forced to try to find a solution by himself. Therefore, motivation being an important aspect in the process of creating tasks should not be neglected, since it arouses the students' interest in the task.*"

Several studies are addressing how problem-solving competency levels are identified. The Assessing Analytic and Interactive Aspects of Problem Solving Competency study presents two ways to solve problems:

- Analytical;
- Interactive.

In the case of analytical problem-solving, there exists one type of problem that allows only a single option solution, based on the information provided at the outset. These types of problems can be solved analytically because all the necessary information is given at the beginning.

In the case of interactive problem-solving, the existing problem can be solved through multiple ways; the latter solution choices may be affected by previous results. When trying to solve such a problem the resolver can adapt and modify his original solution plans during the process itself. The study mentioned above, deals with the evaluation of these two ways of problem-solving in high school and university students. The results of the study indicate that university students are particularly successful in analytical problem-solving, while high school students are successful both in analytical and interactive problem-solving (Fischer et al, 2015). However, based on the mentioned study, only 15 % of adult individuals can be referred to as 'strong problem solvers' and up to 35 % of individuals are 'weak problem solvers'. It is precisely because of the relatively small percentage of strong solvers that it is necessary to ensure proper development of competencies needed for problem-solving already in elementary school students and thus prepare them for correct and quality problem-solving in their upcoming study, professional and social life.

Among the studies that focus on the desired competency in the elementary education in the Czech Republic, a study called An Opportunity to Develop Problem-Solving Competency in Elementary Schools Instruction (Knecht et al, 2010) is worth mentioning. The authors deduce 3 significant characteristics not only in terms of competency development but also in terms evaluating its level and its evolution:

- The problem lies in the context of students' real life (the problem has personal or social significance for the student);
- The problem cannot be solved by a routine procedure;
- The problem spans several areas.

A task that presents an opportunity to develop problem-solving skills should contain the following features:

- Solving the task requires transferring knowledge between different contexts/situations or fields;

- To solve the task, it is necessary to take the situational context into account;
- The task reflects "real life";
- Solving the task is a process that shows typical problem-solving phases.

The difficulty of the task should be proportionate to the age and individuality of the student (Chlupáč 2008). Nevertheless, as stated by the authors (Knecht et al, 2010) it is seldom possible to create such a task that would meet all these criteria.

2.1.1 Problem-solving based on PISA

The tasks applied in the PISA international assessment follow the conceptual framework that takes into account (Palečková et al, 2014):

- The context of the problem:
- *environment (technical vs. nontechnical);*
- *focus (personal vs. social);*
- The nature of the problem situation – interactive, dynamic, static;
- Procedures – cognitive skills in problem-solving.

The context of the problem is understood to be the extent to which a student is familiar with the issue. The context of the problem in terms of the technical environment results from solving a technical problem, such as the ability to utilize a tablet.

The interactive nature of the problem situation is such, where the solver does not initially have all the relevant information and has to actively seek it. The dynamic nature of the tasks assumes spontaneous change due to various influences that the solver cannot control. The static nature represents a case where at the beginning the student has all the information about the problem that needs to be solved.

Individual types of problems that can be addressed by the tasks:

- Decision-making – tasks oriented to choose the most optimal solution from range of options, evaluation, justification and solution presentation;
- Analysis and creating a system – comprehension or system design;
- Technical issues.

3. H5P

The HTML5 language allows for the creation of new interactive teaching aids. Moreover, thanks to the native display of multimedia content in the web environment, it also allows for the use of the original source. The open-source tool known as Interactive Content H5P (further only H5P) presents a user-friendly option when creating different types of interactive tasks, that is, learning objects that can be integrated free if charge into plug-ins or embeds in various educational systems (known as CMS, LMS, LCMS), teaching materials or web environment. The goal of H5P is to support the creation, sharing and reuse of interactive HTML5 based content. The individual types of tasks are available in the following categories: Games, Multimedia, Questions and Social Media. At present, the teachers can base their work on more than 40 types of interactive tasks, such as:

- Games (Memory Game, Flashcards, Image pairing, Arithmetic Quiz, Branching Scenario...);
- Multimedia (Agamotto, Dictation, Image Hotspots, Flashcards, Impressive Presentation…);
- Questions (Drag and Drop, Mark the Words, Multiple Choice, Questionnaire, Quiz…);
- Social media (Course Presentation).

A comprehensive overview of all task types is available from: h5p.org.

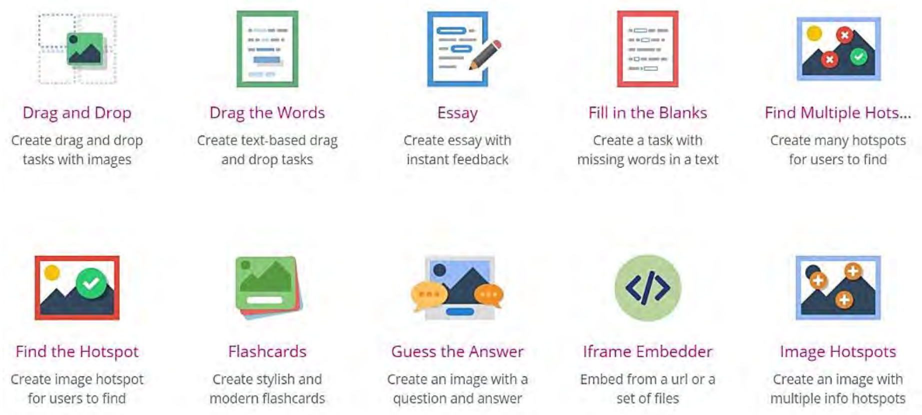


Figure 1: An Example of H5P Task Type Menu (Source: H5P)

In the Czech Republic, H5P was previously used in the preparation of educational materials for students of the Faculty of Education in Ostrava.

4. Aim of study

The paper presents a partial output of a complex problem aimed at the current use of interactive learning objects in primary education; their creation; incorporation of interactive learning objects into instruction and determining how they can help elementary school students develop their problem-solving skills.

The paper is aimed at creating interactive problem-based tasks that would help elementary school students develop their problem-solving skills, which is one of the main educational goals.

The rubric-based approach was used to categorize and analyze the available resources. The following criteria were used to determine whether or not a particular tool was suitable for creating problem-based tasks:

- Versatility (enables the user to create tasks for various subject areas);
- Simplicity, user-friendliness (enables even the technologically inexperienced users to create content);
- Functionality, technical support;
- System compatibility (can be integrated into the web environment, LMS, e-materials, etc.);
- Availability, open-source (price, access restrictions).

The H5P Interactive Content tool was chosen.

The study presents options for creating and using H5P interactive content, introduces task types and minimum requirements for their creation. Due to a large number of tasks, the HP5 interactive content was analyzed. The tasks were analyzed based on the following input criteria:

- Assessment, self-assessment (enables feedback and assessment of students' progress and results);
- Amount of integrated content:
- Complexity – from the description of a problem to its solution;
- Multimedia content – enables the use of animations, images, schemes, etc.;
- Tasks behavior setting – number of functionalities, display options and task behavior.

The paper presents two selected types of tasks that most correspond to the input requirements and provide significant potential in creating tasks designed to develop students‘ competencies to solve problems. They are the following:

- Branching Scenario;
- Drag and Drop.

With H5P, teachers can not only independently create their own tasks to practice problem tasks, but also support the idea of creating and sharing open learning resources.

5. Designing of H5P tasks

The teacher does not need any advanced programming skills to create tasks. The H5P tasks are largely created only by inserting content into predefined fields from which the content is lately generated. All tasks have a visually uniform template consisting of common attributes:

- Content section;
- Behavioral settings;
- Text overrides and translations;
- H5P options.

The teacher can transfer all the textual content of the task to the required mother tongue which the students will understand and so they will not be limited by their language literacy. Working with the created tasks during testing or practicing requires only basic skills working with a computer or mobile device, such as a keyboard or a mouse. Only content that matches the required data formats can be inserted into the H5P environment. Nevertheless, these formats are currently among the most widespread (e.g. MP4, WebM, jpeg, png) and widely available in terms of compatibility and openness. H5P also supports creation of tasks with different forms of evaluation (selection of one correct answer, multiple possible answers, open answer).

5.1 Branching scenario

5.1.1 Task description, reflection

This type presents a possibility of creating tasks based on students‘ decisions when solving problems and so offers a broad application potential. A task based on the principle of creating branched scenarios (so-called decision tree) with adaptive content. A task can contain an unlimited number of branches with the option of setting a continuous or final evaluation with feedback. A student working through the task is faced with a decision how to proceed (what to do, which option to choose in response to the mediated content – e.g. text, image or video) in order to solve the problem. Based on the student‘s particular choice a scenario corresponding to the given choice unfolds. Thus, the solution process consolidates adaptively with the students‘ answers. A task type with a broad application area (technical, non-technical, personal, social, etc.) tasks for different types of problems (decision making, technical, etc). Tasks can be designed as interactive and static.

5.1.2 Task design

This type of a task is more demanding in terms of design because of the number of functionalities it offers. However, that also makes it a very flexible tool with great potential for use. In addition of texts and images it also allows insertion of certain other types of H5P tasks, specifically Course Presentation, Image Hotspots or Interactive Video. Since through the Course Presentation task it is possible to embed other tasks, such as Dialog Cards, Drag Text, Drag and Drop etc., into the original task, the Branching Scenario task can be considered a broadly complex tool able to integrate most of the major H5P task types (see Fig. 2). Individual content elements can be combined in individual branches during the processing of a task. Nevertheless, the focus can be limited to only one major type of a task – for example Interactive Video (see 4.1.3. Example).

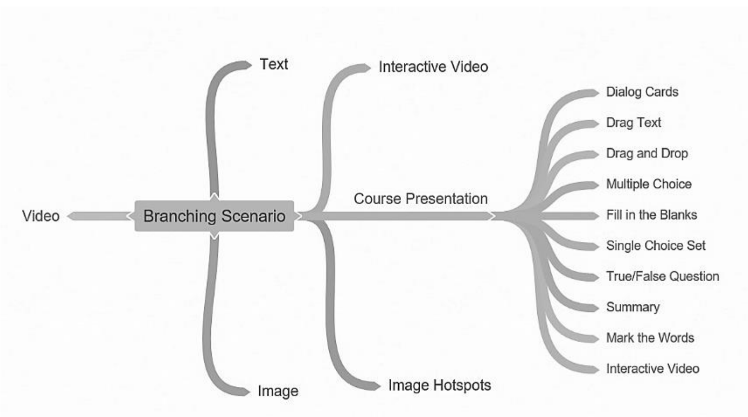


Figure 2: Branching Scenario vs. sub-nested types of H5P tasks

5.1.3 Example

Annotation example: Simulation Interactive Game for students that replicates and real-life situations - educational strategies based on simulation videos and the right decisions to solve the problem (the application of knowledge and skills related to establishing a therapeutic nurse-client relationship, see Simulation Game). Student based on video interaction select the most appropriate response, which allows him to further pass through the game, or mediate feedback (visual - video solution of the situation, descriptive, at the end of the game also contains a summary). In case of incorrectly chosen answers, the client refuses to cooperate further. The game supports active learning, problem solving and critical thinking skills.

Problem type: Decision-making

Question format: questions with answer choice (possible responses are classified as: *„Correct, Not the Best, and Incorrect"*).

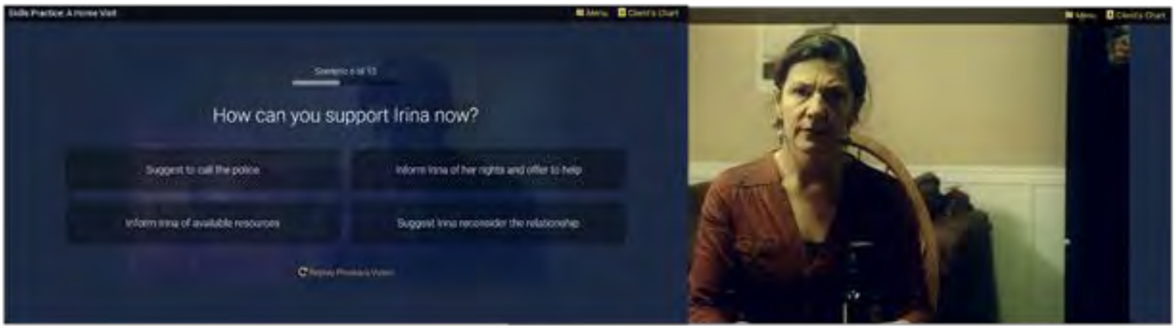


Figure 3: Examples Branching Scenario (Serious Learning 2015)

5.2 Drag and Drop

5.2.1 Task description, reflection

A task where images or texts are moved to the correct places are used primarily in decision-making or system analysis and design tasks. Tasks suitable for static problem solving.

Through the Drag and Drop task, pupils link pairs a drop zones and picture or text based on the correctness of the solution. Feedback is available after sending a response to the verification using a Score range and Feedback for defined score range. At the same time, descriptive feedback can be defined for each correct and incorrect response.

5.2.2 Task design

Drag and Drop design works with a combination of images and texts. An image is placed in the background (e.g. diagram, plan, and map), in which the author marks sections reserved for text or image content. The second way to create this type of task where a background is not significant, is to create (1) a drop section with a label and (2) images that are subsequently linked by a key (useful when matching concepts, names or objects with their visuals). H5P allows placing content into more than one section, which is effective when a task can have more than one correct solution. Nowadays, when a picture can be created simply by using a screen shot, it is possible to extend the validity of the task, for example, by tables, to which the students can add missing fields by dragging words.

5.2.3 Example

Annotation example: a sample task type is presented on an example of the task called "Happy Birthday" that was designed for PISA 2012. The main objective of the task is properly placed persons in accordance with the terms of respecting the seating.

Problem type: Analysis and creating a system

Question format: questions with answer choice

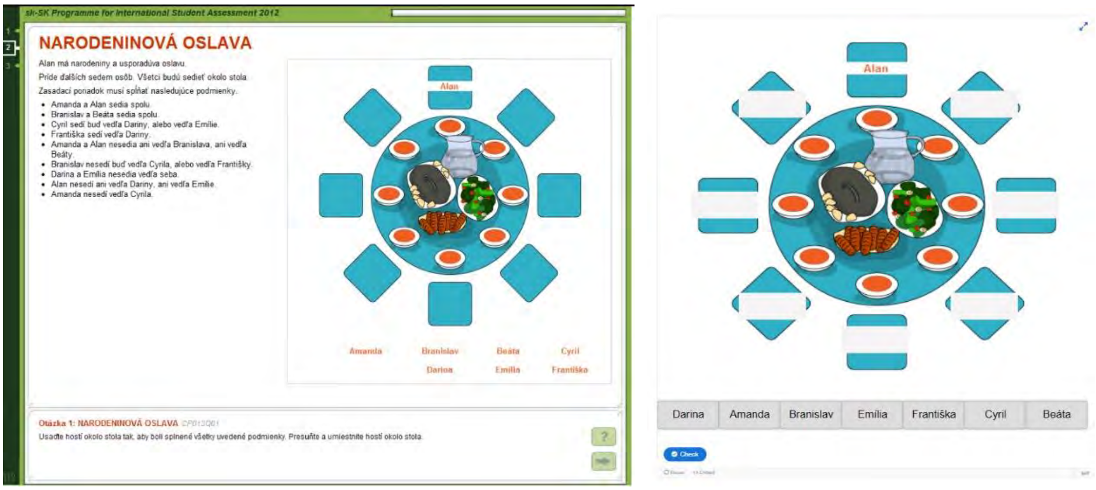


Figure 4: Happy birthday - PISA 2012 (Zatloukal 2014) and H5P

Note: PISA 2015 mapping capabilities of team problem solving, using different scenarios. Tasks in these cases work with so-called agents who substitute other persons for solving problems (Blažek and Boudová, 2017). This option H5p does not support

Obviously, the Drag and Drop task itself (not only) provides a workspace to solve a task without the ability to display input information - task assignment and other associated instructions. This deficiency is eliminated by a task called Column, which allows you to compose interactive H5P content (different types of tasks or multimedia elements) below each other. Thus, the teacher can create tasks that contain all the necessary attributes (see 4.2.4. Example - Column).

5.2.4 Example column

Annotation example: Drawing with Scratch - the purpose of the problem task is to draw a picture according to the template based on the commands. To fulfill the task, the students have available sample cases to help them in solving problems. The task consists of a total of 5 parts of the interactive H5P content (see Fig. 5).

Problem type: Analysis and creating a system

Question format: questions with answer choice

The task consists of:

- A table snapshot (can be created in text or spreadsheet editor);
- Pictures of Scratch commands and outputs;
- Text (assignment, instructions).

To create a given type of task, you need only basic PC skills - especially, ability to work with spreadsheet or text editor, taking screenshots of a monitor and making basic adjustments to graphical outputs (especially cropping the image).

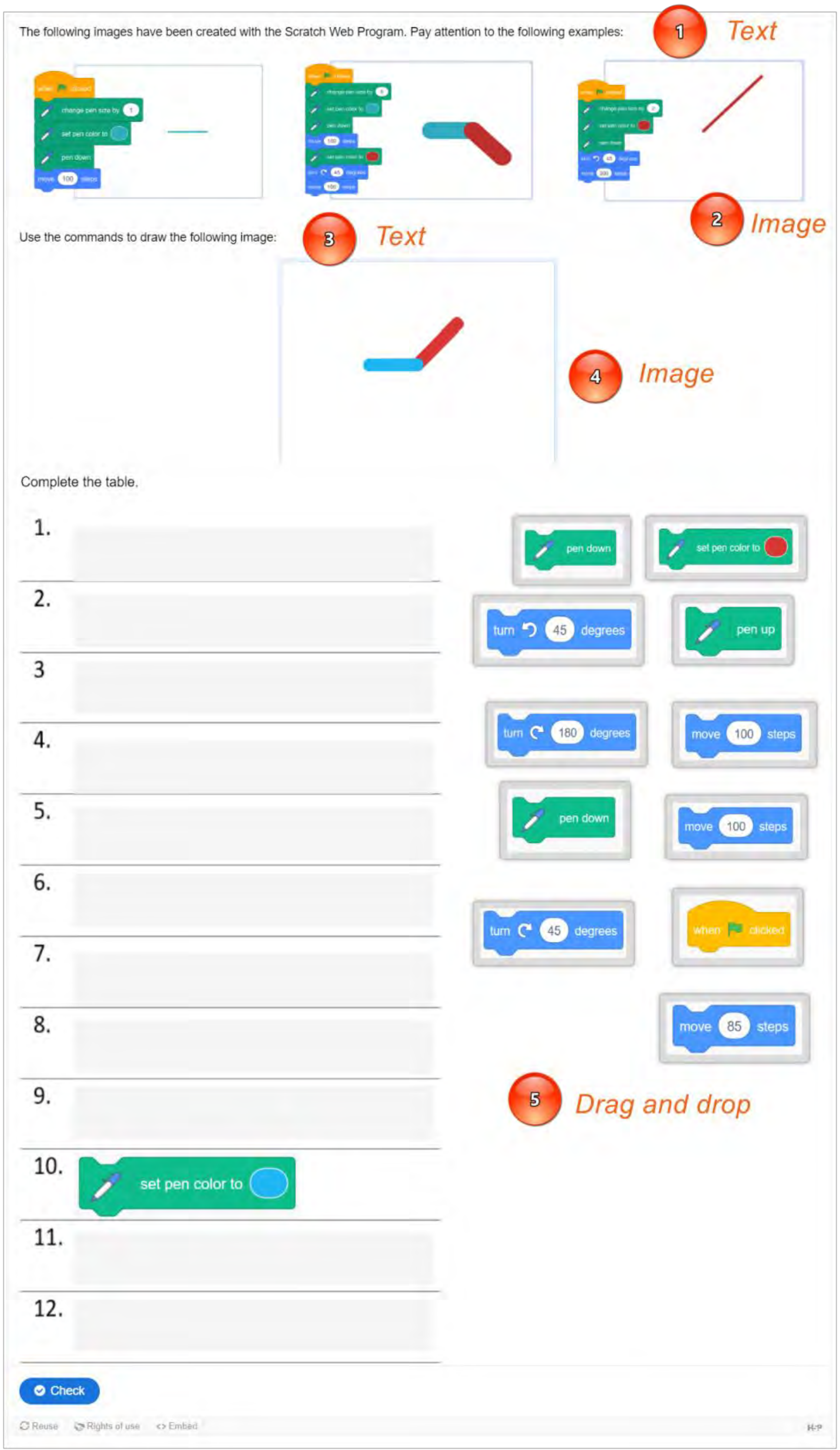


Figure 5: Drawing with Scratch

6. Conclusion

Current trends in the Czech Republic follow the direction of supporting the development of computational thinking, digital literacy and key competencies in students where problem-solving competency is also represented. Problem-solving capacity is considered to be a higher order skill and it is extremely important to start its development in elementary education, when students prepare for the future. Connected with the testing of problem-solving skills level in elementary school students is, for example, the PISA survey conducted under the auspices of the OECD. In addition to developing the competency, the schools also strive to properly prepare their students for testing. H5P represents one of the available tools for independent creation of interactive exercises and problem tasks designed to support problem-solving skills. H5P allows teachers to create interactive objects free of charge at the level of elementary education and without the need to master any programming language. By selecting from more than 40 types of tasks, a number which continues to grow, the majority of problem tasks the students can encounter can be easily covered. Although H5P does not reach such a level of behavioral data analysis of student activity as is recorded by PISA directly into the computer system, there are some options such as measuring the time needed to solve a task, setting feedback in case of successful or unsuccessful attempts or the option to repeat the task in order to get better results. The complexity of H5P design varies depending on the type of the selected task – from trivial to tasks that combine number of sub-types of H5P tasks. In terms of content, it is up to the teacher, in what way, how appropriate in quality and how difficult the tasks will be (supports the recommendation of involving all cognitive challenges in a balanced, adapted ratio). The following paper presents the possibilities of creating problem tasks such as Drag and Drop and Branching Scenario in H5P, based on the conceptual framework used in the international PISA survey of 15-year-old students. Despite some limitation (eg absence of virtual agents as co-investigators), H5P can be considered a flexible and versatile tool for creating interactive activities and exercises to support the development of key competencies in students.

Acknowledgements

This paper was supported by the Student Grant Competition of the University of Ostrava. Project Title: Using interactive learning objects to develop problem-solving competencies - SGS02/PdF/2019.

References

Bělecký, Z. (2007) Klíčové kompetence v základním vzdělávání, Prague.

Blažek, R. and Boudova, S. (2017) Národní zpráva PISA 2015: týmové řešení problémů, dotazníkové šetření, ČŠI.

Csapó, B. and Funke, J. (2017) The Nature of Problem Solving: Using Research to Inspire 21st Century Learning, OECD Publishing, Paris.

Češková, T. (2016) Výukové situace rozvíjející kompetenci k řešení problémů: teoretický model jako východisko pro analýzu výuky. Pedagogika, 66(5), pp 530-548.

Dostal, J. (2015) A Contribution to a theory of problem solving, Trends in Education, 8(1), pp 44-53.

Fischer, A., Greiff, S., Wüstenberg, S., Fleischer, J., Buchwald, F., and Funke, J. (2015) Assessing analytic and interactive aspects of problem solving competency [Online], Learning And Individual Differences, 39, pp 172-179.

H5P [online], Available from: https://h5p.org.

Havlová, M., Janoušková, S. and Pumpr, V. (2010) Využití komplexních úloh ve výuce chemie, Metodický portal RVP.

Hämäläinen, R., De Wever, B., Nissinen, K., and Cincinnato, S. (2019) What makes the difference – PIAAC as a resource for understanding the problem-solving skills of Europe's higher-education adults [Online], Computers & Education, 129, pp 27-36.

Hesová, A., Kitzbergerová, L., Kocourková, Š., Koubek, P., Maršák, J. et al (2011) Klíčové kompetence ve výuce na základní škole a gymnáziu, Prague.

Chlupáč, A. (2008) Rozvoj klíčových kompetencí žáka při řešení problémových učebních úloh v chemickém vzdělávání. Pedagogická orientace, 18(4), pp 73-82.

Informatics thinking [online], 2018, Available from: https://www.imysleni.cz/imysleni.cz.

Knecht, P. (2014) Příležitosti k rozvíjení kompetence k řešení problémů v učebnicích a ve výuce zeměpisu.

Knecht, P., Janík, T., Najvar, P., Najvarová, V. and Vlčková, K. (2010) Příležitost k rozvíjení kompetence k řešení problémů ve výuce na základních školách, ORBIS SCHOLAE, 4(3), pp 37-62.

Kocourková, Š., and Pastorová, M. (2011) Pojetí klíčových kompetencí v kurikulech vybraných zemí, Prague.

MŠMT (2017), Rámcový vzdělávací program pro základní vzdělávání, Prague.

Müller, A. and Helmke, A. (2008) Qualität von Aufgaben als Merkmale der Unterrichtsqualität verdeutlicht am Fach Physik, In: J. Thonhauser, Aufgaben als Katalysatoren von Lernprozessen, pp 31–46, Münster.

Palečková, J., Tomášek, V. and Blažek, R. (2014) Mezinárodní šetření PISA 2012: schopnost patnáctiletých žáků řešit problémy, Prague.

Serious Learning (2015) Skills Practice: A Home Visit, Ryerson University, Available at: https://de.ryerson.ca/games/nursing/mental-health/game.html#/.

Šlejšková, L. and Gošová, V. (2011) Řešení problémů (kompetence). Metodický portál RVP: wiki.

Zatloukal, T. (2014) PISA 2012: oblast řešení problémů. Prague.

On the Role of Unplugged Programming in K-12 Education

Niklas Humble[1], Peter Mozelius[1] and Lisa Sällvin[2]
[1]Department of Computer and System Science, Mid Sweden University, Östersund, Sweden
[2]Department of Information Systems and Technology, Mid Sweden University, Sundsvall, Sweden
niklas.humble@miun.se
peter.mozelius@miun.se
lisa.sallvin@miun.se
DOI: 10.34190/EEL.19.049

Abstract: The integration of programming in K-12 setting is a global phenomenon with different implementations in different countries. In Sweden this is a rapid process where programming should be a part of K-12 mathematic and technology with an implementation during 2018 and 2019. The time frame has been narrowly defined, but there are few directives considering which types of programming that should be used. Three main programming types are textual programming, block programming and unplugged programming, this study has a focus on unplugged programming. The research question to answer was: Which are K-12 teachers attitudes on the role of unplugged programming in education? The research study has been a qualitative cross-sectional study with the aim to collect teachers' attitudes towards unplugged programming halfway through their introductory programming course. Cross-sectional study is an approach to capture snapshots of an ongoing process at a given point in time. Data were collected from discussions and online postings during a workshop in the above-mentioned programming course. Participants postings have been grouped into categories in a content analysis based on the frequency of occurrence and relevance for answering the research question. Findings show that most teachers see a benefit of unplugged programming as a means to learn the fundamental programming concepts in their teaching and learning activities. However, there are different opinions on when this unplugged introduction should occur. Some teachers also pointed out that unplugged programming could be used as an alternative to block programming and textual programming when the digital environment lacks or fails. Conclusions are that unplugged activities are a valuable complement to block programming and textual programming, but teachers have different opinions on the optimum age group for unplugged programming activities. The recommendations for K-12 teachers is to seriously consider the unplugged complement, both for pedagogical reasons and as a never-failing analogue backup.

Keywords: unplugged programming, block programming, textual programming, K-12 education, teacher professional development

1. Introduction

A global phenomenon during recent years have been the integration of programming in K-12 education, where the levels and time plans for the implementation vary between different countries (Balanskat & Engelhardt, 2015). Some of the expectations for this integration are that it should equip students with skills such as self-efficacy, problem solving and reasoning skills that can be beneficial for other subjects, and not only computational thinking skills (Psycharis & Kallia, 2017; Duncan & Bell, 2015). The Swedish government approved a new curriculum for K-12 education in mars 2017 to be implemented during 2018. This contained explicit directives for mathematics and technology to work with programming, algorithms, problem solving, and controlling physical artefacts; and with mentions of programming and digital competence as interdisciplinary traits. (Heintz et al, 2017) Even though the first mentioned time frame for the implementation have passed, many teachers still perceive a lack of concrete guidelines concerning from their schoolboards and the Swedish National Agency for Education (Humble & Mozelius, 2019).

The traditional way of learning and applying programming is trough textual programming, which could be carried out in programming languages such as Python or Java. However, two other types of programming have gained in popularity in educational settings: block programming and unplugged programming. Block programming can be conducted through the programming tool Scratch, while unplugged programming is programming without the use of a computer. (Faber et al, 2017; Wohl, Porter & Clinch, 2015; Bell et al, 2009) Both block programming and unplugged programming are also mentioned at the website for the Swedish National Agency for Education as recommendations for K-12 teachers that want to involve programming in their teaching and learning activities (Swedish National Agency for Education, 2019).

Research on programming education has traditionally had a focus on programming in higher education, and since the implementation of programming in K-12 settings recently has started, there are relatively few studies in this area. Earlier studies on K-12 programming mainly have a focus on textual programming and block programming. In this study the focus was on unplugged programming, in a strive to answer the question: *Which are K-12 teachers attitudes on the role of unplugged programming in education?*

2. Extended background

In this section the three main types of programming, textual programming, block programming and unplugged programming, are presented with research related to educational contexts. Lastly, a brief summary of research concerning computational thinking in education is presented.

2.1 Textual programming

A computer processor can only execute binary instructions, and writing such instructions is difficult as well as time consuming for humans. To facilitate for programmers the first assembly language was developed at the Cambridge University in the 1940s where binary instructions were aligned to mnemonics. Sometimes, but not that often, computer programs are still written in an assembly language, but the vast majority of programs are today written in high-level languages where one single instruction in a programming language such as Python can correspond to tens or hundreds of machine instructions. (Gaddis, 2011)

The first high-level programming language FORTRAN was created and introduced by IBM in the 1950s, a language with textual programming interface close to modern programming languages like Java and Python. Imperative textual programming is carried out with combinations of statements, selections, iterations, constants and variables together as textual code in a file that later is checked by a compiler or an interpreter (Erwig & Meyer, 1995). Like in assembly languages, reading and writing code can be hard in traditional textual languages like C, C++ or Perl. In the early 1990s new programming languages such as Java and Python emphasised the importance of high readability (Lutz, 2001).

Python is a modern programming language with high readability and high writability designed and developed by a team led by Guido Van Rossum. The language is multi-paradigm in the sense that the Python language, seen as a snake, could change its imperative skin to an object-oriented one, or use the built-in features that supports functional or aspect-oriented programming (Lutz, 2001; Van Rossum, 2007). Python's dynamic flexibility in combination with its high readability and high writability makes the language an interesting candidate for a multi-purpose programming tool in K-12 settings. However, for the younger age groups block programming and unplugged programming are interesting alternatives.

2.2 Block programming

Block programming can be described as a graphical or visual representation of a programming code, for example with the use of graphical icons or blocks that can be combined (Lavonen et al, 2003). The development of block programming is by many considered to start with the LISP-LOGO programming language, that was developed to be an easier and more visual alternative to its textual predecessor LISP, in its use of graphical commands (Jehng & Chan, 1998). Perhaps the most widespread block programming tool used in K-12 settings is Scratch (Lye & Koh, 2018), an environment that was developed by the Lifelong Kindergarten research group at MIT Media Lab. The Scratch environment has a similar approach to programming as how we build things with LEGO bricks (Brennan & Resnick, 2012; Resnick et al, 2009). A strength mentioned about Scratch is that it includes key factors for a broad participation among both boys and girls in that it combines programming with music, storytelling and art (Maloney et al, 2010; Rusk et al, 2008).

Research suggests that block programming, with its relatively low threshold compared to textual programming, can be used to teach students the basics of computer programming, while still maintaining the opportunity to support large and complex programming projects (Shute, Sun & Asbell-Clarke, 2017; Tundjungsari, 2016; Resnick et al., 2009). Further, studies indicate that an introduction to programming through block programming, can enhance students' performance in later programming assignments, providing a wider understanding for the place of the code in the software development cycle (Topalli & Cagiltay, 2018). Block programming tools, such as Scratch, also have a clear connection to the concept of computational thinking, since it is designed to create interactive multimedia products and through that facilitate engagement in, and development of, computational thinking skills (Lye & Koh, 2018). Block programming tools have also been used to develop frameworks for assessment of computational thinking skills (Brennan & Resnick, 2012).

2.3 Unplugged programming

Unplugged programming can be described as programming without the use of a computer (Aranda & Ferguson, 2018; Faber et al, 2017; Wohl, Porter & Clinch, 2015; Bell et al, 2009) and was first developed at the University of Canterbury in New Zealand, providing teaching material for computer science in an unplugged environment (Aranda & Ferguson, 2018; Wohl, Porter & Clinch, 2015; CSUnplugged, 2019). Unplugged programming can take various form, from boardgames (Tsarava, Moeller & Ninaus, 2018; Jagušt et al, 2018) to controlling each other or something with commands or written instructions (Aranda & Ferguson, 2018; Miller et al, 2018; Faber et al, 2017; Wohl, Porter & Clinch, 2015). An advantage mentioned about the unplugged approach, compared to the more traditional use of digital devices, is that it can be especially important for schools with low technical resources or lack of stable access to the internet or electricity (Brackmann et al, 2017).

Research surrounding unplugged programming suggests that it can be used to teach computing concept to both students and teachers (Bell & Vahrenhold, 2018; Curzon et al, 2014), as well as some aspects of computational thinking (Tsarava, Moeller & Ninaus, 2018; Brackmann et al, 2017). Unplugged activities are also used to teach basic programming and robotic manipulation to students (Miller et al, 2018; AlAmer et al, 2015). However, research suggests that there is a need for further investigations of the benefits and drawbacks of unplugged activities long-term impact on computational thinking skills, and when digital devices need to be introduced (Brackmann et al, 2017; AlAmer et al, 2015). There is also research indicating that certain types of unplugged activities have no impact on students perceived understanding of computational thinking, or on their attitudes towards computer science (Feaster et al, 2011).

2.4 Computational thinking

Computational thinking is a recurrent concept in research about programming education and its potential effect on students learning. However, research indicates that there are some uncertainties about what computational thinking entails (Shute, Sun & Asbell-Clarke, 2017; Román-González, Pérez-González, & Jiménez-Fernández, 2017; Weintrop et al, 2016; Brennan & Resnick, 2012). The concept of computational thinking stems back to the work of Papert (1980, 1991) and have its basis in the idea of constructionism (Aranda & Ferguson, 2018; Shute, Sun & Asbell-Clarke, 2017). The term was coined by Wing (2006), who described computational thinking as a way of using the fundamentals of computer science to solve problems, design systems, and understand human behaviour (Shute, Sun & Asbell-Clarke, 2017; Chen et al, 2017; Wing, 2006).

Brennan and Resnick (2012) have developed a framework for assessment of computational thinking where it is suggested that computational thinking stretch over computational concepts, computational practices, and computational perspectives as its three key dimensions. A more recent study by Shute, Sun and Asbell-Clarke (2017) suggests the following definition “The conceptual foundation required to solve problems effectively and efficiently (i.e, algorithmically, with or without the assistance of computers) with solutions that are reusable in different context”. Based on this definition and on previous research they have constructed a model for computational thinking encompassing the following aspects: decomposition, abstraction, algorithms, debugging, iteration, and generalisation (Shute, Sun & Asbell-Clarke, 2017). Considering the development of computational thinking skills, studies have indicated that computational thinking is not necessarily developed through the teaching of programming, and seems to need more explicit teaching strategies to support the development of computational thinking (Duncan & Bell, 2015).

3. The programming course

The course referred to in this study was held in Mid Sweden region for mathematics and technology teachers in K-12 education. It was given during twenty weeks in spring 2019, at 25% study pace corresponding to 7.5 ECTS. The participants had little or no prior experience in programming or how programming can be used as a tool in their education.

The course was divided in five sections: ‘Programming in school, why, what and how?’. ‘The fundamental building blocks of programming’, ‘Didactics for Technology and Mathematics’, ‘Didactics for programming education’ and ‘Project work’ (Mozelius, 2018). General aspects of digitalisation and computational thinking of

K-12 education were presented and discussed, before introducing the fundamentals of programming with textual programming in Python and block programming in Scratch. These two different programming types were then used in parallel throughout the course to show similarities and differences, strengths and weaknesses when used in mathematics and technology education. Unplugged programming was later introduced in the section for programming didactics.

Each section combined face-to-face meetings with lectures and interactive workshops, followed by online learning organised in the Moodle virtual learning platform. The participants were encouraged to create local study groups to collaborate and share ideas during the course.

4. Methodology

The research strategy was a qualitative cross-sectional study with the idea of capturing K-12 teachers' attitudes towards unplugged programming. An identified disadvantage with cross-sectional studies are that they only depict the situation at the actual chosen time (Bryman, 2016:690). On the other hand, this type of studies could be useful for identifying phenomena that later can be followed-up with more detailed and more longitudinal studies (Mann, 2003). Cross-sectional studies are often carried out with a quantitative design, but there are also many examples of qualitative cross-sectional studies in contemporary research (Rosemann & Szecsenyi, 2004; Moja et al., 2014; Keleş, Kavas & Yalım, 2018).

In this cross-sectional snapshot the teacher attitudes were collected halfway through an introductory programming course for K-12 teachers in mathematics and technology during the 2019 spring semester. Data were gathered during a workshop session in the course where teachers had group discussions on advantages and disadvantages of unplugged programming. Before the group discussions, a video of an unplugged programming lesson (Code.org, 2015) was shown and each teacher posted a brief summary of their individual thoughts on the subject. The activity was based on the questions: "Do you see a place for unplugged programming and computational thinking in your teaching activities?", and "What knowledge in programming would you like the students to acquire before they reach your level of education?". The video and their individual online postings were later used as the starting point for the group discussions.

The course participants online postings were analysed with content analysis for systematically examination of occurrence in the data and to identify relevant topics (Bryman, 2016:283; Drisko & Maschi, 2015:25-26). Findings from the analysis were further gathered and structured in a spread sheet document with the help of inductive coding (Driskp & Maschi, 2015:43). Results from the analysis were later compared to the observations of the workshop discussions.

5. Results and discussions

A majority in the online postings includes ideas on how to use unplugged programming in teaching and learning activities. Corresponding to findings presented in previous research, the most common fields of use mentioned were: as an introduction to other kinds of programming or computational thinking, and as a compliment to other types of programming activities (Bell & Vahrenhold, 2018; Tsarava, Moeller & Ninaus, 2018; Brackmann et al, 2017; Miller et al, 2018; AlAmer et al, 2015; Curzon et al, 2014). Some more concrete examples from the postings are: to explain a mathematical concept, to show and explain a though process, how to break down problems in smaller parts, and how to better write and structure code.

Some teachers also mention in their online postings that unplugged programming probably might constitute a majority of their programming activities in the classroom, due to the technical limitations at their schools. This was further discussed and elaborated later during the workshop. This is coherent with the strength about unplugged programming as a way for schools with low technical resources to still get started with programming activities (Brackmann et al, 2017). However, it could also be argued that this is a sign of inequality between schools in their technical ability to make the integration of programming successful.

Duncan and Bell (2015) mention that it is not clear that unplugged activities have the desired impact on students understanding and attitudes. This was an aspect of unplugged programming that was discussed during the workshop, and mentioned in some of the online posting, as reason for not using unplugged programming in the classroom. Two examples of what was discussed, and mentioned in the online postings, were that the benefits of unplugged programming activities were unclear, and that unplugged programming possibly is more suited for younger students with no, or little, experience in programming or computers.

Regarding what programming knowledge and skills teachers would like their students to have when they reach their level of education (grade 7-12), the most common aspects discussed during the workshop and mentioned in the online postings corresponds with aspects of computational thinking (Shute, Sun & Asbell-Clarke, 2017; Brennan & Resnick, 2012). For example, that the students should have basic knowledge of programming concepts, computational thinking, problem solving, and an understanding of the instruction-structure. Some also mentioned that they would prefer if students had some prior experience in programming, for example in block programming. On the other hand, some teachers mentioned that they would prefer that students had no prior experience in programming, to better match the current level of teachers' proficiency in the field.

6. Conclusion

The conclusion of this study is that the participating K-12 teachers are generally positive towards the use of unplugged programming in education. There is, however, an uncertainty among the teachers about when and to what extent unplugged programming should be used, which corresponds with existing research in the field. An unexpected but interesting finding, was that many teachers discussed the possibility of using unplugged programming as a back-up, or even as the main programming activity, in their teaching activities due to the lack of technological resources in their schools.

Considering the need of further research on the long-term benefits of unplugged programming, mentioned in previous research, authors’ recommendation is that unplugged programming should be used together with other kinds of programming and computational thinking activities, and not as an isolated activity. This have the potential of making unplugged activities a valuable compliment in the classroom, as an introductory step to block programming and textual programming. Finally, unplugged programming could also be used as a never-failing analogue back-up in case of technical problems or lack of digital equipment.

7. Future research

Since the integration of programming in K-12 education is affecting teachers to a great extent, a next interesting step would be to combine unplugged programming with textual programming and block programming in future research. Such a study could further, and to a greater extent, examine similarities and differences in teacher attitudes towards programming in K-12 education relating to the type of programming used.

References

AlAmer, R. A., Al-Doweesh, W. A., Al-Khalifa, H. S., & Al-Razgan, M. S. (2015, October). Programming unplugged: bridging CS unplugged activities gap for learning key programming concepts. In *2015 Fifth International Conference on e-Learning (econf)* (pp. 97-103). IEEE.

Aranda, G., & Ferguson, J. P. (2018). Unplugged Programming: The future of teaching computational thinking?. *Pedagogika*, *68*(3), 279-292.

Bell, T., Alexander, J., Freeman, I., & Grimley, M. (2009). Computer science unplugged: School students doing real computing without computers. *The New Zealand Journal of Applied Computing and Information Technology*, *13*(1), 20-29.

Bell, T., & Vahrenhold, J. (2018). CS Unplugged—How Is It Used, and Does It Work?. In *Adventures Between Lower Bounds and Higher Altitudes* (pp. 497-521). Springer, Cham.

Balanskat, A., & Engelhardt, K. (2015). Computing our future computer programming and coding-priorities, school curricula and initiatives across Europe. Brussels, Belgium: European Schoolnet.

Brackmann, C. P., Román-González, M., Robles, G., Moreno-León, J., Casali, A., & Barone, D. (2017, November). Development of computational thinking skills through unplugged activities in primary school. In *Proceedings of the 12th Workshop on Primary and Secondary Computing Education* (pp. 65-72). ACM.

Brennan, K., & Resnick, M. (2012, April). New frameworks for studying and assessing the development of computational thinking. In *Proceedings of the 2012 annual meeting of the American Educational Research Association, Vancouver, Canada* (Vol. 1, p. 25).

Bryman, A. (2016). *Social research methods*. Oxford university press.

Chen, G., Shen, J., Barth-Cohen, L., Jiang, S., Huang, X., & Eltoukhy, M. (2017). Assessing elementary students’ computational thinking in everyday reasoning and robotics programming. *Computers & Education*, *109*, 162-175.

Code.org (2015). *Unplugged Lessons in Action – Graph Paper Programming [Video File]*. Retrieved from: https://youtu.be/vBUtejDNvrs [Accessed 2019, June 4]

CSUnplugged (2019). *Computer Science Without a Computer*. Retrieved from: https://csunplugged.org/en/ [Accessed 2019, June 3]

Curzon, P., McOwan, P. W., Plant, N., & Meagher, L. R. (2014, November). Introducing teachers to computational thinking using unplugged storytelling. In *Proceedings of the 9th workshop in primary and secondary computing education* (pp. 89-92). ACM.

Drisko, J. W., & Maschi, T. (2015). *Content analysis*. Pocket Guides to Social Work Research Methods.

Duncan, C., & Bell, T. (2015, November). A pilot computer science and programming course for primary school students. In *Proceedings of the Workshop in Primary and Secondary Computing Education* (pp. 39-48). ACM.

Erwig, M., & Meyer, B. (1995). Heterogeneous visual languages-integrating visual and textual programming. In *Proceedings of Symposium on Visual Languages* (pp. 318-325). IEEE.

Faber, H. H., Wierdsma, M. D., Doornbos, R. P., van der Ven, J. S., & de Vette, K. (2017). Teaching computational thinking to primary school students via unplugged programming lessons. *Journal of the European Teacher Education Network*, *12*, 13-24.

Feaster, Y., Segars, L., Wahba, S. K., & Hallstrom, J. O. (2011, June). Teaching CS unplugged in the high school (with limited success). In *Proceedings of the 16th annual joint conference on Innovation and technology in computer science education* (pp. 248-252). ACM.

Gaddis, T. (2011). *Starting out with Python*. Addison-Wesley Publishing Company.

Heintz, F., Mannila, L., Nordén, L. Å., Parnes, P., & Regnell, B. (2017). Introducing programming and digital competence in Swedish K-9 education. In *International Conference on Informatics in Schools: Situation, Evolution, and Perspectives* (pp. 117-128). Springer, Cham.

Humble, N. & Mozelius, P. (2019). *Teacher perception of obstacles and opportunities in the integration of programming in K-12 settings*. In proceedings of EDULEARN 2019.

Jagušt, T., Krzic, A. S., Gledec, G., Grgić, M., & Bojic, I. (2018, October). Exploring Different Unplugged Game-like Activities for Teaching Computational Thinking. In *2018 IEEE Frontiers in Education Conference (FIE)* (pp. 1-5). IEEE.

Jehng, J. C. J., & Chan, T. W. (1998). Designing computer support for collaborative visual learning in the domain of computer programming. *Computers in human behavior*, *14*(3), 429-448.

Keleş, Ş., Kavas, M. V., & Yalım, N. Y. (2018). LGBT+ individuals' perceptions of healthcare services in Turkey: A cross-sectional qualitative study. *Journal of bioethical inquiry*, *15*(4), 497-509.

Lavonen, J. M., Meisalo, V. P., Lattu, M., & Sutinen, E. (2003). Concretising the programming task: a case study in a secondary school. *Computers & Education*, *40*(2), 115-135.

Lutz, M. (2001). *Programming python*. " O'Reilly Media, Inc.".

Lye, S. Y., & Koh, J. H. L. (2018). Case Studies of Elementary Children's Engagement in Computational Thinking Through Scratch Programming. In *Computational Thinking in the STEM Disciplines* (pp. 227-251). Springer, Cham.

Maloney, J., Resnick, M., Rusk, N., Silverman, B., & Eastmond, E. (2010). The scratch programming language and environment. *ACM Transactions on Computing Education (TOCE)*, *10*(4), 16.

Mann, C. J. (2003). Observational research methods. Research design II: cohort, cross sectional, and case-control studies. *Emergency medicine journal*, *20*(1), 54-60.

Miller, B., Kirn, A., Anderson, M., Major, J. C., Feil-Seifer, D., & Jurkiewicz, M. (2018, October). Unplugged Robotics to Increase K-12 Students' Engineering Interest and Attitudes. In *2018 IEEE Frontiers in Education Conference (FIE)* (pp. 1-5). IEEE.

Moja, L., Liberati, E. G., Galuppo, L., Gorli, M., Maraldi, M., Nanni, O., ... & Vaona, A. (2014). Barriers and facilitators to the uptake of computerized clinical decision support systems in specialty hospitals: protocol for a qualitative cross-sectional study. *Implementation Science*, *9*(1), 105.

Mozelius, P. (2018). Teaching The Teachers To Program: On Course Design and Didactic Concepts. In *11th annual International Conference of Education, Research and Innovation*(Vol. 11). IATED.

Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas*. Basic Books, Inc.

Papert, S. (1991). Situating Constructionism. I. Harel, & S. Papert (Eds), Constructionism. Norwood.

Psycharis, S., & Kallia, M. (2017). The effects of computer programming on high school students' reasoning skills and mathematical self-efficacy and problem solving. *Instructional Science*, *45*(5), 583-602.

Resnick, M., Maloney, J., Monroy-Hernández, A., Rusk, N., Eastmond, E., Brennan, K., Millner, A., Rosenbaum, E., Silver, J., Silverman, B. & Kafai, Y. B. (2009). Scratch: Programming for all. *Commun. Acm*, *52*(11), 60-67.

Román-González, M., Pérez-González, J. C., & Jiménez-Fernández, C. (2017). Which cognitive abilities underlie computational thinking? Criterion validity of the Computational Thinking Test. *Computers in Human Behavior*, *72*, 678-691.

Rosemann, T., & Szecsenyi, J. (2004). General practitioners' attitudes towards research in primary care: qualitative results of a cross sectional study. *BMC Family Practice*, *5*(1), 31.

Rusk, N., Resnick, M., Berg, R., & Pezalla-Granlund, M. (2008). New pathways into robotics: Strategies for broadening participation. *Journal of Science Education and Technology*, *17*(1), 59-69.

Shute, V. J., Sun, C., & Asbell-Clarke, J. (2017). Demystifying computational thinking. *Educational Research Review*, *22*, 142-158.

Swedish National Agency for Education / Skolverket (2019, May 23). *Getting started with programming / Kom igång med programmering.* Retrieved from: https://www.skolverket.se/skolutveckling/inspiration-och-stod-i-arbetet/stod-i-arbetet/kom-igang-med-programmering [Accessed 2019, June 3]

Topalli, D., & Cagiltay, N. E. (2018). Improving programming skills in engineering education through problem-based game projects with Scratch. *Computers & Education*, *120*, 64-74.

Tsarava, K., Moeller, K., & Ninaus, M. (2018). Training Computational Thinking through board games: The case of Crabs & Turtles. *International Journal of Serious Games*, *5*(2), 25-44.

Tundjungsari, V. (2016, February). E-learning model for teaching programming language for secondary school students in Indonesia. In *2016 13th International Conference on Remote Engineering and Virtual Instrumentation (REV)* (pp. 262-266). IEEE.

Van Rossum, G. (2007). Python Programming Language. In *USENIX annual technical conference* (Vol. 41, p. 36).

Weintrop, D., Beheshti, E., Horn, M., Orton, K., Jona, K., Trouille, L., & Wilensky, U. (2016). Defining computational thinking for mathematics and science classrooms. *Journal of Science Education and Technology*, *25*(1), 127-147.

Wing, J. M. (2006). Computational thinking. *Communications of the ACM*, *49*(3), 33-35.

Wohl, B., Porter, B., & Clinch, S. (2015, November). Teaching Computer Science to 5-7 year-olds: An initial study with Scratch, Cubelets and unplugged computing. In *Proceedings of the Workshop in Primary and Secondary Computing Education* (pp. 55-60). ACM.

A Comparative Study on Language Teachers' Perceptions of ICT Self-Efficacy

Ilknur Istifci
Anadolu University, Eskisehir, Turkey
iistifci@anadolu.edu.tr
DOI: 10.34190/EEL.19.060

Abstract: ICTs are vital both in our lives and in education. The effective integration of ICTs into education is thought to enable citizens and workers to acquire functional and critical thinking skills such as information literacy, media literacy, and ICT literacy in the 21st century (Partnership, 2015). Language teaching cannot be thought without considering the use of ICTs. Language teachers are required to make use of ICTs in language education to make learning enjoyable, colourful and more learner-centred. The aim of this study is to find out foreign language teachers' ICT self-efficacy perceptions. 35 language teachers who are teaching English, French, German and Russian in an intensive language learning program of a Turkish state university participated in the study. The data were collected via the "ICT Self-Efficacy Perception Scale" (ICTSEPS) developed by Ekici, Ekici and Kara (2012). English, French, German and Russian language teachers' perceptions of ICT Self-Efficacy were compared. The data of ICTSEPS were analysed on SPSS 22 packaged software using descriptive statistics finding means and standard deviations. Semi-structured interviews were also carried out with some volunteering language teachers. Interview data were analyzed to find emerging themes and these were categorized using Constant Comparison Method. The results showed that language teachers use ICTs in their lessons and in their lives and they have high ICT self-efficacy. However, English language teachers were found to have higher ICT self-efficacy compared to French, German and Russian language teachers. Based on the results, certain implications were drawn from the study in order to organize language teaching and learning programs that utilize ICTs.

Keywords: e-learning, language learning, ICTs in language teaching, ICT self-efficacy, ICT integration

1. Introduction

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). Today, ICTs are indispensable for our lives and they have been used widely everywhere from hospitals to schools. There are national and international initiatives to implement ICT in the education system (European Commission, 2013; Ferrari, 2012; Fraillon, Ainley, Schulz, Friedman, & Gebhardt, 2014). When examining the use of ICT in the education systems in Europe, the European Commission (2013) found that countries have different priorities and are choosing various strategies regarding how to implement and use ICT at school. 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). Learners of today are observed managing and evaluating their own learning and 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.

In order to use ICTs, teachers are required to have adequate ICT competencies (Goktas¸ Yildirim, & Yildirim, 2009). Teachers who are equipped with technology will have the ability to develop innovative ways of using technology to enhance the learning environment, and to promote technology literacy, knowledge deepening, and knowledge creation (UNESCO, 2011a). Through the emergence of these technologies, traditional methods have been transferred to online platforms since using ICTs in foreign/second language education affects learning positively enabling students to encounter authentic visual and interactive materials and to listen to native speakers (Istifci, 2018).

2. Literature review

2.1 Information Communication Technologies (ICTs)

Information and communications technology (ICT), which refers to the technological tools designed to be used to communicate; access, process and manage information (Erben, Ban & Casteneda, 2009), should be considered as a tool via which both teachers and learners can make use of in or outside the classroom. Teachers and learners get more opportunities to become connected and educated globally as the technology is integrated in L2 (second or foreign language) instruction (Dudeney & Hockly, 2012).

Christenson (2010) defines ICT as "technologies that provide access to information through telecommunications". ICT is an encompassing term that includes the full gamut of electronic tools by means of which we record and store information, and by means of which we exchange and distribute information to others (UNESCO, 2010) Apart from the technologies, ICTs include Web 2.0 tools, Internet telephony, Social Bookmarking, Social Networking Sites, Video Sharing Sites, Multimedia sharing tools, Online Test Creation Tools and Presentation Tools. With the use of ICTs in education, the roles of teachers and students have also changed. Teachers have moved from being "sages on the stage" to becoming "guides on the side". The teacher is no longer the all-knowing authority. Students in classrooms where ICTs are regularly found are likely to participate in virtual excursions and be active researchers, searching the web for information to complete individual or group projects, communicating via email, blogs and/or social networking with students and teachers in other schools, and reaching conclusions on the basis of evidence gathered (UNESCO, 2010).

2.2 Self-efficacy

Self-efficacy beliefs refer not only to someone's capabilities or skills, but also to the belief that they would be able to do something under certain circumstances (Evers, Brouwers, & Tomic, 2002). Self-efficacy refers to 'people's judgements of their capabilities to organize and execute courses of action required and attaining designated types of performances' (Bandura, 1997). In other words, self-efficacy is a belief about what one is capable of doing or learning and is not the same as knowing what to do.

Teachers' personal efficacy beliefs (or teacher self-efficacy) have been defined as judgments about their individual capabilities to bring about desired outcomes of learning and student engagement (Bandura, 1997). Tschannen-Moran and Johnson (2011) underpin the importance of developing and sustaining teachers' self-efficacy beliefs as they have an effect on teachers' motivation, their teaching and students' learning.

Tschannen-Moran and Woolfolk- Hoy (2001) assert that teachers' efficacy beliefs relate to their behavior in the classroom and affect the effort they invest in teaching and the goals they set. Teachers with a strong sense of efficacy are more open to new ideas and are more willing to experiment with new methods to better meet the needs of their students. Greater efficacy enables teachers to be more positive and responsive to students and promote positive classroom environments thus, it impacts the type of the learning environment a teacher provides (Miller, Ramirez, & Murdock, 2017).

2.3 ICT Self-efficacy and professional development

In terms of teachers' ICT self-efficacy, different terms are used when analyzing teachers' perception of their ability to apply the new technologies in educational tasks, such as ICT self-efficacy for teaching, digital competence for teaching, or ICT pedagogic competence.

As Aslan & Zhu (2017) state ICT self-efficacy can be described as one's belief concerning his/her capabilities to use ICT, and perceived ICT competence seems to play a role in determining users' tendency to use ICT in their own lives.

ICT self-efficacy has also been studied in relation to people's abilities to navigate and communicate on the Internet. Individuals' use of the Internet plays an important role in their social and professional lives, and Internet self-efficacy focuses on what a person believes he or she can accomplish online. According to Eastin and LaRose (2006), people having little confidence in their ability to use the Internet, who are dissatisfied with their Internet skills, or who are uncomfortable using the Internet are said to have weak self-efficacy beliefs. Their analyses revealed that Internet usage, prior Internet experience, and outcome expectations were significantly and positively correlated to Internet self-efficacy. However, prior Internet experience proved the strongest predictor of Internet self- efficacy (Hatlevik, Throndsen, Loi & Gudmundsdottir, 2018).

Krumsvik (2011) distinguished between teachers being confident about using ICT as a tool and teachers being confident about using ICT in their own teaching. Teachers' computer self-efficacy includes different factors, such as self-efficacy in basic or advanced skills, or in using computers for instructional purposes (Scherer, Siddiq, & Teo, 2015; Scherer & Siddiq, 2015; Siddiq, Scherer, & Tondeur, 2016).

For Ramîrez et al. (2017), teachers' digital competence is a complex construct that includes a set of contents, skills, and attitudes that are required when using ICT. An area of special interest is digital competence for teaching, which includes the use of technological resources according to one's teaching strategies and didactic knowledge. For their part, Almerich et al. (2016) studied teachers' ICT competence, including the dimensions of technological and pedagogic competences. Teachers' ICT pedagogic competence includes knowledge and skills that allow teachers to suitably design materials or class environments to organize, teach, and evaluate by means of technological resources.

As contemporary environments are highly supported by technology, Yesilyurt, Ulas and Akan (2016) showed the positive impacts of teacher self-efficacy, academic self-efficacy, and computer self-efficacy on their attitude towards applying computer-supported education. The researchers maintain that in order to develop positive attitudes towards computer-supported education, to attach importance to its use in professional life, and to apply it effectively, it is necessary for teachers to have high levels of academic self-efficacy and computer self-efficacy (Alt, 2018).

Teachers make use of ICTs in order to keep up with the changes because of the spread and the rapid developments in ICT. Use of ICT is also inevitable in teacher development. Kabakci, Odabasi, and Kilicer (2010) argue that it is necessary to take adult-education- based learning theories, which might be also referred to as life-long learning theories, as the basis for the organization of effective, productive and practical professional development activities. Thus, professional development is considered important in improving teachers' ICT skills and to foster positive attitudes towards ICT integration and has been demonstrated as such in several studies (Alt, 2018). For example, in Koh, Chai, and Lim's (2016) study, ICT professional development process was found valuable in developing teachers' technological pedagogical content knowledge for the 21st-century learning. Moreover, it enabled teachers to assess their current ICT lessons, design goals, redesign, implement, and evaluate student learning outcomes, as well as reflect on their pedagogical practices. Vanderlinde and van Braak (2010) summarize the conditions for effective ICT professional development: the training has to be linked with context-specific questions, give teachers opportunities for “hands-on” work, be consistent with teachers' needs, and the level of ICT competence of the teachers involved. In their study, they found a strong link between teachers' ICT competencies and their ICT professional development and suggested that teachers who participate in ICT-related professional development courses and keep up to date with developments in the field of ICT integration also feel more competent in integrating ICT into education (Alt, 2018).

In the light of the findings above, the aim of this study is to obtain ICT self-efficacy perceptions of language teachers who are teaching English, French, German and Russian in an intensive language learning program of a Turkish state university. The study will shed light on language teachers’ self-efficacy perceptions of ICTs in language learning and give insights into language teachers. Moreover, the study tries to fill a gap in literature since there are no studies investigating English, French, German and Russian language teachers’ ICT self-efficacy perceptions.

This study tries to answer the following research questions:

- What are the ICT self-efficacy perceptions of Russian, French, German and English language teachers towards ICT integration in language education?
- Are there any similarities and differences among these 4 groups of teachers in terms of self-efficacy perceptions?
- What are their views on using ICTs in their lessons?

3. Methodology

3.1 Participants

Participants of this study were 35 teachers in an intensive language preparatory school of one of the state universities in Eskisehir, Turkey. Of these 35 teachers, 5 of them teach French, 5 of them teach German, 5 of them teach Russian and they teach students who will become language teachers in Russian, German and French departments after they finish the preparatory school with B1+ level. The remaining 20 teach English to students who will join different faculties and departments of the university.

3.2 Instrument and data collection

A questionnaire that had two parts was given to the teachers. In the first part, questions were about personal information concerning the language teachers, their age, teaching experience, about the use of ICTs, if they had received any training on ICTs, details about the training, how often they use ICTs in their lessons, and the advantages of using ICTs in their classes. In the second part, in order to find out language teachers' ICT self-efficacy perceptions, the "ICT Self-Efficacy Perception Scale" (ICTSEPS) developed by Ekici et al. (2012) was used. The scale consists of 27 five-point Likert type items ranging from "Totally disagree" to "Totally agree". The Cronbach alpha reliability coefficient was calculated as .97 by the researchers. The data of ICTSEPS were analysed on SPSS 22 using descriptive statistics finding means and standard deviations. Semi-structured interviews were also carried out with some volunteering language teachers. Interview data were analyzed finding emerging themes and these were categorized using Constant Comparison Method.

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 their ICT use, if they had received any training on using ICTs and how often they use them in the classroom. When the first part of the questionnaire is examined, it is seen that most of the teachers have used ICTs for more than 6 years and most of them especially the English language teachers received training on how to use ICTs in the class. Most of them stated that they had participated in-service training given by their employer, the School of Foreign Languages. In terms of the use of ICTs in class, their answers ranged from every lesson to sometimes. It shows that they make use of ICTs in their teaching.

Table 1: Personal information about the participants

	Russian teachers	**French teachers**	**German teachers**	**English teachers**
Gender	**Number**	**Number**	**Number**	**Number**
Male	4	2	2	9
Female	1	3	3	11
How long have you been teaching Russian/German/French/English?	**Number**	**Number**	**Number**	**Number**
1-5 years	4			
6-10 years	1	4	5	2
11 + years		1		18
How long have you been using ICTs?	**Number**	**Number**	**Number**	**Number**
1-5 years				1
6-10 years	1	2	1	6
11+ years	4	3	4	13
Have you attended a training course on ICT use?	**Number**	**Number**	**Number**	**Number**
Yes	2	1	2	9
No	3	4	3	11
How often do you use ICTs in your lessons?	**Number**	**Number**	**Number**	**Number**
every lesson		2		6
Always	5	2	2	7
sometimes		1	3	7
Seldom				
Never				

There was one open-ended question in the questionnaire that was about the advantages of ICTs. All the teachers were asked to write 3 advantages of using ICTs in the class. Their responses can be seen in Table 2.

Table 2: Advantages of using ICTs

Russian teachers	French teachers	German teachers	English teachers
Saving time Attracting students' interest Practical Enhance motivation More enjoyable lessons Appealing different skills Participation in the lesson Interactivity	1. Interesting content 2. Enhance motivation 3. Student evaluation 4. Improving different skills 5. Attracting students' interest 6. Current activities 7. Good resource 8. Saving time	Updatable content Improve imagination Help learning Fast communication Visual/auditory media Participation in the lesson Reinforce learning More enjoyable lessons Saving time Enhance motivation Attracting students' interest	Attracting students' interest Saving time Variety Visuality Reinforce learning Help the teacher More enjoyable lessons Immediate feedback Participation in the lesson Multimedia Practical Appealing to different skills Interactivity Avoid monotony

4.2 Russian, French, German and English teachers' perceptions of ICT self-efficacy

The second part of the questionnaire aimed to detect ICT self-efficacy perceptions of English, French, German and Russian teachers by using the "ICT Self-Efficacy Perception Scale" that was developed by Ekici et al. (2012). The scale consists of 27 five-point Likert type items that included items as "Totally disagree", "Disagree", "Undecided", "Agree" and "Totally agree. The data of ICTSEPS were analysed on SPSS 22 using descriptive statistics finding means and standard deviations.

As Table 3 reveals, Russian teachers seem to have ICT self-efficacy for most of the items in the questionnaire. They felt they were self-efficacious in 21 items out of 27. Items above 3.5 were accepted as having higher self-efficacy. Russian teachers did not feel they had ICT self-efficacy in items in: creating and using back-up files, using data bases, creating a web page, transferring/using files using file transfer protocol (FTP), preparing evaluation rubrics and using Learning Management Systems.

French teachers, on the other hand, seemed to be less efficacious than Russian teachers since they stated they felt self-efficacious in 14 out of 27 items. French teachers did not feel they had ICT self-efficacy in items in: using back-up files, understanding terminology related to hardware and software, learning advanced features of computer programs, using data bases, creating a web page, transferring/using files using file transfer protocol (FTP), solving problems, conducting a video conference, preparing evaluation rubrics, using interactive white boards, describing communication technology tools and using LMS systems.

German teachers seemed to be capable in 25 out of 27 items. German teachers did not feel they had ICT self-efficacy in: using back-up files, using data bases and using LMS systems.

English teachers seemed to be capable of 25 items out of 27. English teachers did not feel they had ICT self-efficacy in creating a web page and using a data base.

When all the teachers' responses are taken into account, English teachers seemed to be the most efficacious, followed by German teachers, Russian teachers and French teachers. French teachers in this study seemed to be the least efficacious. The teachers in this study did not feel they had ICT self-efficacy in some items that required higher technical knowledge.

Table 3: ICT Self-Efficacy perception scale

	Russian Teachers		French Teachers		German Teachers		English Teachers	
	M	SD	M	SD	M	SD	M	SD
I can create a back up file in order to start the system properly if my computer breaks down.	3.40	1.51	3.40	1.51	3.40	2.19	3.94	1.05
I can understand terminology related to computer hardware and software.	4.20	0.4	3.20	1.64	4.20	1.10	3.83	0.79
I can use the anti-virus program in my computer.	5.00	0.00	4.00	2.00	5.00	1.00	4.00	1.00
I can learn the advanced features of computer programs.	4.00	1.00	3.00	1.00	4.00	1.00	4.00	1.00
I can use word processor programs such as MS word, Openoffice, etc.	4.60	1.00	3.80	1.60	4.60	0.50	4.30	0.80
I can use presentation tools (MS Power Point, Prezi, etc.)	5.00	1.00	4.00	2.00	5.00	0.00	5.00	1.00
I can use data bases (MS Access, etc.)	2.80	1.00	2.60	1.10	3.00	2.00	2.90	1.00
I can use e-mail.	5.00	0.00	4.00	2.00	5.00	0.00	5,00	0,00
I can use any search engine on the web.	5,00	0,00	4,00	2,00	5,00	0,00	5.00	0.00
I can prepare a web page.	3.00	1.00	2.00	1.00	4.00	2.00	3.00	1.00
I can download and use every kind of resource (document, pictures, video, music, animation, etc.)	5.00	0.00	4.00	2.00	5.00	0.00	5.00	1.00
I can transfer/use files using file transfer protocol (FTP)	2.40	1.00	2.40	0.90	3.80	1.80	3.70	1.10
I can join forum/discussion groups.	5.00	1.00	4.00	2.00	5.00	0.00	5.00	1.00
I can use a scanner.	4.00	1.00	4.00	2.00	5.00	0.00	5.00	1.00
I can make changes on pictures on the computer.	5.00	1.00	4.00	2.00	4.00	2.00	4.00	1.00
I can use multimedia tools such as TV, DVD, projection, etc.	4.80	0.00	3.80	1.60	4.60	0.90	4.80	0.40
I can solve problems I encounter when I use communication technologies.	4.00	1.00	3.00	1.00	4.00	2.00	4.00	1.00
I can join/conduct a video conference.	4.00	1.00	3.00	2.00	4.00	2.00	4.00	1.00
I can use a computer in order to organize information (save, organize, restructure.)	4.40	0.50	3.80	1.64	4.80	0.45	4.72	0.46
I can use chat programs (Chat, Skype, Google talk)	4.60	0.50	4.00	1.73	5.00	0.00	4.61	1.04
I can search for information using library web sites.	4.00	0.00	4.00	1.73	5.00	0.00	4.72	0.46
I can prepare evaluation rubrics in an electronic media.	3.20	0.40	2.80	1.48	4.20	1.10	4.28	1.07
I can use interactive white boards.	4.20	0.40	2.60	0.39	4.60	0.55	4.00	0.84
I can evaluate students using grading rubrics or electronic rubrics.	4.00	0.00	2.80	1.48	4.20	1.10	4.00	1.03
I can describe functions of communication technology tools such as computer software, projection, scanner, web, smart board.	4.20	0.40	3.40	1.34	4.00	1.73	4.11	0.68
I can use information technologies in my lessons for presentation.	4.40	0.50	3.40	1.34	4.60	0.55	4.50	0.62
I can use learning management systems such as Moodle, Blackboard, and Web CT for education.	3.20	0.80	2.60	1.14	3.40	1.67	3.61	1.14

4.3 Interview responses

Semi-structured interviews were also carried out with 4 language teachers teaching English, French, German and Russian and their views on using ICTs were asked. They were asked to comment if they had faced any problems when using ICTs in their classes, if they have had any difficulties finding materials in the language they teach and their views on in-service training about how to use these tools. The interviews were also recorded and transcribed. Emerging themes were found.

The emerging themes from the Russian, German and French teachers on facing problems were as follows:

- Finding the right materials in the language they teach
- Finding lots of materials in English so there may be a translation problem
- Their books' not having a decent LMS to use in lab classes like English books have

The emerging themes from the Russian, German and French teachers on in-service training were as follows:

- In-service training only in English
- Not participating in training sessions regularly

The emerging themes from the Russian, German, French and English teachers on their views of in-service training were as follows:

- More in-service training and hands-on experience needed

5. Conclusions and implications

The aim of this study was to obtain the perceptions of 35 Russian, French, German and English teachers on their ICT self-efficacy perceptions. The results of the study indicated that they felt self-efficacious in terms of ICT use and they use ICTs in their teaching but that English language teachers were found to be the most efficacious group. Most of them had taken an ICT course so it helped them to be aware of these tools. The English language teachers might have benefited from the training and in-service professional development activities carried out by the Technology Integration Unit of the university in which they work in order for them to use ICTs effectively in the class. As the majority of the teachers in the university covered by this study are English teachers, the in-service training sessions are carried out in English. Training sessions for Russian, French and German teachers may also be carried out by the Technology Integration Unit. Continuous ICT integration professional development programs for educators that are linked to the curriculum goals and learning objectives should be implemented (Loqo, 2017). Teachers should be encouraged to participate in programs such as online learning communities. Through such communities and practice platforms, they can exchange information, converse through an online threaded discussion forum as well as within small and large group face-to-face meetings as part of their ICT professional development activities. Such ICT-based training programs might raise the functioning and productivity of professional learning (Prestridge, 2009). Through these routes of information and collaboration, teachers might be exposed to effective ICT practices (Richardson, 2010) such as e-portfolio, blogs, wikis, podcasts, and other powerful web tools for classrooms that might help to support students' and teachers' 21st-century learning skills (Alt, 2018).

6. Limitations

This study was carried out with 35 teachers. More reliable and generalized results would have been obtained if the study had been carried out with more participants. An in-depth statistical analysis could not be made because of the low number of Russian, French and German teachers. Moreover, the gender and age of the teachers were not taken into consideration when using ICTs. Future studies may compare teachers’ gender and age with their perceptions.

References

Alt, D. (2018). Science teachers' conceptions of teaching and learning, ICT efficacy, ICT professional development and ICT practices enacted in their classrooms. *Teaching and Teacher Education,* 73, 141-150.

Almerich, G., Orellana, N., Suárez, J., & Garcîa, I. (2016). Teachers' information and communication technology competences: A structural approach. *Computers & Education*, 100, 110–125.

Aslan, A. & Zhu, C. (2017). Investigating variables predicting Turkish pre-service teachers’ integration of ICT into teaching practices. *British Journal of Educational Technology,* Vol 48 No 2 2017. doi:10.1111/bjet.12437

Bandura, A. (1997). Self-efficacy: The exercise of control. New York, NY: Freeman.

Christensson, P. (2010, January 4). ICT Definition. Retrieved 2016, Dec 28, from http://techterms.com

Dudeney, G. & Hockly, N. (2012). ICT in ELT: How did we get here and where are we going? ELT Journal, 66(4), 533-542. http://dx.doi.org/10.1093/elt/ccs050

Eastin, M. S., & LaRose, R. (2006). Internet self-efficacy and the psychology of the digital divide. Journal of Computer-Mediated Communication, 6(1), Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/j.1083-6101.2000.tb00110.x/full .

Ekici, E., Ekici, F.T. & Kara, I. (2012). Validity and Reliability Study of ICT Self-Efficacy Perception Scale for Teachers. *Pamukkale University Journal of Education*, 31 (1), 53-65.

Erben, T., Ban, R., & Castaneda, M. (2009). Teaching English Language Learners through Technology. New York: Routledge.

European Commission. (2013). Survey of schools: ICT in education. Luxembourg: The European Union.

Evers, W. J. G., Brouwers, A. & Tomic, W. (2002). Burnout and self-efficacy: a study on teachers’ beliefs when implementing an innovative educational system in the Netherlands. *British Journal of Educational Psychology*, 72, 227–243.

Eynon, R. (2005). The use of the Internet in higher education. Aslib Proceedings, Vol. 57, No. 2, pp.168-180 [Online] Available at: http://www.emeraldinsight.com/journals.htm?articleid=1465002 (Accessed: 10th February 2014).

Ferrari, A. (2012). Digital competence in practice: An analysis of frameworks (Report EUR 25351 EN). Luxembourg: Publications Office of the European Union.

Fraillon, J., Ainley, J., Schulz, W., Friedman, T., & Gebhardt, E. (2014). Preparing for Life in a Digital Age. The IEA International Computer and Information Literacy Study International Report. Cham: Springer.

Goktas, Y., Yildirim, Z. & Yildirim, S. (2009). Investigation of K-12 teachers' ICT competencies and the contributing factors in acquiring these competencies. *The New Educational Review*, 17, 1, 276–294.

Hatlevik, O. E., Throndsen, I., Loi, M. Gudmundsdottir, G. B. (2018). Students' ICT self-efficacy and computer and information literacy: Determinants and relationships. *Computers & Education* 118 (2018) 107–11.

Istifci, I. (2018). Perceptions of Pre-service English teachers on using Information Communication Technologies. Proceedings of the 17th European Conference on E-Learning ECEL 18, Ntalianis, K., Andreatos, A. & Sgouropoulou, C. (Eds.), Academic Conferences and Publishing: Reading, UK.

Kabakci, I., Odabasi, F. H., & Kilicer, K. (2010). Transformative learning-based mentoring for professional development of teacher educators in information and communication technologies: An approach for an emerging country. *Professional Development in Education*, 36, 263-273.

Krumsvik, R. J. (2011). Digital competence in Norwegian teacher education and schools. Högre Utbildning, 1(1), 39–51.

Loqo, T. (2017). Academic Staff Perceptions and Challenges in Technology Integration: A Case Study of Walter Sisulu University. *Proceedings of the 16th European Confererence on ELearning*, Portugal, Porto, 26-27 October, 2017, A. Mesquita & P. Peres (Eds.), pp.318-325, Academic Conferences and Publishing International: Reading.

McLoughlin, C., & Lee, M. J. W. (2010) Personalised and self-regulated learning in the Web 2.0 era: International exemplars of innovative pedagogy using social software. *Australasian Journal of Educational Technology*, 26, 28–43.
Retrieved from http://www.asci- lite.org.au/ajet/submission/index.php/AJET/index

Miller, A. D., Ramirez, E. M., & Murdock, T. B. (2017). The influence of teachers' self- efficacy on perceptions: Perceived teacher competence and respect and student effort and achievement. *Teaching and Teacher Education*, 64, 260-269.

Oliver, P. & Clayes, E. (2014). Issues of Using Information Communication Technologies in Higher Education. Proceedings of the European Conference on Social Media, Rospigliosi, A. and Greener, S. /Eds.), University of Brighton: Brighton.

Partnership for 21st century learning. (2015). Retrieved August 21, 2015, from http://www.p21.org/ our-work/p21-framework

Prestridge, S. (2009). Teachers' talk in professional development activity that sup- ports change in their ICT pedagogical beliefs and practices. *Teacher Development*, 13(1), 43-55.

Ramîrez, M. S., Mena, J., & Rodŕiguez, J. A. (2017). In-service teachers' self-perceptions of digital competence and OER use as determined by a xMOOC training course. *Computers in Human Behavior*, 77, 356–364.

Richardson, W. (2010). Blogs, wikis, podcasts, and other powerful web tools for classrooms. Thousand Oaks, CA: Corwin.

Scherer, R., & Siddiq, F. (2015). Revisiting teachers' self-efficacy: A differentiated view on gender differences. *Computers & Education*, 53, 48–57.

Scherer, R., Siddiq, F., & Teo, T. (2015). Becoming more specific: Measuring and modeling teachers' perceived usefulness of ICF in the context of teaching and learning. *Computers & Education*, 88, 202–214.

Siddiq, F., Scherer, R., & Tondeur, J. (2016). Teachers' emphasis on developing students' digital information and communication skills (TEDDICS): A new construct in 21st century education. *Computers & Education*, 93, 1–14.

Tech Terms (2014). ICT, Tech Terms [Online] Available at: http://www.techterms.com/definition/realtime (Accessed: 7th March 2014)

Tschannen-Moran, M. & Woolfolk Hoy, A. 2001. "Teacher Efficacy. Capturing an elusive construct", *Teaching and Teacher Education*, vol. 17, pp. 783-805.

Tschannen-Moran, M., and D. Johnson. 2011. "Exploring Literacy Teachers' Self-efficacy Beliefs: Potential Sources at Play." *Teaching and Teacher Education* 27: 751–761. doi:10.1016/j.tate.2010.12.005.

Tongkaw, A. (2013). Multi Perspective Integrations Information and Communication Technologies (ICTs) in Higher Education in Developing Countries: Case Study Thailand. *Procedia – Social & Behavioral Sciences*, Vol.93, pp. 1467-72 [Online] Available at: http://www.sciencedirect.com/science/article/pii/S1877042813035106 (Accessed: 17th March 2017).

UNESCO (2010). ICT transforming education: a regional guide. Bangkok, Thailand: UNESCO. Retrieved October 8, 2018 from http://unesdoc.unesco.org/images/0018/001892/189216e.pdf

UNESCO (2011a). ICT competency framework for teachers. Retrieved August 4, 2015 from http://unesdoc.unesco.org/images/0021/002134/213475e.pdf

Vanderlinde, R., & van Braak, J. (2010). The e-capacity of primary schools: Development of a conceptual model and scale construction from a school improvement perspective. *Computers & Education*, 55, 541-553.

Warschauer, M., & Meskill, C. (2000). Technology and second language learning. In J. Rosenthal (Ed.), Handbook of undergraduate second language education. (pp. 303-318). Mahwah, New Jersey: Lawrence Erlbaum.

Yesilyurt, E., Ulas,, A. H., & Akan, D. (2016). Teacher self-efficacy, academic self- efficacy, and computer self efficacy as predictors of attitude toward applying computer-supported education. *Computers in Human Behavior*, 64, 591-601.

e-Learning and Classroom Learning Activities

Antonín Jančařík
Charles University, Prague, Czech Republic
antonin.jancarik@pedf.cuni.cz
DOI: 10.34190/EEL.19.109

Abstract: Systems for e-learning or blended learning support of teaching have become an integral part of teaching process from primary schools to universities. There is an enormous number of various LMS systems and educational programmes. Most available systems offer teaching and learning materials and provide feedback to the teacher – information on results achieved by their students. The paper introduces the Techambition system and its potential and opportunities it provides. The system was designed to support mathematics education on upper secondary schools and has been developed by a British company of the same name. This system is used in mathematics education on dozens of upper secondary schools in the Czech Republic. The number of students who work with it exceeds 10,000. Last year Faculty of Education, Charlese University signed a contract with the company Techambition. Academic staff of Faculty of Education are involved in development of educational content. Unlike other product, the Techambition system offers a brand new function – planning teaching activities. A system of artificial intelligence evaluates students' work and prepares a list of activities for them that the teacher should use in the next lesson. The plan includes both incentives for frontal teaching and proposals for collaborative learning. The system prepares for the teacher not only a set of tasks but also divides the students into groups. When dividing the students into groups, the system uses their characteristics (learning styles, knowledge of the topic, solving procedures used) with the aim of making the group work as effective as possible. Some activities are conducted on-line on computers and having evaluated the results new activities are proposed. The goal of the paper is to introduce the Techambition system as such, the method of designing individual activities as well as pupils' and teachers' experience with using the system. Results show that the use of AI in classroom management and lesson planning has a significant potential and deserves attention of further research.

Keywords: techambition system, collaborative learning, classroom learning activities, artificial intelligence, e-learning

1. Introduction

Systems for e-learning or blended learning, supporting the process of education have become common in the teaching process at all school levels, from primary schools to universities. The market offers a wide range of various LMS systems and learning programmes. Most of the available systems offer teaching materials and give feedback to the teacher (information on the pupils' and students' progress). Some systems provide space for direct pupils' and students' activity in the lesson (in-class activities) (e.g. Kahoot! or Interactive whiteboard software). The conception of the Techambition system, introduced in this paper, differs from other systems, as it is able to connect activities conducted online with activities in a lesson. The goal of the Techambition system is the use of artificial intelligence to help upper secondary teachers to include challenging and entertaining teaching procedures with the aim of increasing efficiency of the learning process. The activities Techambition system offers are namely:

- Group work
- Peer Instruction
- Flipped classroom

This paper focuses on group work and its benefits.

2. Group work

Group work is one interactive method that can be used in mathematics education. The benefits of group work in education are generally acknowledged (e.g. Webb, 1989; Pea, 1993). In group work, pupils communicate about the solved problem, learn to formulate their ideas, to work with hypotheses, to look for ideas that support or contradict their reasoning (examples and counterexamples). At the same time, pupils learn to use the right terminology and the language of mathematics. Communication among pupils results in development of mathematical competences (Schwarz at al, 2012). Some authors warn that some pupils may find it extremely difficult to communicate about mathematics (Ryve, 2006; Sfard, 2001). Teams are social systems in which cognitive, motivational and behavioural processes become increasingly interdependent and these processes need to be studied (Salomon, and Globerson, 1989). If we want to make sure communication in the group is effective, the groups have to be formed with due attention and care (Dlouhá et al, 2011). Still, a good composition of the group does not guarantee success. It is essential also to select appropriate tasks and questions the groups will solve as well as to propose tools that they will be allowed to use while solving, e.g. visual mediators and technical terms (Ryve at al, 2012).

A special case of group work is collaborative learning. The basic paradigm of collaborative learning is that “it is not so much the individual student who learns and thinks, as it is the collaborative group.” (Stahl, 2005). There are two basic methods for group work in technology-supported education:

- Group work in lessons where information technology is used.
- Group work on-line.

Koschmann (1996) introduces the concept computer supported collaborative learning (CSCL). Blaye and Light (2012) state that CSCL is a theme that brings together researchers from several disciplines: educationalists interested in information technology and group work in the classroom, researchers in artificial intelligence, software developers, developmental and educational psychologistArtificArtificia. Computers can be used in group work in a number of ways. Eraut and Hoyles (1989) state that if there is group work in lessons, information technology is usually used as one of the tools for solving the tasks or problems. However, this is far from the only possibility of using information technology. It can also be employed as the source of information or recording equipment. In the here presented project Techambition, information technology is used in group work primarily as an information channel through which individual groups are set tasks and through which they provide feedback to the teacher about their work progress.

In online learning, computer is primarily used for creation of an environment in which pupils and students can collaborate (e.g. Frankl at al, 2016, Jančařík and Novotná, 2017). However, computer can also manage the online learning process and coordinate its course. An example of this approach is the software conversational agent. Conversational agents try to encourage academically productive talk in which students work together in ways that are accountable to each other and to their task (Stahl at al, 2010). They are a very sophisticated tool. Computers can influence the learning process also in the form of scaffolding – using help, gradual showing of individual steps of the solving process, by making additional explanation or much simpler tasks available. Belland (2017) presents a meta-analysis of research on scaffolding within STEM. This study includes 227 outcomes of conceptual scaffolding, 28 outcomes of metacognitive scaffolding, 75 outcomes of strategic scaffolding and 3 outcomes of motivation scaffolding. Belland documents that even though context-specific scaffolding is most common, its effect is comparable to other forms of scaffolding (generic scaffolding).

The fundamental issue in organizing technology-supported group work is how to maximise the benefits and how to prepare teachers to provide adequate tasks and help (Grugnetti and Jaquet, 1996). Support to teachers is not limited only to pre- and in-service teacher training. Thanks to computer technology, it can be provided to teachers within the teaching process and can have the form of various software tools that help them manage the learning process, motivate pupils, support them through scaffolding or enter into their discussion as the conversational agent. The following section introduces one of the new systems that is developed, among other, to support teachers when using group work.

2.1 Classroom management and artificial intelligence

The impact of the use of artificial intelligence on classroom management is a relatively new topic. Research in the area focuses on two major issues:

Pre-service teacher training

Use of AI in management of classroom activities

One of the applications of artificial intelligence are massive multi-player online games (MMPOGs) that create a microworld. “Microworlds are perhaps the ultimate example of active learning environments, because users can exercise so much control over the environment” (Jonassen, 2000). An example of microworld used in lessons are games such as Minecraft, The Sims or Second Life. In pre-service teacher education, artificial intelligence is used e.g. for simulation of random student behaviour, much as it would arise in the classroom (Mahon et al., 2010).

Current developments in technology related to virtual reality enable high-technology simulations and change the perspectives on pre-service teacher training (Brown, 1999).

The other field of the use of artificial intelligence is immediate evaluation and organization of activities in lessons. This area comes out of researches focusing on evaluation of teachers' work on the basis of data analysis (e.g. Tyler et al., 2010). Timms (2016) introduces a daring vision of lessons taught by teachers supported by cobots. Although first systems monitoring students activity are using facial-recognition technology already tested (Jha, 2007), we are very far from teaching robots. A vast majority of systems are developed with the aim of managing learning in on-line environments. Only very few (e.g. Aquilar et al., 2015, Kuhn et al., 2055, Soh et al., 2008,) are developed with the aim of giving recommendations to teachers in regular classrooms. The Techambition system is one of these.

3. Techambition system

Techambition system (see Fig. 1) is an e-learning system used for mathematics education at upper secondary schools. This system has been developed by the company Techambition LTD. In 2017, it was enriched by the functionality that gives the opportunity of group work. Subsequently algorithms allowing automatic pairing of students were implemented. The system is currently used by 799 teachers (360 of which on a commercial basis at 124 school) in the Czech Republic, i.e. 11.809 students work with it.

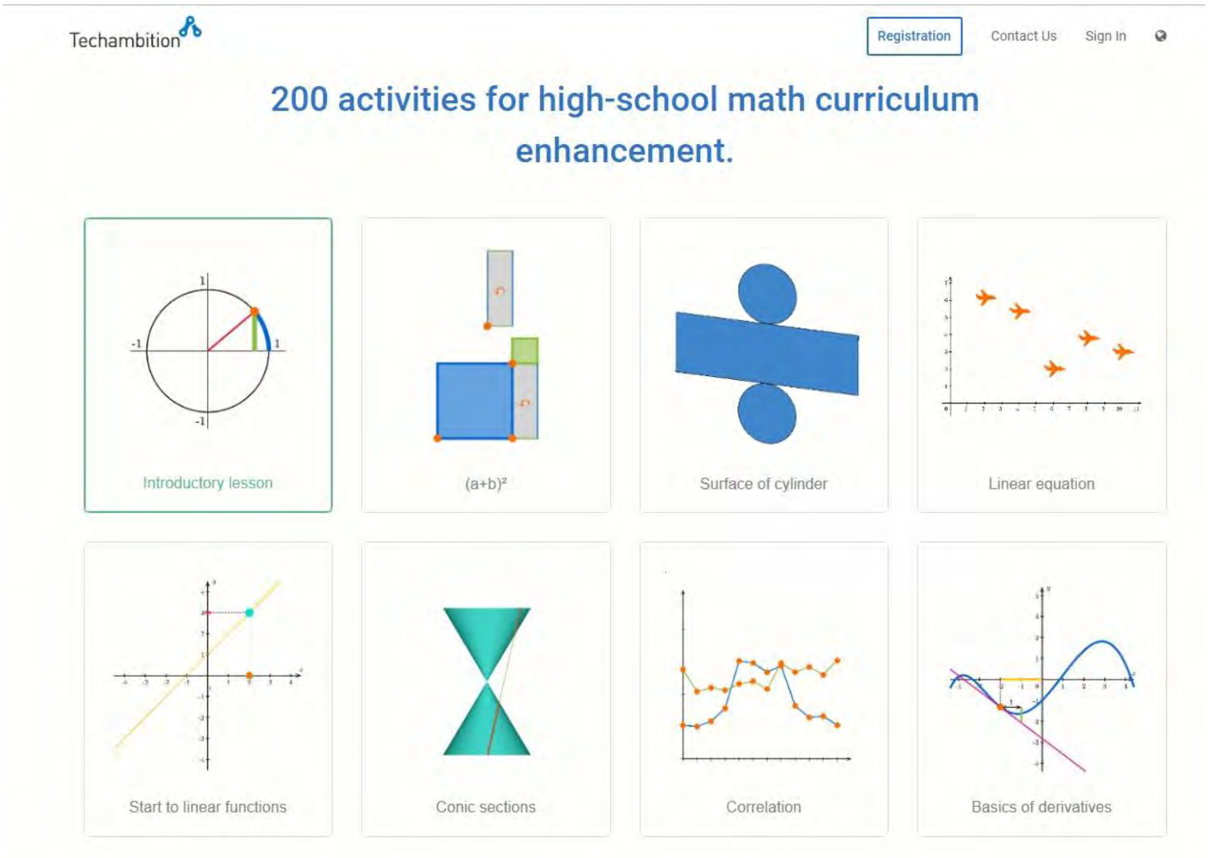


Figure 1: Techambition system website

Currently the system offers more than 200 units in Czech, based on upper secondary school mathematics topics. Each of the units focuses on one mathematical concept and consists of several (usually less than ten) tasks and visualizations. Techambition system provides automatic evaluation of the tasks. In addition to the tasks given in lessons, students can also solve other tasks that the system offers. Vančura (2018) compares different systems used in the Czech Republic through which teachers can set homework. For him, the disadvantage of the Techambition system is a smaller number of units and tasks. At this point, its extent makes it a complementary, not the core tool. The developer of the system has been cooperating on the development of the system with the Faculty of Education, Charles University since 2018. The aim of this cooperation is to extend the content and unify quality.

However, tasks for individual work are only one of the functionalities of the system. The system offers three basic types of use:

- As an individual task
- For various types of collaborative learning
- During in-class explanation

Data obtained from individually solved tasks are further processed by the system using artificial intelligence systems. The system does not only record students' individual results, but also their approach to the solution, the response to the help provided, and the procedures used for the solution. Based on this data, it creates the characteristics of a student's learning style, which it then uses to plan other activities to support collaborative learning in the classroom.

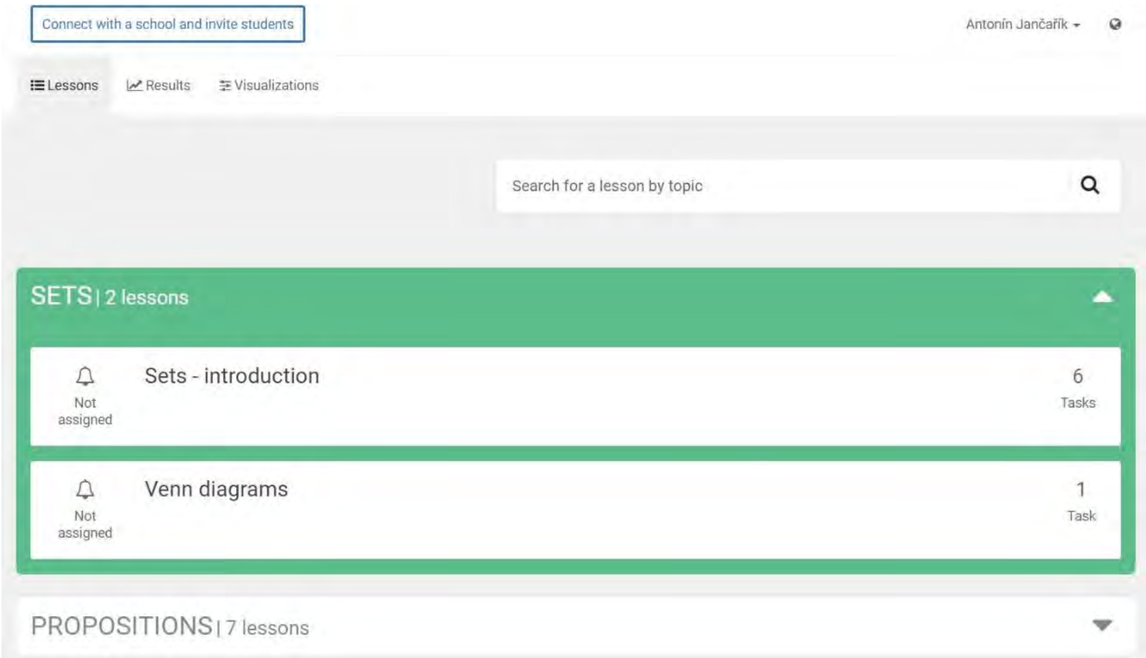


Figure 2: Lesson plan

3.1 Group work in Techambition system

One of the tools the Techambition system offers to teachers is group work. On the basis of all previous work (mostly on an individual student's work online), the system proposes to the teacher what tasks to set in case of peer instruction or plans division of students into groups for group work. The tasks are then set by the teacher to the students in group work. Each group always works with one device through which they submit their work. The system then evaluates the results of each group and based on these results modifies its own decisions (see Fig. 3). Various types of students' characteristics are used for organization of group work (learning styles, knowledge in the area, solving procedures). The groups are put together in such a way that they are more or less homogeneous with respect to students' learning styles. The data are first normed and then using clustering methods organized to become the basis for creation of groups of students.

3.2 Principles of division into groups

As stated above, when dividing students to groups the system uses a strategy that tries to put in one group students with the same or similar learning styles. When deciding which strategy to choose, there are three possibilities:

- Create heterogeneous groups
- Create homogeneous groups
- Create mixed attaining group

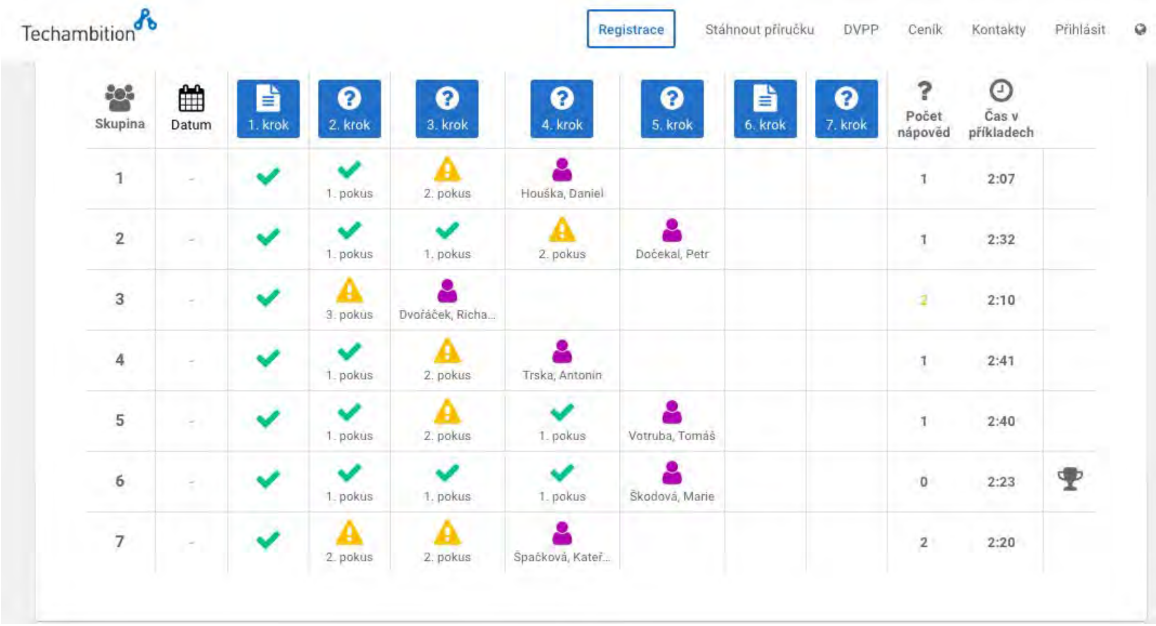


Figure 3: Group work in Techambition system from the teacher's point of view

Each of these approaches has its pros and cons (cf. Bennet and Cass, 2006). When deciding which strategy to choose, the developers make their decision with respect to the way of its use. As a rule, group work in the Techambition system is very short, often makes only a part of one lesson. This way of its use is based on teachers' requirements. That is why the approach chosen for creating groups is the one in which students do not have to overcome the obstacles arising from differences in attitudes. Students that can be expected to approach the solution in a similar way or will use the same tools to solve the task are put in one group.

The method and parameters used for dividing students into groups are still evolving. Effectiveness of the tool is tested continuously.

3.3 Efficiency of use of group work in lessons

In order to evaluate use of group activities in lessons, students' activity from classes that use group work and do not use group work were compared.

The analysis processed data from the school year 2018/19 (from 1st September 2018 to 31st May 2019). The criterion for selection of classes was the parameter of how many group activities were set in the class by the Techambition system. The following two groups were formed based on this parameter:

- Class A where the teacher set at least 20 individual tasks but no collaborative task.
- Class B where at least 8 collaborative tasks were set.

The condition for a class to be put in group A was met by 102 classes with the total of 2,437 students. These classes were from 38 different schools, out of which 16 (42%) were upper secondary grammar schools. The condition for inclusion of a class in group B was met by 13 classes with 294 students. They were from 11 different schools, out of which 5 (45%) were upper secondary grammar schools. 8-17 collaborative tasks were set in these classes within the studied period of time (the average was 10.31).

The criterion for comparison of the two groups was their activity in the online environment, specifically their independent solving of voluntary additional tasks provided by the system. This criterion was selected because it shows students' attitude to the subject and the Techambition system. Students who are willing to study the subject on their own, without being asked by the teacher, can be expected to achieve better results. The study focuses only voluntary extra tasks offered by the Techambition system. They are tasks selected and offered by the system beyond what was set by the teacher. These materials are available to all students logged into the system.

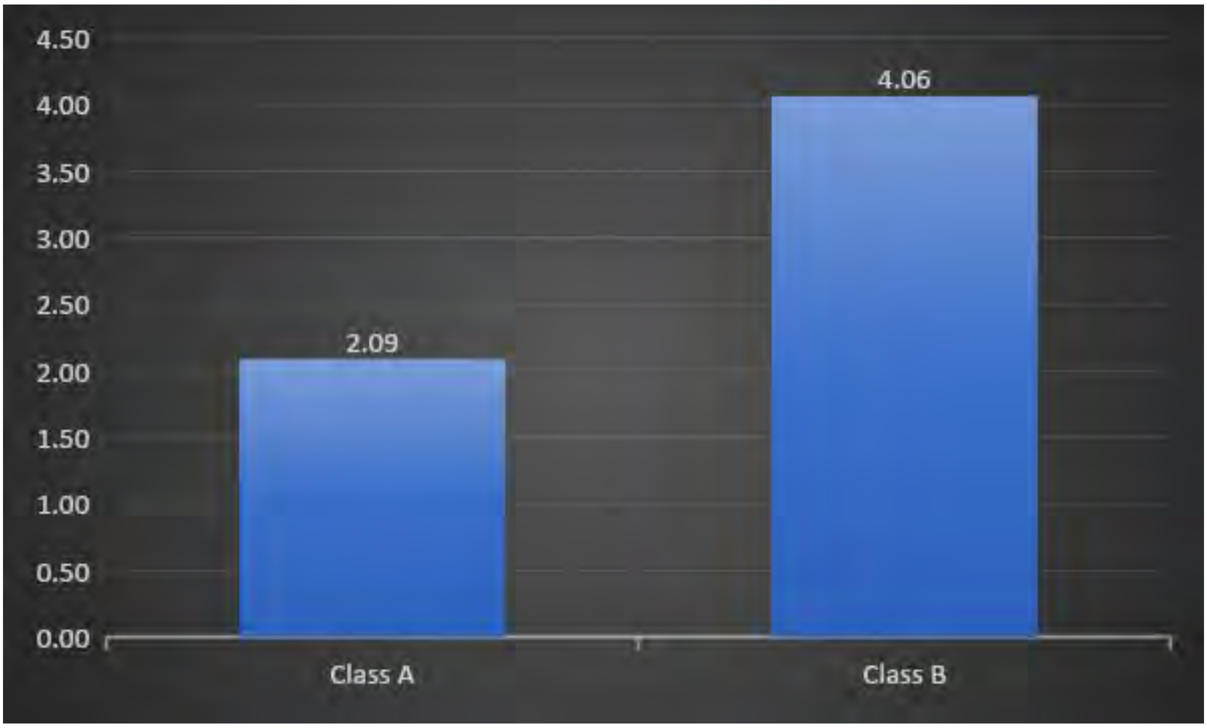


Figure 4: Number of voluntary additional tasks per student

The average number of tasks solved voluntarily in group A was 2.09 per student. In group B this average was 4.06 per student (see Fig. 4). This clearly shows that the number of tasks solved voluntarily by students who work in groups in lessons of mathematics is twice as high as in case of students who do not work in groups in lessons of mathematics. We also studied what percentage of students solved at least four voluntary tasks.

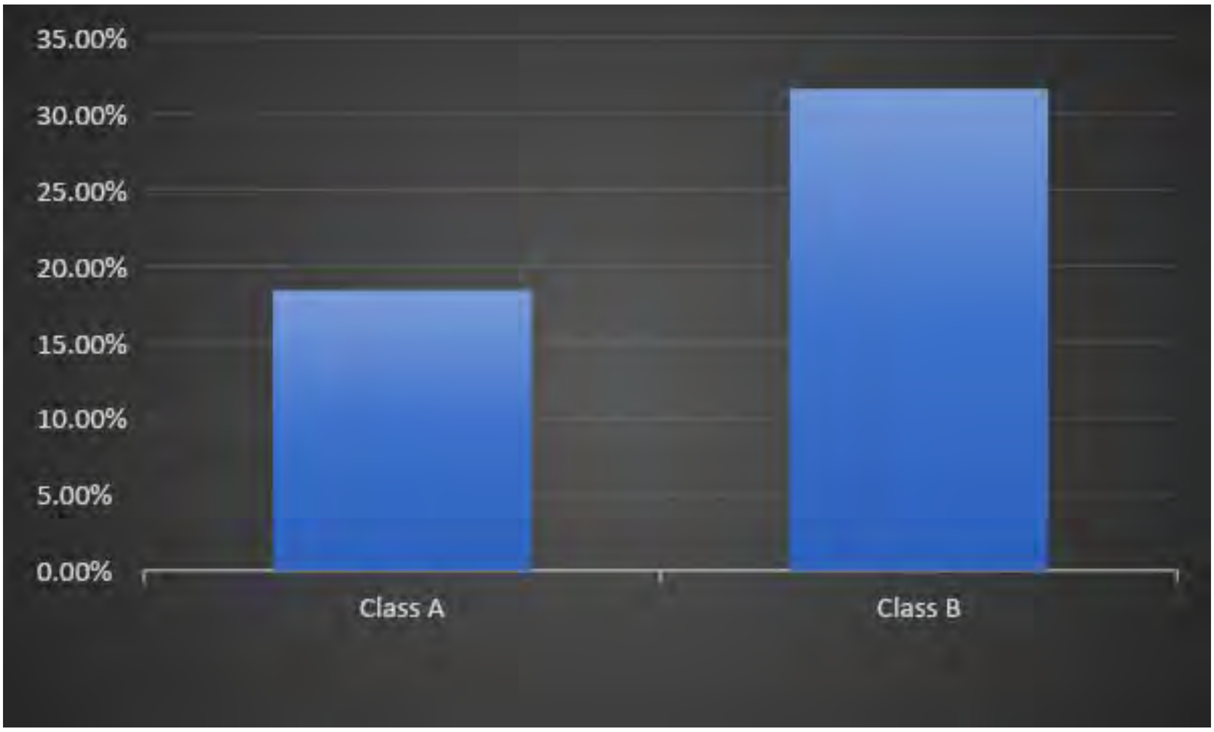


Figure 5: Number of students solving voluntary additional tasks

Only about one fifth (18.38%) of students from group A solved at least 4 voluntary tasks, whereas it was almost one third (31.63%) in group B (see Fig. 5). Also in this case, we can observe a significant growth (by 72%) in the group where teachers use group work in contrast to groups where this classroom management form is not used. This means use of group work has a positive effect in both of the studied criteria.

4. Discussion

Group work is one of the activities supporting students' involvement in the learning process and contributing to improvement of quality of education. The Techambition system helps to solve one of the fundamental issues connected to group work, which is division of students into groups. The criterion used for evaluation of efficiency of group work was individual solving of voluntary extra tasks. The fact that a student solves problems and tasks that are not compulsory signals that they are interested in the subject and have the will to learn.

The collected data show that students' interest in solving voluntary extra tasks is much higher (almost twice) in classes where group work organized on the basis of recommendations of the Techambition system was used. It was higher in both of the studied criteria (average number of tasks per student, number of students solving a higher number of tasks). This allows us to state that use of group work in mathematics lessons supported by the Techambition system has positive effect on the students' attitude to mathematics and on their willingness to study it beyond the duties set by the teacher.

In this context, it is worth noting that the benefit of Techambition system is not merely in motivating students to study mathematics. Equally important is the fact that it motivates teachers to use other forms of teaching (including group work) by providing them with an effective tool by which they can organize and evaluate such forms of work.

5. Conclusion

The paper presents the e-learning Techambition system, which uses artificial intelligence for classroom management. The Techambition system equips teachers with various activities. The paper focuses on of type of these activities – group work and its positive impact on students' attitude to learning. Namely, it documents the impact of the use of group work activities organized on the basis of recommendations of the Techambition system on the willingness of students to solve voluntary tasks. The results show that group activities conducted on the basis of stimuli from the Techambition system contribute to an increase of students' willingness to work autonomously.

The use of artificial intelligence in a well-founded trend in education. Developments in new technologies allow a change in the context where students are educated. Results presented in this paper confirm that the use of AI in classroom management and lesson planning is of a significant potential and deserves attention of further research.

Acknowledgements

The paper was supported by the grant Progres from Charles University no. Q16 entitled "Environmental research".

I would like to thank the company Techambition for cooperation and for providing the analysed data.

References

Aguilar, J., Valdiviezo, P., Cordero, J., & Sánchez, M. (2015). Conceptual design of a smart classroom based on multiagent systems. In *Proceedings on the International Conference on Artificial Intelligence (ICAI)* (p. 471). The Steering Committee of The World Congress in Computer Science, Computer Engineering and Applied Computing (WorldComp).

Belland, B. R. (2017). Computer-based scaffolding strategy. In *Instructional Scaffolding in STEM Education* (pp. 107-126). Springer, Cham.

Bennett, N., & Cass, A. (1989). The effects of group composition on group interactive processes and pupil understanding. *British Educational Research Journal*, 15(1), 19-32.

Blaye, A. and Light, P. (2012) Collaborative Problem Solving with HyperCard: The Influence of Peer Interaction on Planning and Information Handling Strategies, in O'Malley, C. (Ed.). (2012). *Computer supported collaborative learning* (Vol. 128). Springer Science & Business Media.

Brown, A. H. (1999). Simulated classrooms and artificial students: The potential effects of new technologies on teacher education. *Journal of Research on Computing in Education*, 32(2), 307-318.

Dlouhá, J., Činčera, J., Jančaříková, K., and Scholleová, H. (2011). The methodology of team cooperation and team creation in higher education. *Envigogika*, 6(1). https://doi.org/10.14712/18023061.150

Eraut, M. and Hoyles, C. (1989). Groupwork with computers. *Journal of Computer Assisted Learning*, 5(1), 12-24.

Frankl, G., Schratt-Bitter, S. and O'Sullivan, D. (2016) Collaborative Learning (Online) and the Role of Student Engagement in Higher Education. In: *Proceedings of the 15th European Conference on e-Learning (ECEL 2016)*, Prague.
Grugnetti, L. and Jaquet, F. (1996) 'Senior secondary school practices', in A. Bishop, K. Clements, C. Keitel, J. Kilpatrick and C. Laborde (eds.), *International Handbook of Mathematics Education*, Part 1, Kluwer Academic Publishers, Dordrecht, pp. 615–645.

Jančařík, A. and Novotná J. (2017) Home Schooling and Computer-Based Collaborative Activities. *Proceedings of the 16th European Conference on e-Learning (ECEL 2017)*, Porto.

Jha, A. (2007). Class room attendance system using facial recognition system. *The International Journal of Mathematics, Science, Technology and Management*, 2(3), 4-7.

Jonassen, D.H. (2000). *Computers as mindtools for schools: engaging critical thinking*, (2nd ed.), Upper Saddle River, NJ: Merrill Prentice Hall. [Google Scholar], p. 157).

Koschmann, T.(Ed.) (1996). *CSCL: Theory and practice of an emerging paradigm*. Mahwah, New Jersey: Lawrence Erlbaum Associates.

Kuhn, M., Jansen, M., Harrer, A., and Hoppe, U. (2005). A lightweight approach for flexible group management in the classroom. In *Proceedings of th 2005 conference on Computer support for collaborative learning: learning 2005: the next 10 years!* (pp. 353-357). International Society of the Learning Sciences.

Mahon, J., Bryant, B., Brown B. and Kim, M. (2010) Using Second Life to enhance classroom management practice in teacher education, *Educational Media International*, 47:2, 121-134, DOI: 10.1080/09523987.2010.492677

Pea, R. D. (1993) Learning scientific concepts through material and social activities: conversational analysis meets conceptual change, *Educational Psychologist* 28(3), 265–279.

Soh, L. K., Khandaker, N. and Jiang, H. (2008). I-MINDS: A multiagent system for intelligent computer-supported collaborative learning and classroom management. *International Journal of Artificial Intelligence in Education*, 18(2), 119-151.

Stahl, G. (2005). Group cognition in computer-assisted collaborative learning. *Journal of Computer Assisted Learning*, 21(2), 79-90.

Ryve, A. (2006). Making explicit the analysis of students' mathematical discourses: Revisiting a newly developed methodological framework. Educational Studies in Mathematics, 62, 191–210.

Ryve, A., Nilsson, P., & Pettersson, K. (2013). Analyzing effective communication in mathematics group work: The role of visual mediators and technical terms. *Educational Studies in Mathematics*, 82(3), 497-514.

Salomon, G., & Globerson, T. (1989). When teams do not function the way they ought to. In N. M. Webb (Ed.), Peer interaction, problem-solving, and cognition: Multidisciplinary perspectives (pp. 89–99). Oxford, UK: Pergamon Press.

Schwarz, B., Dreyfus, T., & Hershkowitz, R. (Eds.). (2009). *Transformation of knowledge through classroom interaction*. New York: Routledge.

Sfard, A. (2001). There is more to the discourse than meets the ears: Looking at thinking as communication to learn more about mathematical learning. Educational Studies in Mathematics, 46, 13–57.

Stahl, G., Rosé, C. P., O'Hara, K., and Powell, A. B. (2010, July). Supporting group math cognition in virtual math teams with software conversational agents. *First North American GeoGebra Conference,* p. 196.

Timms, M. J. (2016). Letting artificial intelligence in education out of the box: educational cobots and smart classrooms. *International Journal of Artificial Intelligence in Education*, 26(2), 701-712.

Tyler, J. H., Taylor, E. S., Kane, T. J., & Wooten, A. L. (2010). Using student performance data to identify effective classroom practices. *American Economic Review*, 100(2), 256-60.

Vančura, J. (2018). Využití Khan Academy pro zadávání a hodnocení domácích úkolů. *Matematika–Fyzika–Informatika*, 27(3), 169-180.

Webb, N. M. (1989) 'Peer interaction and learning in small groups', *International Journal of Educational Research* 1, 21–39.

Good Questions in e-Learning Environments

Kateřina Jančaříková and Jarmila Novotná
Charles University, Faculty of Education, Prague, Czech Republic
katerina.jancarikova@pedf
jarmila.novotna@pedf.cuni.cz
DOI: 10.34190/EEL.19.032

Abstract: The paper focuses on good questions as originally developed by Clarke, Sullivan and their team for primary mathematics education. In accordance to their work, we understand a good question as an open question that asks for more than recollection of known facts. It has several answers that can all be accepted. When answering it, pupils learn something new and the teacher learns something about their pupils from their answers. Most publications focusing on good questions focus on their use in face-to-face teaching of mathematics. The use of good questions in the e-learning environment has not been studied yet. There are obvious differences between face-to-face and e-learning environments. The work in e-learning offers the access to resources, more time to think about possible answers etc. But are open questions used in the e-learning practice? If yes, to which extent? In the paper, an analysis of good questions from mathematics and natural sciences, developed for home schooling at the elementary school ZŠ Březová is presented. The e-learning materials of the 6th and 9th grades (309 pieces in total) were examined. We found 87 good questions in the materials. Usually, however, the educational potential of using good questions was not exploited. The analysis of good questions in the materials resulted in dividing them into categories. The categories are presented with examples, enabling the reader to grasp the specificities of the categories better. Based on the research findings, the e-learning environment at the monitored school will be adjusted.

Keywords: communication, good question, open question, environment supporting discussion

1. Introduction

Learning is a lifelong, never-ending process. The role of teachers nowadays is not to teach their pupils to acquire a set of particular skills but to develop their will to learn, to show them that *learning is sweet*, to allow them to experience the joy of discovery, to teach them the basics of self-study (how to learn, how to search for information) and critical thinking allowing them to understand information and distinguish between reliable and useful information and low quality, unreliable information. One of the methods that supports all these modern educational objectives is the method of good questions.

Good questions as introduced originally in (Sullivan and Clarke, 1988) are one of the tools for creation of an environment supporting discussion among pupils and between pupils and teachers, which are of key importance in constructivist-lead teaching. The main characteristics of this type of questions are content-specific focus and opportunity for answers at different levels of sophistication.

Good questions are a specific type of open questions. If an open question is to be a good question, it must meet the following criteria: It has several answers that can all be accepted; it requires more than mere reference to known facts, provokes discussion. Pupils may learn something when they answer it and/or discuss it and teachers can learn something about their pupils from the pupils' answers. In this sense, a good question is not a question that is well formulated and communicated to pupils, but a question that supports constructivist and activating approaches. Using good questions enables safe class discussions and supports lifelong learning.

Use of good questions in other disciplines was studied by (Jančařík, Jančaříková and Novotná, 2013). The majority of existing studies focusing on the method of good questions (see e.g. Moyer and Milewicz, 2002; Slowiaczek et al, 1992) focus on face-to face learning. In this paper, we choose a new perspective, namely the use of good questions in e-learning environments. We study the case of absolute use of e-learning, i.e. the entire education of pupils is done through e-learning.

2. Literature review

E-learning is the method of education that uses electronic systems. E-learning can be perceived as "modern technology supported education conducted using computer networks (most often the Internet)." (Drtina, 2001, p. 121) The concept of e-learning is not strictly defined. A variety of definitions of e-learning can be come across at different times in recent history. In consequence to the turbulent development in this area, authors define the term as precisely as possible and they differ from each other in how they specify it. Authors of descriptions come out of different perspectives that specify e-learning in more or less detail. In this paper, we work with the conception called the didactical definition of e-learning, Pavlíček (2003, p. 8):

> *"e-learning means linking a systemic proposal and a suitable learning model in the area of information and communication technology".*

Distance education using e-learning support is at the outset at primary and lower secondary school levels, at least in the Czech Republic. It can be similar to face-to-face education but can also be very different and make use of the specifics the environment offers.

3. Our research

The goal of our research was to find out whether materials of e-learning support of individually educated pupils in the Czech Republic in subjects we are interested in (i.e. in mathematics and natural science) include good questions. If so, our plan was to analyse them and study how teachers work with them. This should allow us to optimize the use of this unique method.

With this aim, we contacted the headmaster of the elementary school ZŠ Březová, the only school in the Czech Republic that has an elaborate system of e-learning support for home schoolers. It is a school located in the countryside in the Eastern part of the Czech Republic, close to the border with Slovakia and Austria, more than 300 km from the capital city Prague. Due to its location and the outflow of rural population to cities, this school was in danger of being closed down for a lack of pupils. Distance learning proved to be an excellent option in these circumstances. Currently (in the school year 2018/2019) the capacity of school (1000 pupils) is full. (128 are regular pupils, 725 pupils are in home schooling and 147 pupils are abroad with their parents).[1] (More about this remarkable Czech school in Kostelecká et al, 2016; Jančařík and Novotná, 2017).

The headmaster agreed with our research. For the purpose of the research, we were given access to the school Moodle environment in the role of a pupil.

As the amount of material was immense, the decision was to narrow the selection of the analysed material only to the first and last grade of lower secondary education, i.e. 6th grade attended by 12-13 year old pupils and 9th grade attended by 14-15 year old pupils. There were 89 pupils (75 home schoolers and 14 pupils abroad with parents) in the 6th grade and 92 pupils (87 home schoolers and 5 with parents abroad) in the 9th grade distance education in ZŠ Březová.[2]

3.1 Results

We analysed all e-learning materials for mathematics and natural science education developed for individually educated 6th and 9th grade pupils in the school system Moodle.

In total, we analysed 309 supporting materials for learning (Table 1). Most of them were developed by teachers of the studied subjects. Some of the materials were shared in other learning environments or there is a link to them. Several of the materials were developed by pupils.

Table 1: An overview of supporting materials provided by the school in the environment Moodle

Subject	Mathematics		Science		In total
Grade	6th	9th	6th	9th	
Presentation	23	19	49	53	144
Worksheets	19	42	1	10	72
Videos	10	10	17	-	37
Tests	5	1	9	9	24
Supporting textual material (.pdf) from 2 to 59 pages	-	-	-	5	5
Motivational materials (games, brainteasers, crosswords etc.)	10	5	9	3	27
In total	67	77	85	80	309

[1] Written communication of the headmaster PaeDr. Ludvík Zimčík.
[2] Written communication of the headmaster PaeDr. Ludvík Zimčík.

Good questions (and questions close to good questions) were found only in presentations and worksheets. There were no in any other supporting materials (educational videos, texts, tests) and motivation materials (games, brainteasers, crosswords etc.).

We found 87 good questions or questions close to good questions and instruction[3] in 40 materials (presentations and worksheets). See Table 2.

Table 2: On overview of occurrence of good questions or questions close to good questions in presentations in both analysed subjects and grades

Subject	Mathematics		Biology		In total
Grade	6th	9th	6th	9th	
Total number of materials with good questions or questions close to good questions	11	3	17	9	40
Total number of good questions or questions close to good questions in the analysed materials	35	11	23	18	87

In both subjects, the number of good questions or questions close to good questions was similar (46 in materials for mathematics and 41 in materials for science education).

There were 2x more good questions and questions close to good questions in materials for the 6th grade (59 questions in total) than in materials for 9th grade (29 questions).

All the 87 good questions and questions close to good questions were further categorized. We created 5 categories (good instructions, combined questions, multiple good questions, spontaneously good questions, questions close to good questions and also questions with the logical answer yes/no). Some of the questions fit into several categories.

1st category "Good instructions"

When looking for good questions we came across instructions which, although not questions, played the role of good questions. Because of the role they played we decided to include them in our evaluation. Their examples are in Table 3.

Table3: Good instructions

Authentic wording
Fill in the missing digit so that the new number is divisible by four: 2_4, 13_, 1_3, 58_2.
Give an animal and an example of its usual food.
Create a terrestrial food chain.

2nd category "Combined questions"

In the data set we often came across the phenomenon when a good question was used together with another question (sometimes closed, sometimes also good), e.g. "Which lichen species are used in pharmacy? What for?"

[3] By questions close to good questions we understand such question that can be come **good question by minor modification of the formulation.**

Or "Construct circles circumscribed to the triangles in the picture (see Figure 1). When constructing, study the position of the centre of the circumscribed circles. Is there a difference between acute, right-angled and obtuse triangles?"

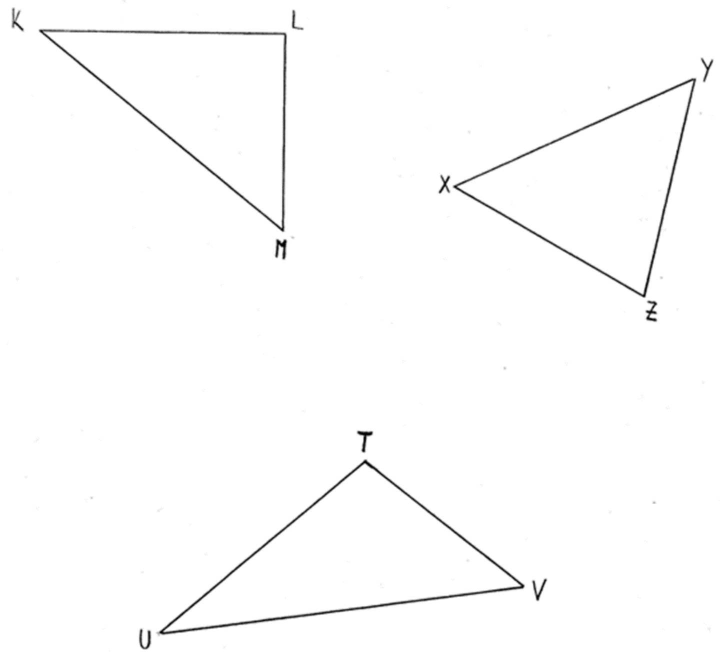


Figure 1: Setting of a task for 6th graders of ZŠ Březová in the e-learning environment

3rd category "Multiple good questions"

Several times (namely 8 x in mathematics and 2 x in science education), materials for the 6th grade included a good question within which there were other, partial good questions.

For example "How does our organism react to various environmental conditions, such as dust, sharp light, etc.?" or "How do people positively / negatively affect the forest ecosystem?" or "What units do we usually use to express: a) area of the floor in the classroom?, area of a field or forest?, area of the garden?, area of a state, region, town?"

This category was not found in materials for the 9th grade (neither in mathematics, nor in natural science education).

4th category "Spontaneously good questions"

The analysed materials included good questions that had originally not be designed as good questions but as questions with one expected correct answer (which is presented as the correct solution or answer on the following slide). Thus the authors did not use the potential of good questions and perhaps did not even realize there were more possible answers. An example of this is the question "Which concepts are related to each other?" for which only one possible answer was given in the presentation. Other examples including the possible modification are presented in Table 4.

Table 4: Examples of good questions for which teachers have only one correct answer in the solution

Question	Expected answer	Other possible correct answers and their justification (by authors of this paper)
Which gas is important for life?	oxygen	Carbon dioxide – part of photosynthesis, nitrogen – important biogenic element, steam – humidity, ozone – protects our

Question	Expected answer	Other possible correct answers and their justification (by authors of this paper)
		planet from UV radiation, natural gas – important for life in our present society, etc.
In which instrument is there an eyepiece and a tube?	microscope	binoculars, telescope, camera
Extinct arthropod?	trilobite	A large number of arthropods have become extinct. The known one are e.g. Eurypterus (eurypterid) – the largest arthropods in the lower Paleozoic or Meganeurus (a giant dragonfly from the Carboniferous period).

In mathematics, it is for example the good instruction: "Try to complete the picture (Figure 2) so that they are symmetrical. Mark the axis of symmetry." The axis of symmetry in the results is always vertical and always intersects the middle of the vertical line; other possibilities are not made use of; it also does not give the opportunity to add some squares to the left of the axis.

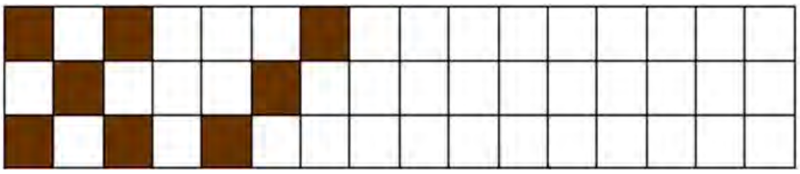


Figure 2: Entering a task for which the teacher expects one solution but which has more

This category was more frequent in natural science than in mathematics. Namely, there were 6 good questions in mathematics (in materials for geometry in the 6th grade), i.e. 17%, whereas there were 14 good questions, i.e. 34%, of this type in science.

5th category "Questions close to good questions"

Very often, a very small change, sometimes only changing one word makes a good question out of an ordinary question. E.g. the first question in tab. 3 would be a good question if it said "Find as many options as possible.", etc., or simply "Fill in the missing digit" instead of "Write all the possibilities".

6th category "Questions with the logical answer yes/no"

These questions are not well formulated (the logical answer to them is yes/no). However, the context implies the purpose of the question was different; they bear a great potential for posing a good question, see Table 5.

Table 5: Wording of the original (yes/no is the logical answer to them) and good question created from the original one by a minor change

Original formulation	Good question
Do you know any other species of butterflies?	What species of butterflies can you name?
Can you describe (the studied species)?	What would you say about (the studied species)?
Can you remember which animals have extracorporeal digestion?	Which animal has extracorporeal digestion?
Is there an example?	Give an example For example, what is it about?
Write all the possibilities	Find as many options as possible What possibility can you think of?
Can you list any axially symmetrical objects of daily use?	Propose some axially symmetrical objects of daily use.

3.2 Discussion

Similar categories of good questions to those that found in the analysed materials of e-learning support were present also in good questions posed by mathematics and science educators following our instructions (Jančaříková and Novotná, 2019).

The results show that teachers use questions in e-learning materials only marginally, mainly for revision and pupil self-assessment. This corresponds to the results of the Czech School Inspectorate survey from observations of lessons in natural sciences (ČŠI, 2019a) and mathematics (ČŠI, 2019b) at elementary schools in the Czech Republic, which state that teachers predominantly use closed questions when asking pupils.

We find it surprising that materials for the 6th grade include 2x more good question and questions close to good question (59 questions in total) than materials for 9th grade (29 questions). Similarly surprising is the presence of multiple good questions only in materials for the 6th grade. (Yet it is clear from the findings of developmental psychology that complexity and multi-criteria approach is easier at older age.) Why is this type of questions not included in materials for older pupils in any of the studied subjects for older age categories? A possible explanation may be that teachers use questions (including good questions) as motivational rather than educational tool.

What is really striking is how many questions are good questions inadvertently, without the teacher using the potential offered by the good question method (and perhaps sometimes without admitting that there are more possible answers). An example of this is the question “Extinct arthropod?” (Table 4). Since in textbooks for elementary schools in the Czech Republic there is only one example of an extinct arthropod (trilobite), a single answer offered in the presentations has some logic. However, with regard to the form of study (home schooling supported by e-learning) and to the fact that many other extinct arthropods can be easily found on the Internet (even in Czech), why do the educational materials not lead pupils to look for more correct answers?

4. Conclusions

Teachers who were developing study materials for home schoolers do not know the method of good questions. They do not use it frequently. Its use is random or intuitive. It serves as a motivational tool, especially at the beginning of lower secondary education. Its potential is not used sufficiently. Authors of the materials also fail to use the potential of e-learning, i.e. the possibility to work with data.

If teachers pose good questions (in both face-to-face or e-learning educational environments), it is without any doubt good for pupils’ and students’ future lives and careers and thus for all society. Our society undoubtedly needs citizens that are able to test and verify traditional concepts, scrutinize and test “generally acknowledged truths”. As stated in (Jančaříková, Jančařík and Novotná, 2013), posing good questions in teaching requires interest, knowledge of the discipline and also courage, will to fight prejudice.

The findings from the presented research are significant for pre-service and in-service teacher education. Clearly, if teachers and other authors of e-learning materials are not acquainted with the potential of the environment of good questions, the developed materials are burdened with the problems detected in the here presented analysis. Moreover, the environment of e-learning allows active participation of the solver in search in various types of resources.

Acknowledgements

The paper was supported by Charles University project “Progres Q16 – Environmental research" and the Czech Science Foundation project GA ČR: GA16-17708S "Home Education - Facts, Analyses, Diagnostics".

References

Česká školní inspekce. (2019a) *Tematická zpráva Rozvoj přírodovědné gramotnosti ve školním roce 2016/2017* [Czech School Inspectorate. Thematic Report on Development of Natural Science Literacy in the School Year 2016/2017], Česká školní inspekce, Praha, [on-line], http://www.csicr.cz/html/2018/TZ_rozvoj_prirodovedne_gramotnosti/html5/index.html?&locale=CSY.

Česká školní inspekce. (2019b) *Tematická zpráva Rozvoj matematické gramotnosti na základních a středních školách ve školním roce 2017/2018* [Czech School Inspectorate. Thematic Report on Development of Mathematics Literacy in the School Year 2017/2018], Česká školní inspekce, Praha, [on-line], https://www.csicr.cz/Csicr/media/Prilohy/PDF_el._publikace/Tematick%C3%A9%20zpr%C3%A1vy/TZ-matematicka-gramotnost-2017-2018.pdf.

Drtina, R. (2011) *Možnosti a omezení elektronické podpory kvality vzdělávání* [Potential and limits of electronic support of quality of education digital copy of a monograph], Extrasystem Praha, Praha, [online], http://www.extrasystem.com/9788087570012.pdf.

Jančařík, A., Jančaříková, K. and Novotná, J. (2013) " "Good" Questions in Teaching". In 3rd World Conference on Learning, Teaching and Educational Leadership, *Procedia - Social and Behavioral Sciences*, Vol 93, pp 964–968.

Jančařík, A. and Novotná, J. (2017) "Home schooling and computer-based collaborative activities". In Mesquita, A. and Peres, P. (Eds.), *Proceedings of the 16th European Conference on e-Learning ECEL 201*7 (pp 205–210), Academic Conferences and Publishing International Limited, Reading.

Jančaříková, K. and Novotná, J. (2019) "Posing good questions – Why are good questions posed not always good?". In Fejfar, J., Fejfarová, M., Flégl, M., Husák, J. and Krejčí, I. (Eds.), *Proceedings 16th International Conference ERIE 2019* (pp 105–112), CULS, Praha.

Kostelecká, Y., Zimčík, L., Jančařík, A. and Jančaříková, K. (2016) "Distance Learning and the Home Schooling in the Czech Republic". In Novotná, J. and Jančařík, A. (Eds.), *Proceedings of the 15th European Conference on e-Learning ECEL 201*6 (pp. 364–372), Academic Conferences and Publishing International Limited, Reading.

Moyer, P. and Milewicz, E. (2002) "Learning to question: Categories of questioning used by preservice teachers during diagnostic mathematics interviews", *Journal of Mathematics Teacher Education,* Vol 5, pp 293–315. http://dx.doi.org/10.1023/A:1021251912775

Pavlíček, J. (2003) *Základy e-didaktiky pro e-tutory: Studijní materiály pro distanční kurz Dovednosti e-tutora* [Foundations of e-didactics for e-tutors: Study materials for the distance course E-tutor's skills]. Ostravská univerzita, Ostrava.

Slowiaczek, L.M., Klayman, J., Sherman S.J. and Skov, R.B. (1992) "Information selection and use in hypothesis testing: What is a good question, and what is a good answer?", *Memory & Cognition,* Vol 20, No. 4, pp 392–405. http://dx.doi.org/10.3758/BF03210923

Sullivan, P. and Clarke, D. (1988) "Asking better questions", *Journal of Science and Mathematics Education in South East Asia*, Vol 11, pp. 14–19.

Practical Application of MicroLearning in Education of Future Teachers

Tomas Javorcik and Radim Polasek
Department of Information and Communication Technologies, Faculty of Education, University of Ostrava, Czech Republic
tomas.javorcik@osu.cz
radim.polasek@osu.cz
DOI: 10.34190/EEL.19.031

Abstract: eLearning is a widely used concept when it comes to using information and communication technologies in the education of people of all ages. Since it was first used in the education process, eLearning has undergone a number of changes and innovations, in order to meet the latest technology requirements as well as the changing requirements of society. As a result, there are various forms of eLearning and it is entirely up to the teacher/tutor which one they decide to use (i.e. which one they consider to be the most effective). The following are some of the forms of eLearning: mobile learning, blended learning, adaptive eLearning or eLearning with gamification elements. Apart from these, the term microLearning is also becoming established. Even though it is not a completely new term, microLearning has yet to be described in detail (in research studies, methodologies and textbooks), despite its popularity with the majority of age groups. The greatest advantage of microLearning is that it is not dependent on the technology that the student is using. Dividing the curriculum into smaller units, microLearning allows the student to learn anytime and anywhere as well as plan their learning, regardless of whether they use a desktop computer, a laptop, a mobile phone or a tablet. The paper describes practical experience with using microLearning in education of future teachers at the Pedagogical Faculty. In order to be able to determine the potential of microLearning, pilot microLearning courses had been created, which were then compared with existing eLearning courses. This part of research was aimed at comparing the behavior of students in the microLearning course with those in the eLearning course. Both courses had the same content, were used in the instruction of students with the same specialization, and both were one semester long. Apart from describing students' way through the course, the paper also presents their opinions on the microLearning-based courses, the level of acquired knowledge and other factors that could prove crucial for the wider use of this eLearning concept in the future.

Keywords: eLearning, microLearning, learning management system, future teachers, Industry 4.0

1. Introduction

eLearning has made education more available, helping people become more educated. Therefore, it has helped improve the education process around the world. Its gradual development has gone hand in hand with the development of various technologies. eLearning has developed from sending textbooks via email into adaptive Learning Management Systems (LMS) and the use of artificial intelligence (Egerová, 2011). An accelerating pace of life, the need to educate more people and the inevitable fourth industrial revolution (Industry 4.0), which will affect all areas of human activity. The educational system needs to adapt to all the aforementioned socio-technological changes by altering the educational content, the form in which it will be presented to students and also training competent teachers who will be able to present the educational content to their students using modern methods and devices.

The paper is aimed at using microLearning to educate future teachers. Its nature makes microLearning suitable not only for students but also for lifelong education of teachers as well as current employees in different fields (Bruck, Motiwalla, Simons, Foerster, & Jonker, 2015). Moreover, it also meets current educational requirements. However, none of the published research on microLearning says how effective it really is when used in education (Bruck, Motiwalla, Simons, Foerster, & Jonker, 2015; Jomah, Masoud, Kishore, & Aurelia, 2016; Sirwan Mohammed, Wakil, & Sirwan Nawroly, 2018). That is why the authors look at microLearning from many different points of view. The paper is aimed at comparing the behavior of students in a microLearning course with those in an eLearning course.

2. Theoretical outcomes of microLearning

When comparing eLearning and microLearning, one discovers that microLearning is not a revolution but rather a continuation of the evolution of eLearning (Giurgiu, 2017). This process is caused by the following factors:

- Easy availability of powerful digital technology which allows users to access information anytime and anywhere.

- The available mobile data plans provided by mobile operators allow users to communicate and work in an online environment. Increasing data usage across the EU proves that more and more individuals use their mobile devices to access online content, using a greater amount of data (see Figure 1). Students are a specific group of mobile device users. In the majority of EU countries, more than 90% of students access the Internet on their mobile device (Eurostat, 2019).

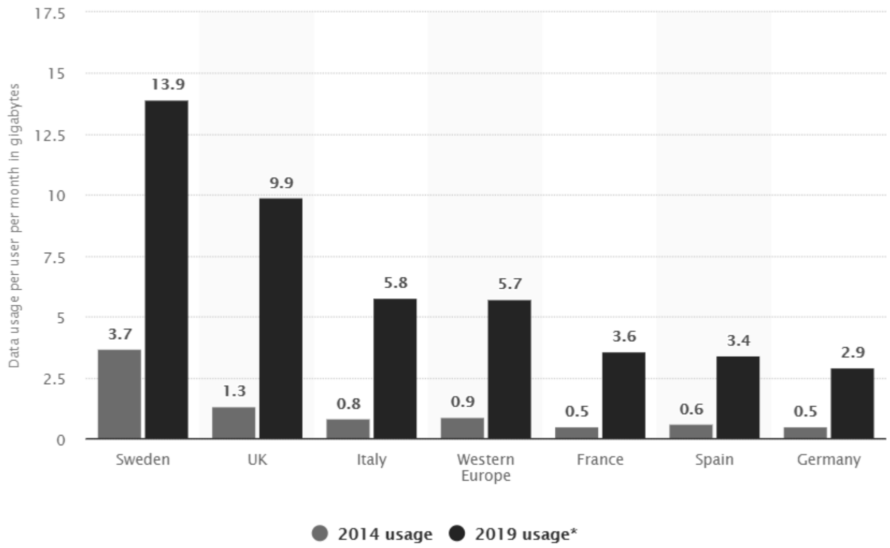


Figure 1: Mobile data usage (in gigabytes) in selected EU countries in 2014 and 2019 (Statista, 2019)

- An accelerating pace of life caused in part by the ever-increasing amount of available information and rapid development of technology.
- New educational systems and applications that allow for the use of new (enhanced or upgraded) pedagogical approaches, methods or different versions of educational content.

The aforementioned factors force the creators to update their courses to meet current technology requirements. Outdated courses do not meet those requirements, as a result of which they are not popular with students, who are losing interest in outdated content and, instead, search for information in unverified sources. As a result, they may fail the final exam (Javorčík, Polášek – DIVAI). Based on these arguments, the authors decided to try and find an effective solution – transforming selected e-courses into microLearning courses.

MicroLearning is not a new term. However, since 2004, when it was first used and defined, it has been rarely used or mentioned by teachers, scientists or educational institutions. MicroLearning means a complex approach to education based on using web content to connect activities that are short in duration (Kamilali & Sofianopoulou, 2015). Such activities are called a MicroLearning Unit (Hug & Friesen, 2009). There are many microLearning concepts and versions. The following dimensional model shows the different versions of microLearning. The model makes it possible to interpret each individual version and enhance instruction.

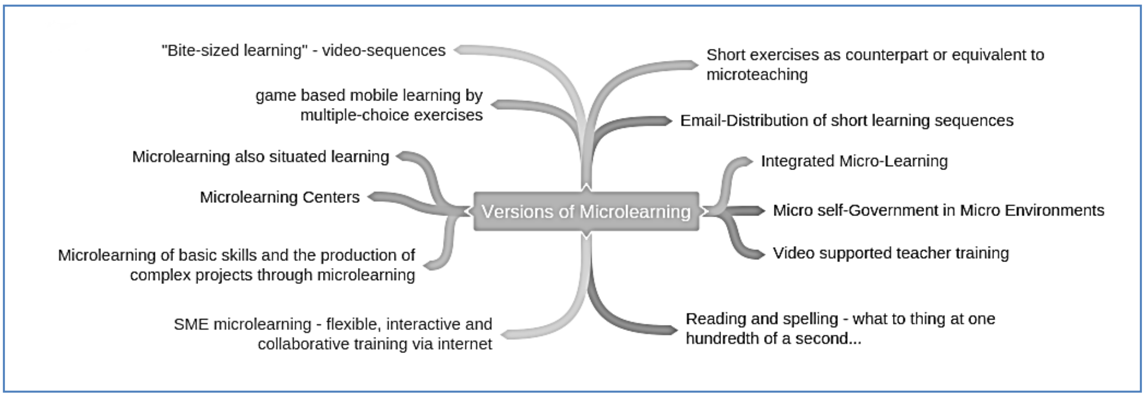


Figure 2: MicroLearning versions according to Hug (2006)

The aforementioned dimensions are the basis for the advantages of microLearning (Malamed, 2015):

- **Immediate Results.** One benefit of effective microLearning is that it enables a person to quickly close a small knowledge or skill gap. For example, some universities are using a microLearning strategy to help students learn about collaborative and social technologies, such as how to set up a Google+ account.
- **Diverse formats.** For both unstructured and structured learning, microLearning has the potential for using a very blended approach to instruction.
- **Budget friendly.** Production costs for microLearning should be much lower than the costs for a major course production. The vision of microLearning is smaller and laser focused.
- **Quick achievements.** Because people can typically process around four bits of information at a time, it is easier for a learner to achieve success from a short learning intervention. I have found this myself when studying a foreign language.
- **Ideal for tagging.** Small chunks of instructional content can be tagged for easy search, access and reuse.
- **Fast-paced culture.** MicroLearning is a solution that busy workers will appreciate because it is not as disruptive as a day of training or even an hour or two of eLearning.

The same author also focuses on the limitations of microLearning. He mentions the following:

- **Lack of research.** There is insufficient research to know whether microLearning is an effective strategy for reaching long-term learning goals.
- **Learning fragments.** For long-term learning goals, microLearning interventions could end up as content fragments that are not tied together.
- **Lack of cognitive synthesis.** We cannot be certain that learners will synthesize content from microLearning well enough to construct appropriate mental models.
- **Potential for confusion.** If a microLearning solution includes a wide variety of formats, some learners could have problems switching between them.

With the expansion of technology, narrowing of curriculum content by the Czech School Inspectorate and the Ministry of Education, Youth and Sports and modernization of the education process, the term microLearning is becoming more and more important. The different ways of presenting the educational content to the student is another reason for detailed examination of microLearning and its effects. Apart from traditional methods (face to face instruction, eLearning or mobile learning), microLearning also enables the teacher to present the educational content through social media, such as Facebook, Instagram, YouTube or Twitter.

3. Implementing microLearning into education of future teachers

To compare the microLearning and eLearning versions of a course, students enrolled in the “Computers in Education” course were selected. The group consisted of 17 full-time and distance students. They were divided into two groups of 9 and 8, respectively, with the larger group studying the microLearning version of the course. Both versions were created in the Moodle Learning Management System environment.

Each thematic unit of the eLearning course contained a lecture in PDF form, which consisted of extensive texts with occasional schemes and images. Apart from the lecture, each thematic unit also contained additional materials (web links) and a correspondence task aimed at practical application of the acquired knowledge.

In the microLearning version of the course, the text lecture was replaced by H5P modules. This Moodle LMS function allows the user to create a short, concise and interactive educational content. The original text lecture was divided into several short microLearning units, with each unit being represented by one H5P module. An H5P module can be, for example, a video, timeline, quiz, short presentation, etc. Each microLearning unit contained at least one fixing question and a correspondence task aimed at practical application of the acquired knowledge. Both versions had the same correspondence task.

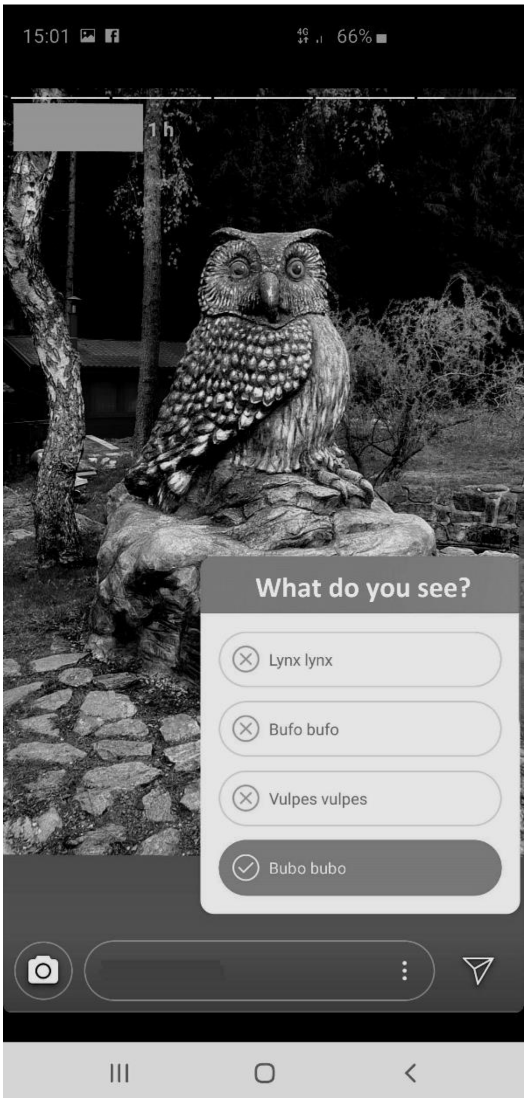


Figure 3: MicroLearning through social networks – Instagram Stories (photo by authors)

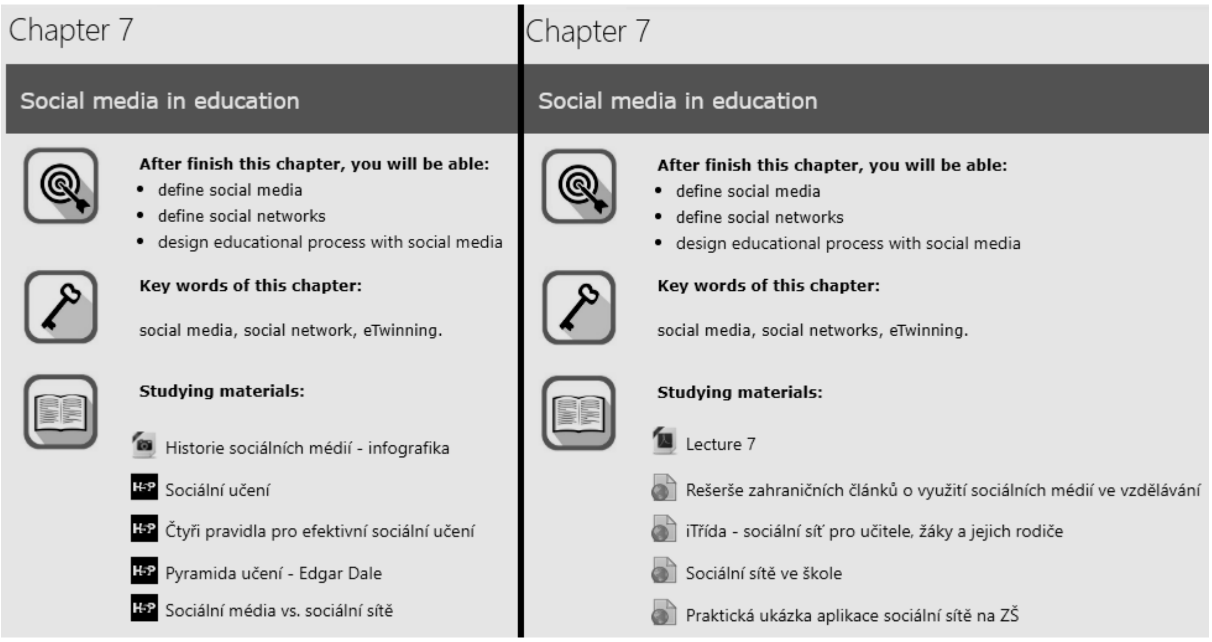


Figure 4: The same topic in microLearning (left) and eLearning (right) courses

4. Monitoring students' activity in eLearning and microLearning Courses

Since both courses were distributed through the Moodle LMS web interface, students' activity could be recorded through various analytical tools for tracking website activity for marketing purposes. The authors used the tool OPEN WEB ANALYTICS (http://www.openwebanalytics.com/) as it best suited their purposes.

- Affordable tool.
- Suitable for the created courses.
- Tracks user activity in real time.
- Monitored parameters are related to students' activity in the course.

The main parameter recorded by the aforementioned tool was how students' activity changed during the course (which took place from February 22nd to May 31st, 2019). If one compares students' activity in the two courses, one can see that from April 16th onward, there is almost zero activity in the microLearning course while the activity in the eLearning course continues (see Figure 5).

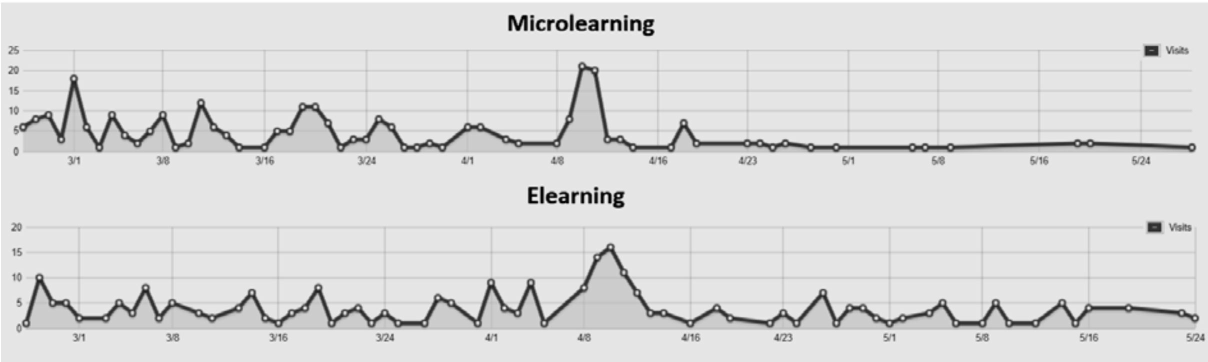


Figure 5: Timeline of accessing microLearning and eLearning courses

Even though the students in the microLearning course had zero activity during the final month, the overall activity (the number of page views) was higher. The microLearning course students had 2,238 page views while the eLearning course students only had 1,653. During one visit, a user in the microLearning course viewed 8.17 pages on average while a user in the eLearning course viewed 6.24 pages.

Average time spent in the course statistics (which can be interpreted as study time) are also extremely interesting. In the eLearning course the average time was 33 minutes and 23 seconds. In the more modern course it was only 9 minutes and 20 seconds.

Bounce rate (the percentage of visitors to a particular website who navigate away from the site after viewing only one page) is another parameter that helps us determine how popular a course is. The microLearning course had a bounce rate of 16.42% while the eLearning course had 23.77%.

The results show that students in both courses used mobile devices (a smartphone, phablet or tablet), i.e. no statistically significant differences were determined. For clarification purposes, the authors are including the following chart:

Recorded parameter	MicroLearning	eLearning
Total page views	2,238	1,653
Average page views in one visit	8.17	6.24
Average time (one visit)	9 minutes and 20 seconds	33 minutes and 23 seconds
Bounce rate	16.42 %	23.77 %
Number of times course was accessed from mobile device	30	24

5. Discussion

Students' activity in both courses was recorded for fourth months, showing differences between the two courses. Students' activity in courses changes over time. Graph curves in Figure 5 show similarities between the two courses on the same dates. However, there is a noticeable difference in the period from April 16th, 2019 onward when there is almost zero activity in the microLearning course while the activity in the eLearning course continues. A more detailed analysis shows that the microLearning course students completed all the assigned correspondence tasks (and the course itself) earlier than the eLearning course students. It can therefore be concluded that dividing a course into smaller interactive microLearning units makes instruction more time efficient. The fact that the microLearning course students had more page views than those in the eLearning course proves this notion to be correct. Since the student needs less time to study one interactive microLearning unit, they go through the entire course faster and therefore have enough time to revise a particular unit and retain their knowledge. As a result, during one visit, a student in a microLearning course views more pages than a student in an eLearning course.

The research was aimed at determining whether or not students in a microLearning course spend less time studying than those in an eLearning course (which was confirmed). Dividing a curriculum into small, related units is more time efficient and comfortable for students than long text files. The microLearning course students were more motivated (lower bounce rate). The authors were surprised to learn that mobile devices were not used as frequently as expected, despite the fact that both courses were designed to encourage their use.

6. Conclusion

The data acquired through recording students' activity in the microLearning and eLearning courses show that a microLearning course is more time efficient – students obtain the required knowledge in a shorter period of time. The form in which the curriculum is presented in a microLearning course better suits students' studying needs, making microLearning course a more comfortable form of education. Since the individual units are not time consuming, the student proceeds in small steps and therefore is allowed to plan their studying. Students can use mobile devices, allowing them to study outside of home/school, e.g. on their way to work, during recess or in a doctor's waiting room.

The paper was not aimed at students' level of knowledge before and after the course, but rather at students' approach to the course and the way in which they study. This approach is often overlooked when examining new teaching/learning methods.

References

Bruck, P. A., Motiwalla, L., Simons, L. P. A., Foerster, F., & Jonker, C. M. (2015). *Microlearning mApp raises health competence: hybrid service design*. https://doi.org/10.1007/s12553-015-0095-1

Egerová, D (2011) *Jak vytvořit studijní opory pro e-learning*, Západočeská univerzita Plzeň, Plzeň.

Eurostat (2019) Individuals using mobile devices to access the internet on the move, https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tin00083&plugin=1

Gassler, G. (2004). *Integriertes Mikrolernen* (Diploma theses, University of Innsbruck).

Giurgiu, L. (2017). *Microlearning an Evolving Elearning Trend. Buletin Scientific*, 22(1), 18–23.

Hug, T (2006*) Microlearning: A New Pedagogical Challenge* (Introductory Note), In T. Hug, M. Lindner, & P. A. Bruck, (Eds.), Microlearning: Emerging Concepts, Practices and Technologies After E-Learning: Proceedings of Microlearning Conference: Learning & Working in New Media, pp. 8-11. Innsbruck, Austria: Innsbruck University Press.

Hug, T., & Friessen, N (2009) *Outline of a Microlearning Agenda. Elearning Papers*, Vol 2009, No. 16, pp. 1-13. https://www.openeducationeuropa.eu/sites/default/files/old/media20252.pdf

Jomah, O., Masoud, A. K., Kishore, X. P., & Aurelia, S. (2016). Micro Learning: A Modernized Education System. *BRAIN: Broad Research in Artificial Intelligence & Neuroscience*, 7(1), 103–110.

Kamilali, D., & Sofianopoulou, C. (Eds.) (2015) *MICROLEARNING AS INNOVATIVE PEDAGOGY FOR MOBILE LEARNING IN MOOCS*. In D. Kamilali & C. Sofianopoulou (Eds.), IADIS International Conference Mobile Learning 2015 (pp. 127-131). Madeira, Portugal: International Association for Development of the Information Society.

Malamed, C (2015) *Is Microlearning The Solution You Need? A Clouser Look at Bite-sized Learning, The eLearning Coach*, http://theelearningcoach.com/elearning2-0/what-is-microlearning/

Sirwan Mohammed, G., Wakil, K., & Sirwan Nawroly, S. (2018). The Effectiveness of Microlearning to Improve Students' Learning Ability. *International Journal of Educational Research Review*, 3(3), 32–38. https://doi.org/10.24331/ijere.415824

Statista (2019) *Mobile data usage per user per month in selected European countries in 2014 and 2019* https://www.statista.com/statistics/612494/mobile-data-usage-per-user-per-month-in-western-europe/

Problem Based Learning: A Facilitator of Computational Thinking

Tanja Svarre Jonasen and Sandra Burri Gram-Hansen
Aalborg University, Department of Communication and Psychology, Aalborg, Denmark
tanjasj@hum.aau.dk
burri@hum.aau.dk
DOI: 10.34190/EEL.19.150

Abstract: This paper explores and analyses the potential of Problem Based Learning (PBL) as a pedagogical framework for Computational Thinking (CT) in educations. CT skills are increasingly recognized as a necessity to all lines of study, as they not only facilitate digital proficiency, but potentially also a sense of computational empowerment and an ability to take a critical and constructive approach to applying computers when solving complex problems. The distinct focus on higher education is routed in theoretical as well as empirically based challenges, as this particular group of learners for the vast majority have started their education in a mainly analogue learning setting, yet now face employments with a much stronger demand for digital competences. With this paper, we aim to highlight the immediate benefits of PBL as a means to develop CT-skills as part of a higher education.

Keywords: problem based learning, computational thinking, collaborative learning

1. Introduction

Digitalisation has and continuously will change both our professional and private lives (Bradley, 2000; Jan vom Brocke et al., 2018; Richter et al., 2018). These changes require a changed set of skills for citizens to become proficient users of digital resources along with critically and constructively applying technologies. The awareness of preparing pupils and students for this reality has been emphasised by the introduction of the notion of CT in schools, both K-12 and higher education (Witherspoon et al., 2017), though with an emphasis on K-12 (Kalelioğlu, 2018). CT represents the idea that learners are provided with a basic understanding of programming and computer modelling, along with tools for structured problem solving.

Much attention has been paid to K12 learners and the STEM disciplines in CT research, where initiatives have had varying length and learning activities (Kalelioglu et al., 2016; Shute et al., 2017). This paper focuses on CT in higher education, and in particular within the humanities, as higher educations is responsible for preparing students for the professional life after graduation. Thus, this is where CT skills should be combined with the disciplinary specialisation to meet the societal requirements for candidates.

Learning designs within CT are often associated with some sort of product development, where learning artefacts and tools are used to establish CT competences (Grover and Pea, 2013; Repenning et al., 2017). However, in order to gain a deeper understanding of CT problem solving which is required in higher education, alternative pedagogical approaches must be exposed. Czerkawski and Lyman (2015) have investigated the potential of game-based learning. The current paper explores, discusses, and analyses how PBL, and in particular AAU PBL comprises another alternative for supporting university students in obtaining CT skills. We argue that PBL may provide a stronger contextual and interdisciplinary understanding of the problem to be solved by means of CT skills. The following sections outline brief presentations of CT and PBL along with a discussion of the potential of PBL in CT. The theoretical basis of the paper is exemplified by a CT pilot study conducted in a PBL context under the faculty of humanities at Aalborg University, Denmark.

2. Theoretical underpinning

2.1 Computational thinking

The aim of CT is to strengthen digital skills by including computing aspects in problem solving. Essentially, the purpose is to become able to reduce complex problems to smaller and manageable problems by approaching them with a computational mindset (Wing, 2006). The computational mindset can thus enable more efficient problem solving (Shute et al., 2017). A set of skills have been defined to identify the CT mindset. They include the ability to:

- Formulate problems in a way which enable us to apply computers in problem solving
- Organise and analyse data logically

- Represent data through appropriate abstractions in models and simulation
- Automate problem solving through algorithmic thinking
- Apply computers for problem identification, analysis and implementation of solutions
- Generalise and transfer problem solving to a broader variation of problems (Caspersen, 2017).

A different way of viewing CT is by the four distinct competences, that forms the concept, namely decomposition (breaking down systems or tasks into smaller units that enables explanation of the process to either a human or a computer), pattern recognition (spotting commonalities or differences that enables predictions or shortcuts), abstraction (identifying information that is necessary and unnecessary in problem solving) and algorithms (developing stepwise strategies for problem solving) (Wu and Richards, 2011).

The increased digitalisation in society along with Wing's (2006) paper on CT have increased the focus on CT in education both at K-12 level and in higher education. Across educational levels CT is seen as a concept that supports students in a more efficient and deeper understanding of the process of problem solving (Wing, 2014). Being a concept that emphasises problem solving, makes CT relevant to a wide range of disciplines (Yadav et al., 2011). Apart from having been implemented within the STEM area, disciplines like art, music and social sciences have also incorporated CT initiatives (Flórez et al., 2017; Wing, 2014). However, comparing the implementation across disciplines reveals some variation. To exemplify: in computer science decomposition is understood as defining objects and methods, while natural science sees it as the classification of species (Barr and Stephenson, 2011).

2.2 Problem based learning

PBL is known to be an exploratory approach to learning, where students learn through practical experience while working with real world problems. PBL differs from traditional learning approaches in using different learning activities that can qualify the students while exploring and solving identified problems. The aim is to provide the students with the possibility to gain new insights and competences in a nurturing learning environment that relates directly to the professional practice awaiting after their graduation (Kolmos, 1996; Kwan, 2012). Moreover, PBL provides better results than lecturing when it comes to students' critical thinking (Tiwari et al., 2006).

In this paper, we focus on the Aalborg University (AAU) PBL approach. Within this approach students builds up skills and insights by exploring and testing theories and methods in practice. Furthermore, AAU PBL enables students in building competences within communication, dissemination and group work (Kolmos et al., 2004). Three principles characterise the AAU PBL model; 1) the learning principle that learning is organised around problems, 2) the content principle that problem solutions arise from an interdisciplinary perspective, and 3) the social principle that learning takes place in teams and groups in the form of collaborative learning (Du and Kolmos, 2006; Kolmos et al., 2004). In collaborative learning students work together towards a common goal (Dillenbourg, 1999). Collaborative learning has been shown to improve students' ability to recall information longer (Johnson and Johnson, 1986) and increase their critical thinking (Gokhale, 1995). Guided by these principles, students form groups to collaborate on real-world problems. Lectures, workshops, self-studies and project supervision facilitates the project process and the project process and eventually the research carried out is documented in a report. The process usually has a duration of 3-4 months (Ryberg et al., 2018). Below Figure 1 illustrates the general process.

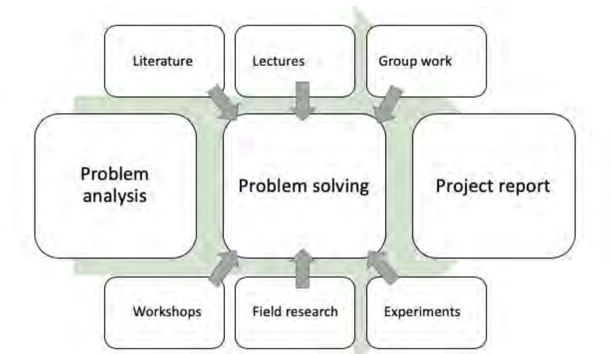


Figure 1: Illustration of the project process derived from Kjærsdam and Enemark (1994)

Although the AAU PBL model is known and recognised for having a strong potential, it also implies challenges. Thus, Huttel and Gnaur (2017) find that faculty staff experience a conflict between students' focus on exam results rather than on the project process. Across various university levels, there is a tendency to refer to the project reports as "the project" and considering the project process to be secondary to the documentation process and the exam grades. This finding is not surprising, considering that the focus on grades have been formed earlier in the schooling system and is what in most cases admit learners to a higher education. However, it is a problem, if students preparing for their professional life are unable to communicate their skills and competences and articulate the process followed in working with real-life problems. Huttel and Gnauer's (2017) recommendation based on their study is to focus more distinctly on the problem-solving process. In relation to the focus in the current paper, a stronger focus on the problem-solving process may also support the students' ability to increase their CT skills as increased problem-solving skills are also in the core of CT.

2.3 Strengthening CT with AAU PBL and collaborative learning

CT and PBL both represent concepts that aim at problem solving and problem understanding, but from different perspectives and with different purposes. However, the PBL approach holds a vast potential in acquiring CT competences for learners at different levels of education. With PBL's focus on enabling learners to explore and develop new skills and understandings in a nurturing environment while actively engaging in collaborative learning to solve real world problems, PBL may provide learners with a structure for acquiring lasting CT skills that represents critical thinking towards technology. A PBL approach to CT in education will contribute with a combined theoretical and practical experience for the learners, as they will have the PBL structure (Figure 1) to structure the identification and understanding of the problem at hand that enables a qualified problem solving, e.g. by applying CT skills in practice.

Understanding the problem prior to engaging in the problem-solving process requires learners to be able to critically reflect upon the distinct problem at hand as well as on the relation between the problem and the context. Iversen et al. (2018) point to the general lack of critical stance towards digitalized society in CT and argue that in educations contexts CT should extend the perspective from distinct skills to a wider focus on Computational Empowerment (CE). The authors point towards participatory design as a valuable contribution to CT in educational setting, pinpointing the importance of enabling children to make critical and informed decisions regarding the role of technologies in both professional and personal settings. In line with these recommendations, we argue that PBL provides a learning design framework, which through its distinct focus on e.g. group work and collaboration between students and supervisors, facilitates a learning process which goes beyond simply acquiring CT skills but also demands more in-depth reflections regarding the problem and the context in which it has emerged, which is required in higher education.

3. Putting theory to practice

In order to further explore and to exemplify how collaborative learning and PBL facilitate students in acquiring CT skills, we in this section refer to a pilot study conducted at Master of Science in Information Technology programs under the faculty of humanities (Cand.it). The study was conducted as a semi-structured investigation, where the initial goal was to explore whether CT also had potential in higher education and more distinctly in university programs under the faculty of humanities.

A distinct benefit of focusing on Cand.it program under the faculty of humanities, was that these programs focus distinctly on the challenges briefly presented in the introduction. The majority of students work towards a professional life where they will be expected to bridge between users and technology, and facilitate developers and designers in ensuring that the needs, values and requirements of the users are considered as new technologies are developed. Consequently, these students not only have a humanistic interest in technologies, they also engage actively in applying new technologies throughout their studies. Applying technologies when collecting data, analysing data, producing prototypes and eventually writing an academic report, is a natural part of the semester process. By reference to Barr and Stephenson (2011), recognition of the program being located under the faculty of humanities also influenced the understanding of CT skills and the expectations towards how CT skills were to influence the students.

20 students were included in the study and introduced to CT at two different occasions. First as part of the semester introduction and secondly at the end of the first semester. In both cases CT was mainly approached at a conceptual level, where the different CT skills provided the students with points for reflections and a

vocabulary to explain own skills. Within the pilot study the aim was to benchmark the students' CT skills at the beginning of their studies and again after having completed a PBL process. The approach was based on the hypothesis that the students would extend their CT skills through the PBL structured semester and assessment focused on the students' ability to reflect upon and articulate their problem-solving process.

As the study was considered a preliminary step towards more stringent investigations of the relation between CT and PBL as well as the potential of CT in higher education, the study was designed to be naturally integrated into the already planned semester activities. It is with this in mind that we refer to the study as semi-structured. Rather than design distinct CT courses and evaluate the outcome of such, the aim was to investigate what the role of CT might be in the broader PBL process which as previously described comprises the centre of each semester at AAU. Data collection was primarily conducted through assignments which were designed to facilitate the involved students in reflecting upon own skills and competences and was consequently to some extent considered a secondary outcome. While follow up studies are naturally expected to be conducted more stringently, it was found beneficial to at this early stage remain as true as possible to the established PBL approach.

The initial benchmarking of the students' CT skills was done through a combination of workshop assignments. Having been introduced to both PBL and CT - with focus on decomposition, pattern recognition, abstraction, and algorithms, the students were on the first day asked to individually exemplify how the skills had been applied in their previous projects (for most students the bachelor project). Reflections concerning skills and competences was addressed once more on the second workshop day, were students were asked to start expressing skills in a competence structured CV template. This second assignment was designed so that it not alone facilitated the pilot study benchmarking process, but also provided the students with insights regarding own skills. This was considered important both when students form groups for the semester project, but also as preparation for internship applications and eventually applying for work.

The secondary benchmarking was conducted as part of the semester evaluation. At this point, the students were prompted to repeat the assignments from the workshop, but this time focusing on the project they had just completed. Again, focusing on the distinct CT skills, students were asked to assess how the skills had been applied through their project work. At this point, the aim was not alone to assess CT skills but also to prompt the students to reflect more critically about what skills they had applied and what competences they might still need building depending on their individual ambitions.

4. Preliminary findings

4.1 CT provides a vocabulary for problem analysis and problem solving

The data collected from the first benchmarking revealed that while all students were able to explain what they had done in their bachelor project, few students were able to reflect upon or even consider the individual CT skills. Students were able to mention distinct methods such as interviews for data collection, but unable to relate the method to the problem they had been solving or identify their approach as a specific competence. This indicated that the students lacked deeper understanding of the processes they had engaged in and potentially also a vocabulary to explain how they had managed the problem-solving process.

In contrast, the secondary benchmarking revealed that the students had acquired a much deeper understanding of their problem-solving process during their first PBL semester. Competences were richly expressed with reference to CT skills. E.g. specific methods were related to the process of decomposition. In consideration that CT had not been a distinct theme of the semester, but rather a perspective brought in for reflection purposes, it was not unexpected that the students did not demonstrate an in depth understanding of CT itself. None the less the development from the first to the second benchmarking was significant enough to motivate a further exploration of the potential of combing CT with a PBL approach. We found that the PBL approach had increased the students understanding of the different CT skills to the extent where they were able to relate them to their own practice. We credit this to the PBL approach as all students had previously completed a BA and as such were not new to academic work itself. Consequently, we find indications that CT may help address the previously mentioned issues presented by Huttel and Gnaur.

4.2 Digital competences were acquired through the PBL process and dependent on the problem at hand

Although the semester did include courses which focused on specific digital skills, the results of the secondary benchmarking indicated that computational competences were primarily acquired through the project work and driven by the problem that a group was working with. E.g. groups working with large batches of data would refer to digital resources for data management and analysis when explaining what CT skills, they had acquired during the semester. Likewise, critical reflections concerning different digital resources were based on practical experience gained through the project work, rather than on the introductions provided through lectures and workshops. This indicated that while the courses might inspire students to consider digital resources in their work, skills were based on practical experience. This was further supported by the second benchmarking in which the students emphasised the technologies which had been applied directly in their individual projects, and also the digital resources which had aided them when writing and preparing their semester report. Students recognized that besides from the problem they were addressing, another problem which could also be handled with CT skills was the documentation process. As exam reports are handed in digitally, students argued that CT skills such as decomposition and abstraction were also beneficial to the writing process and that digital resources such as reference management systems and collaboration-based writing platforms were examples of digital resources handling certain complex tasks and ensuring consistency. While it is debatable whether the examples qualify as CT skills, the arguments did support that the students had gained a stronger understanding of CT and of their own competences, and that this understanding had been acquired through their practical work.

4.3 CT in humanities calls for a stronger focus on Problem analysis

The conducted studies prompt us to further consider the PBL process itself and where in this process the CT perspective comprise a contribution. As mentioned, CT must be implemented and assessed in consideration of the research field in which it is applied. While Figure 1 visualises the PBL approach as comprised by three phases where problem solving is essential, it is particularly in humanities a case that the problem analysis is the essential part of a study. Analytically and in structured manner identifying a distinct problem in a specific context is enough to comprise a semester work. Consequently, it may be necessary to clarify that PBL activities such as group work, lectures and literature studies are of as much value to the problem-solving process and that CT skills may also serve a distinct purpose in the problem analysis phase. When considering CT in humanities, future research should include investigating if for instance a conceptual understanding of decomposition can contribute to a more structured identification of a problem, or if the PBL process benefits more from a more spontaneous curiosity amongst project group members.

5. Discussion

The preliminary findings presented in the previous section indicate that there indeed is a potential in further investigation of the relation between PBL and CT. It also gives reason to consider even further what CT skills comprise in higher education, how it distinguishes itself from CT in K12 programs and how these skills may be achieved through a PBL approach.

As previously explained, the aim of CT is to increase student’s digital skills by actively applying digital resources in problem solving. Based on the insights gained both in theory and through the pilot study, we argue that the potential may go even further to the point where students who achieve CT skills, move from being digital literate, to also being able to critically assess complex digital systems and construct new digital solutions.

Based on Blooms taxonomy (Bloom, 1956), Anderson et al. (2001) present a revised model for thinking and learning. Lower levels of thinking progress from acquaintance to being able to apply, analyse and evaluate, while the highest level of thinking enables creation of new solutions. In relation to CT skills in the mentioned master level programs, CT was expected to enable students to engage in working with digital resources at a much higher and more reflective level. In accordance with Iversen et al. (2018) moving from being proficient users to also being able to critically assess existing technologies and construct new solutions.

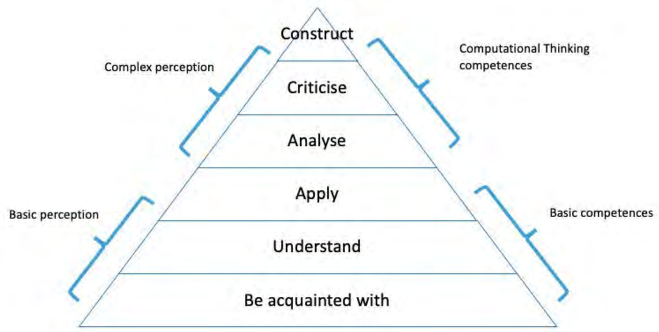


Figure 2: Revised version of Anderson and Krathwohl's (2001) model of Bloom's taxonomy

As visualized in Figure 2, CT was considered not solely an approach to problem solving but also an indication of a higher level of reflection and comprehension not only of technologies but also of one's own practice. CT skills were recognized as the students not simply being acquainted with digital resources but also being able to critically evaluate their possibilities and limitations when solving a distinct problem. At the same level of perception, students were expected to be able to assess their own practice analytically, critically and constructively.

As previously described, the AAU PBL approach is centred around real-world problems, identified and explored by the students in collaboration with supervisors. It is due to this focus on real world problems that it becomes a challenge to identify specific digital resources as essential to learners. As the digital world is rapidly changing, so do the required digital skills. It is thus we argue that critical and constructive skills become essential as it is within these levels of perception that students can identify and construct new solutions which fit their needs. This understanding of CT correlates well with the previously mentioned notion of CE, and furthermore facilitates an understanding of CT which is applicable across different levels of education. While the complexity of problems increases as students' progress from K12 educations into higher levels of education, so does the digital competences required to manage these problems. However, skills related to critically and constructively assessing a problem and solving it in a constructive manner remains essential at all levels.

One of the most important benefits of the AAU PBL approach may however be seen in the prolonged learning period, which in combination with the focus on collaboration is fundamental to the students reaching the higher levels of perception. Although shorter time spans do occur, most AAU PBL processes are conducted over a period of 3-4 months. The prolonged period of collaborative learning is identified as particularly beneficial, as it is during this process that students have time to discuss and reflect upon not only the problem but also their own process. Where shorter time spans tend to rush students into safe solutions and previously tested methods, the prolonged learning process grants the students with time to explore different approaches, and even time to fail and change direction.

6. Concluding remarks

In this paper we have suggested that the AAU PBL approach holds a potential in relation to CT in higher education. In continuation, we have argued towards an understanding of CT, which is applicable across different levels of education and in subjects, which go beyond the traditional STEM disciplines.

CT is identified as not only a practical set of skills but also a higher level of perception - a level of perception, which takes time and calls for an understanding of real-world problems. Whether the aim is for K12 learners to critically assess the possibilities and limitations of an iPad, or for learners at higher educations to be able to handle vast and complex amounts of data, each problem calls for practical experience with different digital resources in order for the students to construct the appropriate method for problem solving.

We argue that acquiring CT competences calls for prolonged use of technologies in educational settings, rather than brief introductions. The ability to critically assess the potential of a technology demands contextual understanding as well as practical experience with the technology. We relate this argument to the PBL understanding that identifying a real-world problem requires frustration or wondering about existing practice. Just as real-world problems come from actual insight, we argue that experience is fundamental to establishing CT skills. It is through experience that we become able to not only see the potential of a technology but also identify its limitations – and in a structured manner propose new and better solutions. Hence, CT also becomes essential not only to the core of humanities, but to all levels of education. With human society and culture in the heart of humanities it is inevitably necessary to move beyond digital literacy towards exploring and evaluating the impact of digital systems in our personal and professional lives.

The empirical study referenced in this paper indicated that CT skills in humanities not only provide the students with digital competences, but also a vocabulary which enables them to evaluate and explain their problem analysis and problem-solving process. This is an important impact of CT particularly for humanistic students who are expected to be able to bridge between users and developers and as such must be able to communicate clearly in both directions.

The AAU PBL approach does have much to offer, however challenges which call for further investigations remain. While the presented understanding of CT may be applicable across different levels of education, the potential of CT in higher education remains a challenge. While K12 students in many cases find themselves in the dawn of their education, students at higher levels of education are in the process of specialising themselves and preparing for professional practice. As such, the potential of CT skills must also be more distinctly related to potential professions. Moreover, if CT is recognized not only as digital skills applied in a problem-solving process, but also as a higher level of perception, there is a distinct need for appropriate methods for evaluation of CT skills.

References

Anderson, L.W., Krathwohl, D.R., Bloom, B.S., 2001. A taxonomy for learning, teaching, and assessing: a revision of Bloom's taxonomy of educational objectives. Longman.

Barr, V., Stephenson, C., 2011. Bringing Computational Thinking to K-12: What is Involved and What is the Role of the Computer Science Education Community? ACM Inroads 2, 48–54.

Bloom, B., 1956. Taxonomy of Educational Objectives: The Classification of Educational Goals, Handbook 1: Cognitive Domain. McKay, New York.

Bradley, G., 2000. The information and communication society: how people will live and work in the new millennium. Ergonomics 43, 844–857.

Caspersen, M.E., 2017. Computational thinking, in: Gymnasiepædagogik. Kbh., pp. 470–476.

Czerkawski, B.C., Lyman, E.W., 2015. Exploring Issues About Computational Thinking in Higher Education. TECHTRENDS TECH TRENDS 59, 57–65.

Dillenbourg, P., 1999. Collaborative Learning: Cognitive and Computational Approaches. Advances in Learning and Instruction Series. Elsevier Science, Inc.

Du, X., Kolmos, A., 2006. Process competencies in a problem and project-based learning environment, in: Proceedings of the 34th SEFI Annual Conference: Engineering Education and Active Students. Presented at the SEFI Annual Conference, Uppsala.

Flórez, F.B., Casallas, R., Hernández, M., Reyes, A., Restrepo, S., Danies, G., 2017. Changing a Generation's Way of Thinking: Teaching Computational Thinking Through Programming. Review of Educational Research 87, 834–860.

Gokhale, A.A., 1995. Collaborative Learning Enhances Critical Thinking. Journal of Technology Education 7, 22–30.

Grover, S., Pea, R., 2013. Computational Thinking in K–12: A Review of the State of the Field. Educational Researcher 42, 38–43.

Huttel, H., Gnaur, D., 2017. If PBL is The Answer, Then What is The Problem? Journal of Problem Based Learning in Higher Education 5.

Iversen, O.S., Smith, R.C., Dindler, C., 2018. From Computational Thinking to Computational Empowerment: A 21st Century PD Agenda, in: Proceedings of the 15th Participatory Design Conference: Full Papers - Volume 1, PDC '18. ACM, New York, NY, USA, pp. 7:1–7:11.

Jan vom Brocke, Maaß, W., Buxmann, P., Maedche, A., Jan Marco Leimeister, Pecht, G., 2018. Future Work and Enterprise Systems. Business & Information Systems Engineering 60, 357–366.

Johnson, R.T., Johnson, D.W., 1986. Cooperative learning in the science classroom. Science and children 24, 31–32.

Kalelioğlu, F., 2018. Characteristics of Studies Conducted on Computational Thinking: A Content Analysis, in: Khine, M.S. (Ed.), Computational Thinking in the STEM Disciplines: Foundations and Research Highlights. Springer International Publishing, Cham, pp. 11–29.

Kalelioglu, F., Gülbahar, Y., Kukul, V., 2016. A framework for computational thinking based on a systematic research review. Baltic Journal of Modern Computing 4, 583–596.

Kjærsdam, F., Enemark, S., 1994. The Aalborg Experiment: Project Innovation in University Education. Aalborg Universitetsforlag.

Kolmos, A., 1996. Reflections on Project Work and Problem-based Learning. European Journal of Engineering Education 21, 141–148.

Kolmos, A., Fink, F.K., Krogh, L., 2004. The Aalborg model: problem-based and project-organized learning, in: The Aalborg Model: Progress, Diversity and Challenges. Aalborg Universitetsforlag, Aalborg, pp. 9–18.
Kwan, A., 2012. Problem Based Learning, in: The Routledge International Handbook of Higher Education. Routledge, London.
Repenning, A., Basawapatna, A.R., Escherle, N.A., 2017. Principles of Computational Thinking Tools, in: Emerging Research, Practice, and Policy on Computational Thinking. Springer, Heidelberg, pp. 291–305.
Richter, A., Heinrich, P., Stocker, A., Schwabe, G., 2018. Digital Work Design. Business & Information Systems Engineering 60, 259–264.
Ryberg, T., Sørensen, M.T., Davidsen, J., 2018. Student groups as 'adhocracies' – challenging our understanding of PBL, collaboration and technology use, in: 7th International Research Symposium on PBL: Innovation, PBL and Competences in Engineering Education. Presented at the 7th International Research Symposium on PBL: Innovation, PBL and Competences in Engineering Education, Aalborg Universitetsforlag, pp. 106–115.
Shute, V.J., Sun, C., Asbell-Clarke, J., 2017. Demystifying computational thinking. Educational Research Review 22, 142–158.
Tiwari, A., Lai, P., So, M., Yuen, K., 2006. A comparison of the effects of problem-based learning and lecturing on the development of students' critical thinking. Medical Education 40, 547–554.
Wing, J.M., 2014. Computational Thinking Benefits Society. 40th Anniversary Blog of Social Issues in Computing.
Wing, J.M., 2006. Computational Thinking. Communications of the ACM 49, 33–35.
Witherspoon, E.B., Higashi, R.M., Schunn, C.D., Baehr, E.C., Shoop, R., 2017. Developing Computational Thinking Through a Virtual Robotics Programming Curriculum. ACM Transactions on Computing Education 18, 4:1–4:20.
Wu, M.L., Richards, K., 2011. Facilitating Computational Thinking through Game Design, in: Edutainment Technologies. Educational Games and Virtual Reality/Augmented Reality Applications, Lecture Notes in Computer Science. Presented at the International Conference on Technologies for E-Learning and Digital Entertainment, Springer, Berlin, Heidelberg, pp. 220–227.
Yadav, A., Zhou, N., Mayfield, C., Hambrusch, S., Korb, J.T., 2011. Introducing Computational Thinking in Education Courses, in: Proceedings of the 42Nd ACM Technical Symposium on Computer Science Education, SIGCSE '11. ACM, New York, NY, USA, pp. 465–470.

Finding an Effective Data Mining Algorithm for Automatic Detection of Learning Styles

Ioannis Karagiannis and Maya Satratzemi
Department of Applied Informatics, University of Macedonia, Thessaloniki, Greece
giankara@gmail.com
maya@uom.edu.gr
DOI: 10.34190/EEL.19.143

Abstract: Students' learning styles are the differences in the methods used to acquire and process information. The main purpose of using learning styles is to adapt the content presentation to the learner, either within Adaptive Educational Hypermedia Systems or Learning Management Systems. More recently several approaches to the automatic detection of learning styles have been proposed, in contrast to the traditional way which has been through students' completion of a specific questionnaire. These approaches are based on the analysis of behaviour data that are gathered from the students' interaction with the system, such as his/her actions and their duration. Automatic detection approaches have a greater potential to be error-free as real data is used in order to detect students' learning styles. Automatic detection techniques can be divided into two subcategories: data-driven and literature-based. Computer science researchers are more familiar with data-driven approaches, because they require the use of an artificial intelligence classification algorithm to automatically detect learning style preferences. This article investigates the precision attained by different data mining algorithms in an online Moodle course after the second and fourth weeks, and at the end of the course, to compare the detection results and check how fast each approach is. An evaluation study of a Moodle course was conducted in the context of an introductory programming course. The study was conducted over the first six weeks of the course, up to the mid-term exam. Students were asked to answer ILS questionnaire right after their first login to the course in order to obtain information regarding their learning style preference and use them to measure the precision of the algorithms. The aim of our analysis was to investigate whether the proposed automatic detection approach can be improved by using different data mining algorithms. Summarizing the findings of the study, we come to the conclusion that the proposed approach for automatic detection of learning styles can attain higher precision by using specific data mining algorithms even only after two weeks into the course.

Keywords: learning styles, automatic detection, educational data mining, user modelling

1. Introduction

Over the last years, several approaches have been proposed to adapt a course to students' different learning preferences. Different frameworks have been used for the development of adaptive systems such as previous knowledge and student background (Thalmann, 2014). Developers reported that student's learning styles were the most useful framework though (Thalmann, 2014) because they can be used to adapt the content presentation to the learner (Bernard et al, 2017). Learning styles summarizes the concept that individuals have different learning preferences and they learn better when they receive information in their preferred way. When learning styles are ignored, students become inattentive in class 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).

Adherents of the learning style theory believe that there is no real scientific basis for the proposition that a learner actually has a certain optimal learning style, there is a reliable and valid way to identify it and learning is improved if teaching is matched to learning styles (Kirschner, 2017). Regarding the validity and reliability of the learning styles tests being used, Stahl (1999) reported inconsistencies and low reliabilities for the measurement of learning styles when individuals complete a particular measurement at two different points in time. In addition the self-reported preferred way of learning is often a bad predictor of the way people learn most effectively.

The aforementioned beliefs led some researchers to classify learning styles as a myth Kirschner, 2017). However, 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) found that the overwhelming majority (89%) of the papers that has been published between 2013 and 2015 and are listed in ERIC and PubMed research databases, implicitly or directly endorse the use of learning styles in higher education. In addition, 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 investigate the performance of a data-driven approach used in Moodle for the automatic detection of students' learning styles. More specific, we investigated whether different data mining algorithms can affect the precision attained. Besides that, we investigated whether a student's learning style can be detected after a short period from the beginning of the course in order to provide an adaptive course early. Summarizing, this study objective was primarily guided by the following questions.

RQ1: Which data mining algorithm is more effective for automatic detection of learning styles?
RQ2: How fast can different data mining algorithms accurately detect students' learning styles?

The remainder of the paper is organized as follows. The next section gives a short description of learning style theory and Felder Silverman Learning Style Model (FSLSM). This is followed by a section where related work is presented. In section 4 the proposed approach for automatic detection of learning styles is described. After a section, where the evaluation study is presented, in the final section are the conclusions.

2. Learning styles

Students differ from one another in many ways, and the way they receive and process information determines their learning style. In the literature there exist a variety of definitions for learning styles. Learning styles term has been used by psychologists to describe the processes used by the learner to realize and process data or information during the learning process, and it concerns about how a person typically thinks, remembers or solves problems (Cassidy, 2004). For some students a course seems to be easy, whereas others face problems with learning in the particular course. 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).

Several theories and learning style models have been put forward. Coffield et al (2004) identified 71 models of learning styles and categorized 13 of them as major models with respect to their theoretical importance in the field and their influence on other learning style models. From the wide variety of learning style models that have been proposed, the Felder-Silverman Learning Style Model (FSLSM) (Felder and Silverman, 1988) has managed to be singled out, probably because it offers an in-depth description of learning styles (Carver, Howard and Lane, 1999).

FSLSM combines 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, which are related to the way students process, perceive, receive and understand information. At this point it should be mentioned that even learners with a strong preference for a particular learning style can at times act differently (Graf, 2007).

Each learning style model is associated with an instrument that can be used 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. Each answer option (a or b) corresponds to one or the other category of the respective dimension (e.g., active or reflective). For statistical analyses it is convenient to use a scoring method that counts "a" responses. Consequently, a learner's preference for each dimension is expressed with a value of between 0 and 11.

3. Related work

Automatic techniques for the detection of learning styles can be divided into two subcategories: literature-based and data-driven (Graf, 2007). The first approach depends on the idea that learners with a particular learning style preference behave in a predefined way. Students' behaviour is used to obtain hints about their learning style and a simple rule-based method is used to calculate the learning style from the number of matching hints. This approach has the advantage of being generic and applicable for data (Graf, 2007). Several literature based approaches have been proposed (Liyanage, Gunawardena and Hirakawa, 2014; Graf, 2007). Most of the aforementioned works attained promising results regarding their precision; their validity can be challenged though mainly due to their small samples.

The second approach aims at building a classifier that imitates the questionnaire that is used by the respective learning style model. Several data mining algorithms have been used to build a classifier and Bayesian networks are one of the most popular ones (Graf, 2007; García et al, 2007; Alkhuraiji, Cheetham and Bamasak, 2011). The reported reasons to use a bayesian network are its natural representation of probabilistic information, its efficiency, and its support to encode uncertain expert knowledge (Feldman, Monteserin and Amandi, 2015). Decision trees are employed mainly because of their simplicity and are used in (Cha et al, 2006; Crockett, Latham and Whitton, 2016; Özpolat and Akar, 2009). Although neural networks are not so easy to built, they were used in many approaches (Kolekar, Sanjeevi and Bormane, 2010; Zatarain-Cabada et al, 2010) due to the speed of execution. Other not so common techniques that were used for automatic detection of learning styles were hidden Markov models (Cha et al, 2006), and genetic algorithms (Yannibelli, Godoy and Amandi, 2006). Liyanage, Gunawardena and Hirakawa (2016) compared the performance of four different data mining algorithms, including J48, Bayesian network, naïve Bayes, and random forests. The specific study revealed that the J48 algorithm was the most suitable for their system and dataset.

Besides the above mentioned classification algorithms, clustering approaches have also been proposed (Despotović-Zrakić et al, 2012; Klasnja-Milicevic et al, 2011). The major disadvantage of these approaches is that since they do not allow real time adaptation, teachers are required to monitor students' progress and if needed move them to another cluster manually.

4. Proposed approach for automatic detection of learning styles

The mechanism that was proposed to adapt a Moodle course to a student's learning style and knowledge was thoroughly presented in our previous work (Karagiannis and Satratzemi, 2018b). Regarding the automatic detection of students' learning styles, the steps of the proposed approach are depicted in Figure 1.

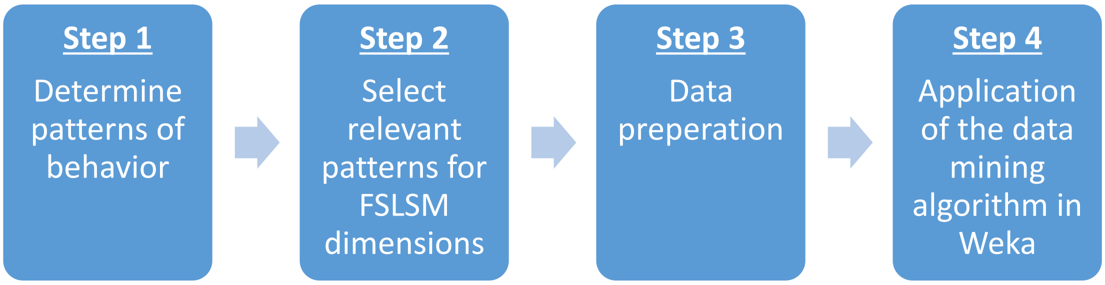


Figure 1: Steps of the proposed approach for automatic detection of learning styles

Taking under consideration the fact that the proposed adaptation mechanism (Karagiannis and Satratzemi, 2018b) used seven different types of learning objects, namely outlines, content objects, videos, solved exercises, quizzes, open-ended questions and conclusions, the behavioural patterns should be related to these types. The patterns of behaviour that were decided to be used (Karagiannis and Satratzemi, 2018b) and their description are presented next:

- outline_dur, outline_vis: relative time spent and number of visits on outlines
- content_dur, content_vis: relative time spent and number of visits on content objects
- video_dur, video_vis: relative time spent and number of visits on videos
- quiz_dur, quiz_vis: relative time spent and number of visits on quizzes
- conclusion_dur, conclusion_vis: relative time spent and number of visits on conclusions
- solved_dur, solved_vis: relative time spent and number of visits on solved exercises
- quiz_review_dur, quiz_review_vis: relative time spent and number of visits on reviewing quizzes' results
- open_dur, open_vis: relative time spent and number of visits on open-ended questions

For all these patterns, relative values were preferred to absolute ones 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.

The literature regarding FSLSM (Felder and Silverman, 1988; Graf, 2007; Karagiannis and Satratzemi, 2018a) describes the expected learners' behaviour for all learning style dimensions, providing a framework to find the relevant patterns for each dimension. Based on the aforementioned descriptions, the relevant patterns are presented in Table 1. The "+" and "-" indicate a high or low occurrence of the particular behaviour from a student with the respective learning style. Taking the example of active learners, the findings in Table 1 indicate that such learners don't spend a lot of time to read content objects while, the opposite behaviour is expected from the reflective learners.

Table 1: Relevant patterns for each dimension of FSLSM

Pattern	*Active*	*Reflective*	*Sensing*	*Intuitive*	*Visual*	*Verbal*	*Sequential*	*Global*
content_dur	-	+	-	+	-	+		
content_vis	-	+	-	+	-	+		
outline_dur	-	+					-	+
outline_vis	-	+					-	+
solved_dur	-	+	+	-			+	-
solved_vis	-	+	+	-			+	-
video_dur					+	-		
video_vis	-	+			+	-		
quiz_dur	+	-	+	-				
quiz_vis	+	-	+	-				
quiz_review_dur	-	+						
quiz_review_vis	-	+						
open_dur	+	-	+	-	-	+		
open_vis	+	-	+	-	-	+		
conclusion_dur	-	+	+				-	+
conclusion_vis	-	+					-	+

Data relevant to each one of the patterns presented in Table 1, are extracted from Moodle's database. A different csv file is created for each dimension of FSLSM. Each one of these files consists of a different row for each student and is created by extracting from the table only the patterns that are relevant for the specific dimension, as well as the equivalent learning style preference as detected from answering ILS. Prior to applying the data mining algorithm, each csv file is randomly divided into a train and test dataset.

Regarding the application of the data mining algorithm in Weka, an extension was implemented in Moodle to enable communication with Weka, which should, in turn, be installed on the server. Weka is open source software that contains tools for data pre-processing, classification, regression, clustering, association rules, and visualization. The algorithms can either be applied directly to a dataset or called from Java code. To achieve flexibility, it was decided to adopt the direct application of the algorithms via the command line (Karagiannis and Satratzemi, 2018b). Therefore, by changing only the respective command line which stores the Weka command in the string variable, the entire algorithm can be replaced by another.

Several classification algorithms have been applied to automatically detect students' learning styles. In their literature review, Feldman, Monteserin and Amandi (2015) investigated trends in the field of automatic detection and found that Bayesian networks are one of the most widely adopted classifiers due to their natural representation of probabilistic information and their efficiency. Besides Bayesian networks decision trees were also widely used (Feldman, Monteserin and Amandi, 2015) because of their simplicity. In addition decision trees produce models that can be comprehensible by human experts.

In order to find an effective data mining algorithm for automatic detection of students' learning styles, we decided to investigate Bayesian networks and decision trees which are most widely used. Neural networks are also used frequently, they are not easy to built and understand though. Therefore, we decided not to include them in our research as they will increase our systems complexity. Naive Bayes are also investigated as they are a special case of Bayesian networks. Regarding decision trees, there are many algorithms that can be used to classify students according to their learning style. Some of these algorithms are ID3, C4.5, J48, NBTree, Random Tree and Random Forest, which vary according to the order in which the attributes are selected and the splitting criterion use to build the tree. Feldman, Monteserin and Amandi (2015) argued that none of the reviewed papers explained the rationale for choosing a particular algorithm, which may indicate that it was chosen based on a trial and error basis. From the aforementioned algorithms for building a decision tree we decided to investigate J48, Random Tree and Random Forest which are most frequently used. Summarizing, five different data mining algorithms were investigated, namely J48, Random Tree, Random Forest, Naive Bayes and Bayesian Networks. Regarding the first three algorithms which belong to the family of Decision Trees algorithms, four different trees were created, one for each dimension of FSLSM. Similarly, Naive Bayes and Bayesian Networks built four networks. Each network relates to a different dimension of FSLSM and all the relevant patterns constitute the network's nodes.

5. Evaluation study

5.1 Methodology

In order to assess the effectiveness of different data mining algorithms used for the automatic detection of learning styles in Moodle, an evaluation study was conducted during the winter semester of the 2016/17 academic year in the context of the Procedural Programming introductory course, taught in our department. The Procedural Programming course is a 13 week long course 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 over the first six weeks of the course, up to the mid-term exam. During this time, five sections about the fundamental concepts of procedural programming were presented to students. Each section of Moodle's course consisted of an outline, content objects, videos, solved examples, one quiz, one open-ended question, and a conclusion. Students are expected to interact with all learning objects and behavior data such as his/her actions and their duration are stored in Moodle's database.

Overall 96 students participated in the study. Students were asked to answer the ILS questionnaire right after their first login to the Moodle course in order to obtain their learning style. The distribution of students 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*
53	43	53	43	57	39	46	50

To investigate RQ1, the results obtained by running the data mining algorithm ($LS_{predicted}$) were compared to those of the ILS (LS_{ILS}). Data mining algorithms that were applied, detect learning styles for each dimension of the FSLSM on a 3-item scale. This scale consists of the values concerning each of the two poles of the specific dimension, as well as the balanced style that falls midway between the two. Similarly, the results obtained from the ILS are divided into 3 equal parts. For measuring the precision of different data mining algorithms used for automatic detection of learning styles, different approaches have been used in the literature. We decided to use the following formula (1) which was proposed in (Garcia et al, 2007) and has managed to be singled out.

$$Precision = \frac{\sum_{i=1}^{n} Sim(LS_{predicted}, LS_{ILS})}{n} \cdot 100 \qquad (1)$$

In (1): n is the number of students. The function Sim compares the predicted learning styles ($LS_{predicted}$) with those that are detected by the ILS questionnaire (LS_{ILS}), and returns 1 if both parameters are equal, 0.5 if one represents a balanced learning style and the other represents a preference for one of the two poles of the dimension, and 0 if they are opposites. The advantage of the specific measure is not only that it determines precision but also how close the predicted learning style ($LS_{predicted}$) is to the learning style detected by the ILS questionnaire (LS_{ILS}). It is expected that the $LS_{predicted}$ can differ from the LS_{ILS}, this however, does not mean that this difference always has the same importance when one of them is balanced or when they are opposites.

5.2 Results

Table 3 presents the precision of the automatic detection of learning styles attained by five different data mining algorithms regarding all the dimensions of FSLSM.

Table 3: Precision attained by using different data mining algorithms

Data mining algorithm	*Active/ Reflective*	*Sensing/ Intuitive*	*Visual/ Verbal*	*Sequential/ Global*
J48	**86%**	80%	**75%**	80%
Random Tree	68%	66%	66%	70%
Random Forest	84%	**84%**	72%	77%
Naïve Bayes	70%	77%	61%	54%
Bayesian Network	**86%**	**84%**	68%	**84%**

As can be seen in Table 3, the results are quite promising for J48, Bayesian network and Random forest. Bayesian network attained higher precision in all dimensions with the exception of the visual/verbal dimension. For this dimension, the J48 algorithm attained precision of 75% compared to 68% attained by Bayesian network. The precision of the other two algorithms (i.e. Random tree and Naïve Bayes) is lower and ranges from 54% to 77%. It can be said, therefore, that Bayesian network and J48 are the most appropriate algorithms for our dataset since their overall precision is higher.

In order to find which of the aforementioned algorithms is the most effective, we also have to investigate how fast it can predict students' learning styles. To accurately detect a student's learning style, the student has to first become involved in studying the Moodle course so as to create a significant amount of interaction data. Therefore, we are not able to detect students' learning styles from the very beginning. In addition, the system can provide an adaptive course to a student only after the detection of his/her learning style and, undoubtedly, it is meaningless to reach satisfactory adaptation at the end of the course. To answer RQ2, it was decided to apply each data mining algorithm not only at the end of the course, but also after the second and fourth weeks to compare the detection results and check how fast each algorithm is. The results are presented in Tables 4, 5, 6, 7 and 8 for J48, Random Tree, Random Forest, Naïve Bayes and Bayesian Network algorithm respectively.

Table 4: Precision attained by using the J48 algorithm

FSLSM Dimension	*2nd week*	*4th week*	*6th week*
Active / Reflective	71%	86%	86%
Sensing / Intuitive	83%	79%	80%
Visual / Verbal	74%	70%	75%
Sequential / Global	81%	79%	80%

Table 5: Precision attained by using the Random Tree algorithm

FSLSM Dimension	*2nd week*	*4th week*	*6th week*
Active / Reflective	71%	75%	68%
Sensing / Intuitive	71%	74%	66%
Visual / Verbal	69%	70%	66%
Sequential / Global	76%	77%	77%

Table 6: Precision attained by using the Random Forest algorithm

FSLSM Dimension	*2nd week*	*4th week*	*6th week*
Active / Reflective	78%	86%	84%
Sensing / Intuitive	76%	86%	84%
Visual / Verbal	68%	70%	72%
Sequential / Global	71%	75%	77%

Table 7: Precision attained by using the Naïve Bayes algorithm

FSLSM Dimension	*2nd week*	*4th week*	*6th week*
Active / Reflective	57%	57%	70%
Sensing / Intuitive	76%	81%	77%
Visual / Verbal	59%	62%	61%
Sequential / Global	52%	54%	54%

Table 8: Precision attained by using the Bayesian Network algorithm

FSLSM Dimension	*2nd week*	*4th week*	*6th week*
Active / Reflective	85%	86%	86%
Sensing / Intuitive	78%	82%	84%
Visual / Verbal	69%	68%	68%
Sequential / Global	78%	80%	84%

The results in Tables 4, 5, 6, 7 and 8 indicate that in most cases although the precision increases as time passes, we were able to accurately detect learning styles even only after two weeks into the course. More specifically, the precision attained after the first two weeks for the four dimensions of the FSLSM were quite similar to the values attained at the end of the course. In order to compare the aforementioned results and answer RQ2, we calculated mean values for each algorithm and the results are presented in Figure 2.

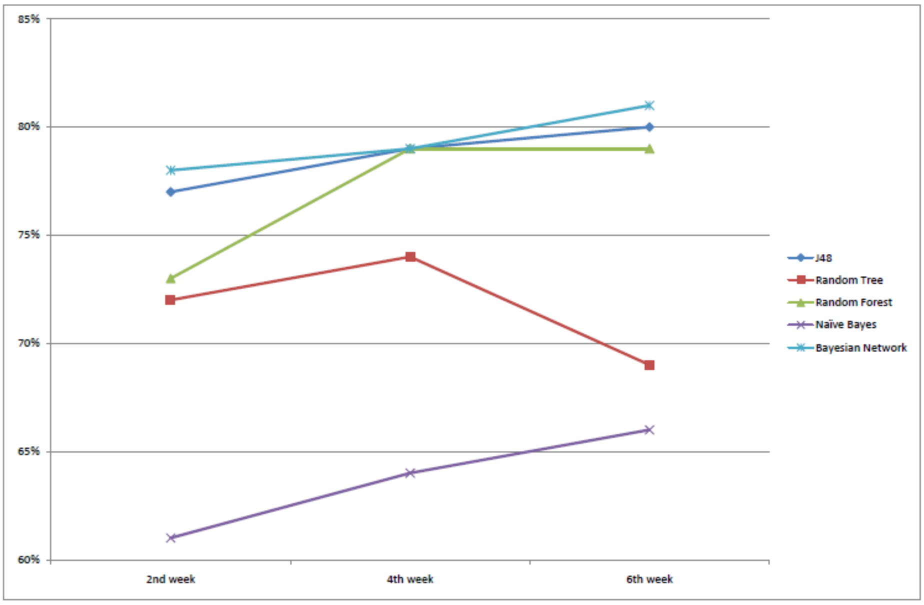


Figure 2: Mean values of precision attained by different data mining algorithms

The findings in Figure 2 are quite similar with those regarding RQ1. Random Tree and Naive Bayes algorithm show large deviation in precision values during the six weeks. In addition, their precision is lower than the precision of the other three algorithms in all cases. Random Forest algorithm attained final precision which is comparable to the precision attained by J48 and Bayesian Networks. However, the precision attained by Random Forest algorithm after two weeks into the course was lower than the respective precision of the other two algorithms.

6. Conclusions

There is a growing tendency to apply data-driven approaches for the automatic detection of students' learning styles. In our contribution to research, five data mining algorithms were applied in a Moodle course in order to evaluate their performance. The findings are promising due to the high level of precision attained in conjunction with the added advantages, which include flexibility of the proposed approach.

Summarizing the findings of the evaluation study, the conclusion can be reached that Bayesian Network and J48 can detect students' learning styles faster and more accurately than the other algorithms. At this point it should be mentioned that this precision is attained by using a less complex set of patterns, compared to the number of patterns of related works (Graf, 2007; Atman, Inceoğlu and Aslan, 2009), coupled with a relatively flexible mechanism (Karagiannis and Satratzemi, 2018b). Moreover, in comparison to similar studies (Liyanage, Gunawardena and Hirakawa, 2014; Atman, Inceoğlu and Aslan, 2009), our sample size was substantially higher which strengthens the validity of our findings. Although the proposed approach for automatic detection of learning styles refers to all four dimensions of FSLSM and the proposed patterns of behaviour can be used in other courses, the approach is sensitive to courseware design. It cannot be used, for example, if the course only consists of videos. Therefore, the results cannot be generalized and further research is needed.

These preliminary findings lay the groundwork for further research in the field of education data mining. Our future work will focus on analyses in different courses, as well as the application of new data mining algorithms to reveal whether it is possible to increase the precision of the approach. There will also be a review of the proposed set of behavioral patterns to pinpoint any possible areas of improvement.

References

Akbulut, Y. and Cardak, C.S. (2012) "Adaptive educational hypermedia accommodating learning styles: A content analysis of publications from 2000 to 2011", *Computers & Education*, Vol 58, pp 835-842.

Alkhuraiji, S., Cheetham, B.M.G., and Bamasak, O. (2011) "Dynamic adaptive mechanism in learning management system based on learning styles", In Proceedings of the 11th IEEE International Conference on Advanced Learning Technologies (ICALT 2011), IEEE Computer Society, USA, Athens, pp 215–217.

Atman, N., Inceoğlu, M.M. and Aslan, B.G. (2009) "Learning Styles Diagnosis Based on Learner Behaviors in Web Based Learning", In Gervasi, O., Taniar, D., Murgante, B., Lagan, A., Mun, Y. and Gavrilova, M.L. (Eds.), ICCSA 2009, Part II, LNCS, Vol 5593, pp 900–909.

Bernard, J., Chang, T.W., Popescu, E. and Graf, S. (2017) "Learning style identifier: Improving the precision of learning style identification through computational intelligence algorithms", *Expert Systems with Applications*, Vol 75, pp 94-108.

Carver, C.A., Howard, R.A. and Lane, W.D. (1999) "Addressing different learning styles through course hypermedia", *IEEE Transactions on Education*, Vol 42, No. 1, pp 33–38.

Cassidy, S. (2004) "Learning styles: An overview of theories, models, and measures", *Educational Psychology*, Vol 24, No. 4, pp 419-444.

Cha, H.J., Kim, Y.S., Park, S.H., Yoon, T.B., Jung, Y.M. and Lee, J.H. (2006) "Learning Style Diagnosis Based on User Interface Behavior for the Customization of Learning Interfaces in an Intelligent Tutoring System", In Ikeda, M., Ashley, K.D. and Chan T.W. (Eds.), Proceedings of the 8th International Conference on Intelligent Tutoring Systems, LNCS, Vol 4053, pp 513-524.

Coffield, F., Moseley, D., Hall, E. and Ecclestone, K. (2004) Learning Styles and Pedagogy in Post-16 Learning: A Systematic and Critical Review, Learning and Skills Research Centre/ University of Newcastle upon Tyne, London.

Dekker, S., Lee, N.C., Howard-Jones, P. and Jolles, J. (2012) "Neuromyths in education: Prevalence and predictors of misconceptions among teachers", *Frontiers in psychology*, Vol 3, 429.

Dorca, F.A., Lima, L.V., Fernandes, M.A. and Lopes, C.R. (2013) "Comparing strategies for modeling students learning styles through reinforcement learning in adaptive and intelligent educational systems: An experimental analysis", *Expert Systems with Applications*, Vol 40, No. 6, pp 2092–2101.

Felder, R.M. and Silverman, L.K. (1988) "Learning and teaching styles in engineering education", *Engineering Education*, Vol 78, No. 7, pp 674-681.

Felder, R.M. and Soloman, B.A. (1997) "Index of Learning Styles Questionnaire", http://www.engr.ncsu.edu/learningstyles/ilsweb.html

Feldman, J., Monteserin, A. and Amandi, A. (2015) "Automatic detection of learning styles: state of the art", *Artificial Intelligence Review*, Vol 44, No. 2, pp 157-186.

García, P., Amandi, A., Schiaffino, S.N. and Campo, M.R. (2007) "Evaluating Bayesian networks' precision for detecting students' learning styles", *Computers & Education*, Vol 49, No. 3, pp 794-808.

Graf, S. (2007) "Adaptivity in Learning Management Systems focusing on learning styles", *Ph.D. dissertation*, Vienna Univ. of Technology, Vienna, Austria.

Karagiannis, I. and Satratzemi, M. (2018a) "Analysis of Students' Navigational Behaviour in a Moodle Course", In Proceedings of the European Conference on e-Learning ECEL 2018, Academic Conferences International Limited, Kidmore End, pp 226-234.

Karagiannis, I. and Satratzemi, M. (2018b) "Implementation of an adaptive mechanism in Moodle based on a hybrid Dynamic User Model", In: Auer, M. and Tsiatsios, T. (eds), The Challenges of the Digital Transformation in Education - Proceedings of the 21st International Conference on Interactive Collaborative Learning (ICL2018), Advances in Intelligent Systems and Computing, Vol 916, Springer, Cham, pp 377-388.

Kirschner, P.A. (2017) "Stop propagating the learning styles myth", *Computers & Education*, Vol 106, pp 166-171.

Liyanage, M.P.P., Gunawardena, K.S.L. and Hirakawa, M. (2014) "Using Learning Styles to Enhance Learning Management Systems", *International Journal on Advances in ICT for Emerging Regions*, Vol 7, No. 2, pp 1-10.

Newton, P.M. (2015) "The learning styles myth is thriving in higher education", *Frontiers in Psychology*, Vol 6, 1908.

Newton, P.M. and Miah, M. (2017) "Evidence-Based Higher Education – Is the Learning Styles 'Myth' Important?", *Frontiers in Psychology*, Vol 8, pp 1-9.

Stahl, S.A. (1999) "Different strokes for different folks? A critique of learning styles", *American Educator*, Vol 23, No. 3, pp 27-31.

Thalmann, S. (2014) "Adaptation criteria for the personalised delivery of learning materials: A multi-stage empirical investigation", *Australasian Journal of Educational Technology*, Vol 30, No. 1, pp 45-60.

Formal Education as Lifelong Learning for Working Professionals: A Case Study

Thashmee Karunaratne and Pooyeh Mobini
Department of Computer and Systems Sciences, Stockholm University, Kista, Sweden
thasmee@dsv.su.se
pooyeh@dsv.su.se
DOI: 10.34190/EEL.19.088

Abstract: Compared to traditional work-based skills development programs, commissioned education is an attractive solution for working professionals to develop skills to better fit into their constantly reshaping job profiles while acquiring a higher educational qualification. Commissioned programs, on the other hand, typically require a high level of commitment, such as constant engagement in learning and rigorous assessment of knowledge. However, comparatively less light is shed on the designs and impacts of commissioned education than the other lifelong learning and professional development methods. This paper, therefore, presents a systematic empirical study on design, execution and evaluation of commissioned education based on a program at masters' level for middle and senior project managers offered for seven years at the Department of Computer and Systems Sciences, Stockholm University. The program is evaluated at the end of every academic year, and the reforms are duly implemented. Impact of these reforms is systematically evaluated based on perceptions of the teachers and students of the program. Blended form of courses offering was voted best in contrast of complete online and face-to-face forms, with a structure of classroom meetings in the beginning and the end of a course, and synchronised online meetings for formative assessments. Didactical indicators included problem-based learning approaches that tights the workplace problems into course assignments and formative discussions. Need for pre-planning with adequate information about the course workload and deadlines, increased communication between stakeholders, flexibility and efficiency in the course offers are identified as essential success factors. Emotional support from the family is also recognized as an equally important factor in adult learning. A formal education qualification such as a master's degree is a difficult goal to achieve in one step, and should ideally be achieved by aggregating short term goals such as certifications of shorter durations, according to the outcome of the study.

Keywords: commissioned education, lifelong learning, professional development, program evaluation, pedagogy, blended learning, problem based learning

1. Introduction

In a knowledge society, rapid changes occur in the labour market that urges specialisations, improved skills and increased competences (Jackson & Wilton, 2016; Figueiredo, et al., 2017; Allen & Van der Velden, 2011). Organisations, at the same time, are demanding increased flexibility and mobility in all the aspects (Kirpal, et al., 2007; Camps, et al., 2016). In such a demanding and dynamic environment, employees and job seekers are required to improve their knowledge and skills on a regular basis (Jackson & Wilton, 2016; Quintana, et al., 2016), Thus, being on par with the upgrades in the job profiles is a challenge for the current and prospective employees. From an organisational perspective, continuous skills development of the workers is important to sustain the organisations (Jackson & Wilton, 2016; Camps, et al., 2016; O'Reilly, et al., 2015). According to the latest statistics, a knowledge gap exists which either limit the employability or, that employees struggle to carry out the tasks in their jobs (Camps, et al., 2016). In 2015 nearly 29% of the EU population was not meeting the skills levels required for their designated jobs (Cedefop, 2015). Almost 50% of the newly created jobs require higher education level qualifications. The European skills and jobs survey in 2014 states that about 33% of adult employees in the EU believed that they could perform better in their jobs if they have a tertiary education degree (Cedefop, 2015).

There is a long history for the existence of professional development and work-based training programs in organisations (Manuti, et al., 2015). However, the workplace programs are aligned heavily towards the development of specific competencies required for efficient and effective conduct of the employee's daily routines, but do not necessarily focus on formal education degree programs; for e.g., Manuti, et al. (2015) stipulates that "*Transitions from school to work are not as distinct and linear as they once were. Learning is no longer confined to occasional formal activities in classroom environments*". Hence, the mismatch of the demand and the supply leads to a rising need of professional development and university education become closer to each other and let the universities, public and business sectors collaborate on opening education doors to employees to be trained in universities in a lifelong learning setting (Field, et al., 2015; Hegli, et al., 2011). In order to meet the demand for the formal education level qualifications to become a major pathway for acquiring expected skills to compete in the labour market (Figueiredo, et al., 2017; Quintana, et al., 2016), the higher educational institutions must focus on education reforms that could be inclusive to cater to the growing interests of different stakeholders in the education sector and the modern labour market (Hegli, et al., 2011). As a result, more flexible, open and personalised education alternatives in contrast to the traditional education settings that are based on the campus study programmes are sought after (Quintana, et al., 2016). This expansion naturally allows a wider range of prospective students to engage in learning irrespective of their demography, age or any other personal specifications. Lifelong learning, open and distance learning and other similar practices, which provide flexible and personalized education, are among the promising practices in higher educational institutions (Figueiredo, et al., 2017; Allen & Van der Velden, 2011). Lifelong learning opportunities in the commissioned education fashion (University of Borås, 2018) stands out among the rest, for its flexibility for employees to enter into mainstream education with obligations from their workplace, so that it has a natural tendency of higher performance rates compared to other lifelong learning settings (University of Borås, 2018). Although there are examples exist on commissioning higher education, e.g., ((Lund University , 2019; University of Borås, 2018), not much attention is paid on commissioned programs among the related research, which is justified by the number of hits in the Google scholar for commissioned education falling below 500. While emphasising the need of understanding the dynamics of paid education as a solution to meet the labour market gaps of skills and competencies, this paper discusses a design, implementation, execution and evaluation of a commissioned education program in order to seek answers for the questions; what would be the composition of a higher education program serving for organisational professional development? What are the underpinning pedagogy and didactics that can improve the throughput of commissioned education programs? And, How and in which ways a collaborative process of organisations and academia succeed commissioned education? In answering the research questions, this study focuses on a specific commissioned education program offered in Sweden.

2. Background of the commissioned education (CE) program

The program considered herein is primarily focussed on catering specific needs of a labour organisation for improving the employability of its members. The organisation consists of technicians, engineers and managers, and as a benefit of membership, the association is providing tailor-made education to their members, for upskilling and at the same time acquiring a formal degree qualification. The university, their education partner, offers a master's degree program in a commissioned setting for eligible members who are members in the particular organisation, aiming at providing an educational (theoretical) base to their level occupations. This partnership started in 2013 as a pilot project to investigate the feasibility of commissioned education (CE) solutions and ends in 2019. Since its start, the project conducted three iterations in 2013, 2014 and 2015. The allows full-time employees to follow, in a lifelong learning setting, courses with a minimum of 50% study phase for four years (8 terms) with two courses of 7.5 credits per term. The examination requirements are similar to those of typical university students. The university is responsible for design, management and implementation of the education, while the labour organisation contributes to the practical implementation of education. In this way, higher education is commissioned to meet the demands of the modern labour market. Quality of the education is measured based on whether the participants get new or more qualified job tasks, a new job after graduation or if they feel that they acquired greater confidence in the work situation.

Prospective candidates of this program have many years of work experiences but may have not necessarily achieved formal educational qualifications to foster the experiences to go for further accomplishments. Also, the emerging skills and new technologies that are becoming essential in succeeding the day-to-day activities, and, may be of utmost importance to develop themselves as professionals in their career are expected to achieve by the degree program, which is the specific objective of the project.

3. Commissioned education design

Crafting commissioned education is challenging since it is limited by "*a detailed understanding of complex relationships that are contextually bound*" (Mishra & Koehler, (2006), and the context is dependent on the stakeholders, educational settings, pedagogy and didactics, organisational factors and policies etc. This also is affecting the reusability of already existing methods and models. However, the methodology of design experiments (Cobb, et al., 2003; Mishra & Koehler, (2006) allow the interplay of the theory and pragmatic settings in an evolving environment of pedagogical goals as well as the detailed implementation of the ecology of learning (Cobb, et al., 2003). Specifically, as stated in (Cobb, et al., 2003), the perspective and reflective aspects of design experiments, that is, the characteristic of iterative design is exploited as an underlying methodology in the design of this programme. The other specific technologies and theoretical principles considered in design, implementation and evaluation of the courses are discussed in the subsequent sections.

3.1 Programme planning and design of the courses

In designing the specific courses, the principles of lifelong learning and open distance learning (Mason, 2006; Field, et al., 2015) and the success factors identified by a feasibility study in (Hegli, et al., 2011) are followed. Accordingly, to maximize the quality of the courses and the performance rate of the students, the program was structured in a blended fashion, consisting of on-campus activities, online synchronised and online asynchronised activities. A carefully chosen pedagogy, technology, and the assessment criteria were implemented to optimise the learning outcome. In doing so, the six challenges identified in (Hegli, et al., 2011) , that is, finding relevant courses for the program, funding for education, work-life experience but little to no academic experience, distance learning through a tailored learning management system, experiential learning and relation to work life, and students' fear of school have been taken into account. Current and advanced digital technologies are included in the teaching-learning process based on the theoretical grounding of the technological pedagogical content knowledge (TPCK) (Mishra & Koehler, (2006) framework. The detailed structure of a typical course in the programme would consist of components illustrated in Figure 1.

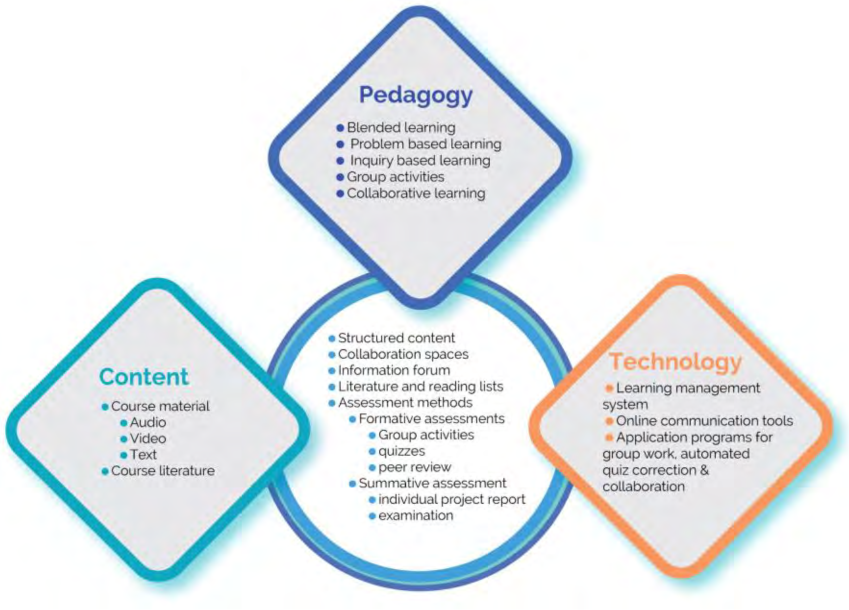


Figure 1: The technology pedagogy and content consideration of the course design

Inspired by the success factors for commissioned education (Hegli, et al., 2011), the learning content is tailor-made to maximize the benefit of the student's current and future profession. Furthermore, adult students require support in organising the learning activities in the courses. As students who are returning to education, they may have knowledge gaps required to be filled in. However, in contrast to typical students, the adult students bring in work experiences, mostly in the exact area of education they plan to take. Therefore, the challenges concerning time, flexibility and ease of learning can be mitigated by including practices to drive students to build up, based on their experiences, their learning community, collaborative work and to have constant interactions between the teachers, peers and the content. As and whenever possible, the CE students are blended with the normal university students for increased motivation. The technical support for such functions is implemented in a learning management system (LMS), Moodle. At the beginning of each semester, students start courses as a group, by participating in on-campus face to face sessions. These sessions are held during weekends to minimize the disturbances to their professional life. Teachers, in these sessions, inform students about the demands and efforts required by the courses, the expectations etc., and provide advice on the individual study plan and how the students should organise their learning activities. Such an exercise enables students to get into know the teachers and fellow peers in the courses. This sets up a fairly good and friendly ground for improved interactions. Since the students pursue different levels of experiences, such a setting enable sharing experiences to enhance the learning experience.

Individual counselling and group discussions were included in the pedagogy. The other key activity in structuring a course is to design the formative and summative assessments. As mentioned above, the learning activities of the courses follow problem-based learning (PBL) and inquiry-based learning principles and allow establishing a direct connection to the student's work environment. The idea is that the students should be able to use their knowledge directly in the work situation and vice versa. As shown by related studies, e.g., (Hegli, et al., 2011), applied course projects have resulted in better performance outcomes for the individual student as well as contributes to major changes of quality systems in multinational companies. In this model of education, the final examination of each course unit was held on-campus, or as similar as for normal university students, since students receive a formal education qualification from a recognised university, facing a similar examination as other regular master's students. The on-campus sessions, typically held during weekends, is compacted with teaching, counselling, self-study, peer collaboration etc. Furthermore, it is financially beneficial for the project to organise the final exam of a completing course in parallel with the introduction of the subsequent course during the same on-campus weekend.

3.2 Stakeholder responsibilities and the process of delivery of education

There are three groups of stakeholders in this CE program, namely, the labour organisation which is the project client (customer), the university; the education provider, and, CE students; eligible members of the labour organisation. Figure 2 depicts the responsibilities of the stakeholders in this program.

Figure 2: The stakeholder responsibilities in the process of delivery of commissioned education

The underlying design principles of the process is driven by the critical factors as described in (Hegli, et al., 2011). Emphasis is paid on increased support for students to plan education from well ahead of the course start, clear course goals and tasks descriptions, counselling, and, maximising the impact of the face-to-face sessions. There is a communication channel that runs across the whole process in Figure 2. When the courses are starting, extensive communication between the stakeholders is anticipated for the smooth function of the programme. As the students are adults and perhaps were away from education for many years before they enrolled in the commissioned education program, they need more support than a typical campus student in planning their learning activities. After the administration stage, it is the teacher's responsibility to drive through the course until the course is completed and the grades are reported in the Student Management System.

3.3 Program and course evaluation by retrospective analysis

Design experiment methodology demands constant assessment of the teaching-learning sessions and iterative improvement of the initial design based on "*testing and revising conjectures as informed by ongoing analysis of both the students' reasoning and the learning environment*" (Cobb, et al., 2003). Further, Cobb, et al. (2003) describes facilitating improvements to the design by conducting retrospective analysis. Following a retrospective analysis, the programme is evaluated at both programme and individual courses levels.

3.3.1 Evaluation of individual courses

At the end of each course, the participants are given a course evaluation questionnaire. Also, the teacher produces an evaluation report based on the questionnaire outcome and the teacher's observations during the course. The questionnaire consists of 16 questions, including age and gender, questions about the perception of the course (level of difficulty and the relevance), and the questions about what is good about and what needs to be improved in terms of content, literature and assessment. To illustrate how the outcomes of these evaluations have been used for improving the course design and delivery, one-course evaluation activity is randomly chosen and elaborated further. Controlling in IT projects is the course selected, thereby to illustrate here. Seven students have responded to the questionnaire out of 9, where three students were below 35 years old, and 4 were females. The students think the overall level of difficulty of the course is average, and on average, they manage to complete 75% of the tasks of the whole course. Also, 75% of respondents think that the course content and the assessment methods employed are in accordance with the learning goals of the course. But the students believe that the "*feedback given on assignments*" can be further improved.

Further, on average, the students think the course improved their factual (terminology, classifications, methods and trends) knowledge, and helped develop the skills of the subject as well as collaboration, presentational and academic writing skills. The course evaluation report mentioned that two major pedagogical changes were made before offering the course in this term, 1) limiting the flexibility of the assignment deadlines, and 2) improving motivation and communication. Hence, at the beginning of each week of the active period, the teacher sends a message to students listing the tasks they have to fulfil (with the submission requirements and deadlines) and the level of commitment required (time allocation for tasks). The teacher reported the impact of the change as "*helps resolving student's confusions of tasks and deadlines of submissions*" and "*improvement in completion rates*". Recommendations for change in pedagogy and contents included "*quiz database need to be revised whenever necessary*" and "*more clarification for the final exam/assignment*".

3.3.2 Programme evaluation

The programme's overall evaluation was based on a survey questionnaire. Seventeen students were included in this survey, and 14 out of the 17 have responded. Among the 14 respondents, 86% males, and 14% females, and with an average age of 35. 44% of the students are over 40 years of age. 86% had a university education, but everybody was full time employed. 50% had a managerial title, and 78% had a leadership role in their working space. Focusing further on statistics, 75% of respondents had more than ten years of working experience (37% had more than 20 years of experience), where 43% had been continuously (more than five years) employed by their current employer.

The questionnaire consisted questions about 1) students' ability to take a program of CE (digital skills and resources, motivation for education, time, self-assessment of the achievements), 2) Challenges hinder the learning process, 3) the CE process given in Figure 1, and, 4) their suggestions for improvements (for the stakeholders, for prospective students).

The respondents had a high rate of digital skills, and 93% had a high rate of connectivity to the internet, which is higher than the average of on-campus students. The following motivational factors for enrolling in the program are mentioned; 1) scholarship for studies 2) develop intellectual abilities 3) degree qualification for the CV 4) cognitive skills 5) improvement of self- belief and confidence 6) for better Job 7) increasing professional status 8) employers request and, 9) inspired by colleagues. Their self-assessment results include that everybody believed they had gained new knowledge and skills. Half of the respondents felt they achieved a higher level of self-confidence in the working place. Higher life quality (14%), Getting promotion in the job (7%), Found a better job (7%) we among the other achievements.

In terms of the CE programme setting and process, the respondents perceived that the open distance learning setting corresponds to their expectations of the education (79%). 66% were satisfied by the flexibility of the program, and 71% thought the program is in the right phase, but 29% thought it was too fast. 79% satisfied with the registration processes and 64% with face to face meetings. They were satisfied on average, with the lecturer's response time for feedback, Quality of lecturer's response/feedback, number of course activities-assignments and quizzes, and, the course content was applicable to their work context. The course platform is good enough and easy to use according to the users. But, the participants were not satisfied with the clarity of course expectations and assignments (36% satisfied, 43% neutral, 14%not satisfied). For 64% of the respondents, however, the courses are difficult, and the support and encouragement from their employers for education were inadequate (43% had no support, 21% neutral, 35% had some level of support).

Although the respondents are motivated overall, they encounter many challenges in following the courses. As adult learners, study time allocation was identified as the main challenge. Only 7% of the students managed to allocate the desired time for studies that is 15-20 hours per week. The majority, that is, 57% manage only to allocate between 5 to 10 hours per week on average. Albeit, the students valued their achievements; 100% agreed the program helped gain new knowledge and skills. Half of the group thought they achieved higher self-confidence in working place. Getting promotions, and higher life quality were the other factors mentioned. A participant who got promotion and found a better job is the one who also completed three courses and studies 10-15 hours a week. The other identified factors include 1) Time constraint for study in your non-working hours, 2) more face to face communication with lecturers and other learners 3) more support from employer 4) Course difficulty level (hence more support from lecturers) 5) Hard to adapt to online/distance courses 6) digital skills.

Detailed explanations were provided by the respondents for these challenges. Concerning time constraints, respondents stated;

> *"My working days have been overloaded with too much work over periods, and there has unfortunately not been enough understanding about that from employer …." and "I have also been father to a little girl for one year ago, and that also infect the study condition".*

Course-related issues such as the changes of teachers, language, less information on the course process and commitments, use of library and login to LMS and other tools, were also mentioned by the respondents. The students seemed to be relying on the teachers to a great extent, and also, they expected everything they do in the course, from reading to assessments and activities should be countered towards the final grade, unlike the on-campus students.

> *"A lot of the tasks carried out at the weekend seminars were not graded or carried any weight. This meant that a great deal of time and energy was used to carry out tasks that could have been used as coursework material." and "…I am quite a busy person and aim to make the most out of my time. I feel that the weekend sessions need to carry more weight for this to be successful. There is probably a little overkill when it comes to coursework." as well as "The group work in the coursework for me is what takes the most time and shuts everything else down due to the structure" were some of the responses that express concerns of the course pedagogy and didactics.*

The respondent's suggestions for improvement of CE included the following;

For academic institution: Start communication well ahead of the course start.

For the employer: Support with less workload

For the teacher: Clear guidelines and effort estimations for the courses, better feedback, more face to face meetings, online and on-campus tasks should be proportionate. Multiple choice tests should show answers (help practice), pack the seminars with more activities. Reduce the scale of coursework. Make seminars count for something.

For prospective students: One comment of a respondent had all in it: "*… as a part-time student and also working 100% (perhaps also with family) - you should be able to be a flexible student... don't panic if work takes most of your time at some point…you need to prioritise for yourself - but also be aware that the lecturers may expect differently from you*".

4. Reflections and discussion

Naturally, students expect a maximum outcome from a fair engagement in learning, but for adult students, who tend to measure commitment to corresponding rewards, this factor is of more intense. Perceptions such as, reduce the scale of the coursework, try and make it clearer and concise, reduce workloads, make the face-to-face seminars count for something, etc. stems from such mindsets. Further, responses visualise more focus on results than learning. Such could be contrasting to typical lifelong learning that drives by specific personal desires (Mason, 2006).

Preparation for the studies (courses) was a concern of majority, which may be explained by the fact that the adult students require preparation for studies in mentally as well, unlike young students, since they are just coming back to studies after perhaps a long break. Need of having all the information, course literature and course requirements handy may be the consequences of such preparation. However, a heavy workload in offline individual setting compared to face to face activities has not been admired either, and, therefore the balance of individual vs in class activates are encouraged, although visiting university would be time-consuming for working students. Compact face-to-face sessions in person during the start and end of courses and few online meetings distributed in between would be a better solution. This would also solve "*Feeling a little bit alone in the time between the lessons [in the university]*".

In the impact perspective, the employees who receive continuing education through this model of professional development expressed their successes in increased life quality and business competitiveness. To sustain the motivation and release the pressure of continuous education of four years, the master's programme may be segmented into credited education building blocks, where a building block could be an individual course, or a certification consisting few courses. Crashed courses that will deliver the essence of a subject in a shorter duration would also be a solution for the participants that do not need a deep dive in the study but need to recap some concepts or learn the basics or sharpen their skills. In this way formal degree program can be "*distributed*", and the building blocks can be aggregated towards the formal degree.

But more importantly, the half-phase study might not always be ideal for CE, and a flexible blended learning setting instead of fixed blended learning would be ideal. It gives more pressure on education provider and teachers, but the university can use distance education toolboxes and LMS to offer such flexible learning. The reason is that the attributes of individual CE students cannot be measured precisely (family employer commitment, time, working schedule)

In summary, this attempt of piloting CE provided many important insights, concerning the academic institution, the employers of the students, and the students themselves, as illustrated in Figure 3.

Figure 3: Factors for effective commissioned education

5. Concluding remarks

Commissioned education, compared to other professional development methods and models, is effective since it associates with purchased education, based on the needs of the learners. It is heavily results-oriented, and the students enter to education is obliged to complete the courses they register in. Therefore, intensive focus by all the stakeholders is required to succeed in this type of education. To shed some light on the questions of the composition of a CE education program, the underpinning pedagogy and didactics that can improve the throughput and, the collaborative process of organisations and the academia can implement in succeeding commissioned education. Results showed insights into how academic institution, the employers of the students, and the students themselves can collectively contribute to succeeding CE. Thereby distributed education and applied learning in blended forms are proposed as a way forward.

References

Allen, J. & Van der Velden, R., 2011. The flexible professional in the knowledge society: New challenges for higher education. Springer Science & Business Media.

Camps, J. et al., 2016. Individual performance in turbulent environments: The role of organizational learning capability and employee flexibility. Human resource management, 55(3), pp. 363-383.

Cedefop, 2015. Skills, qualifications and jobs in the EU: the making of a perfect match? Evidence from Cedefop's European skills and jobs survey, Luxembourg: Publications Office of the European Union.

Cobb, P., Confrey, J., DiSessa, A. & Lehrer, R., 2003. Design Experiments in Educational Research. Educational Researcher, 32(1), pp. 9-13.

Field, J., Bernhard, S.-H. & Waxenegger, A., 2015. Universities and Engagement: International perspectives on higher education and lifelong learning. 1 ed.: Routledge.

Figueiredo, H., Biscaia, R., Rocha, V. & Teixeira, P., 2017. Should we start worrying? Mass higher education, skill demand and the increasingly complex landscape of young graduates' employment. Studies in Higher Education, 42(8), pp. 1401-1420.

Hegli, P., Henriksen, N. & Hansson, H., 2011. A model proven successful for lifelong learning – The Case of Addisco, Norway: Open and distance learning for human capacity building in the industry sector. Nusa Dua, Bali, ICDE.

Jackson, D. & Wilton, N., 2016. Developing career management competencies among undergraduates and the role of work-integrated learning. Teaching in Higher Education, 21(3), pp. 266-286.

Kirpal, S., Brown, A. & Dif, M., 2007. The individualisation of identification with work in a European perspective. Identities at work, pp. 285-314.

Lund University, 2019. Lund University Commissioned Education. [Online] Available at: https://www.lunduniversity.lu.se/lucat/group/v1000866[Accessed 24 05 2019].

Manuti, A. et al., 2015. Formal and informal learning in the workplace: a research review. International Journal of Training and Development, 19(1), pp. 1-17.

Mason, R., 2006. Learning technologies for adult continuing education. Studies in Continuing Education, 28(2), pp. 121-133.

Mishra, P. & Koehler, M. J., (2006. Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers college record, 108(6), pp. 1017-1054.

O'Reilly, J. et al., 2015. Five characteristics of youth unemployment in Europe: Flexibility, education, migration, family legacies, and EU policy. Sage Open, 5(1), pp. 2158-2440.

Quintana, C. D. D., Mora, J., Pérez, P. & Vila, L., 2016. Enhancing the development of competencies: The role of UBC. European Journal of Education, 51(1), pp. 10-24.

University of Borås, 2018. Commissioned education. [Online] Available at: https://www.hb.se/en/Collaboration/Commissioned-education/[Accessed 20 05 2019].

Towards an Agile-Based Process Model for Effective Teacher Training on LMS

Thashmee Karunaratne[1], Helena Zhemchugova[1], Jean Claude Byungura[2] and Ulf Olsson[1]
[1]Stockholm University, Department of Computer and Systems Sciences, Stockholm, Sweden
[2]University of Rwanda, Department of Business Information Technology, Kigali, Rwanda
thasmee@dsv.su.se
helena.zhemchugova@dsv.su.se
jcbyungura@ur.ac.rw, byungura@dsv.su.se
ulf.olsson@su.se
DOI: 10.34190/EEL.19.099

Abstract: Successful implementation of e-learning environments requires adequate teacher training. In this study, a solution is sought for how teacher training programmes on newly introduced Learning Management Systems (LMS) can be designed in such a way that they would be inclusive of different levels of digital competence, supportive of individual teacher development and flexible enough to be applied in different institutional environments. Following the soft design science research methodology, two co-creation and co-design sessions, as well as eight in-depth interviews, were used for designing and testing a model for the process of teacher training in using LMS. The outcome of the study indicated the need of an agile-based approach as well as two kinds of segmentation of the training process based on the level of competence and on the position of the training process on the timeline. Besides, the cascading of teacher training was found to be a key approach to make it cost- and time-efficient. Moreover, the introduction of agility to the recursive process of training was found to strengthen consistent knowledge building in teachers. This has been illustrated in the form of a spiral model of knowledge construction, with teachers beginning to learn the basics and incrementally progressing to acquire advanced skills. The proposed process model allows academic institutions to mobilize the teaching task force by equipping them with technological knowledge systematically. This way, the level of expertise in using LMS can be developed incrementally and in synergy with the Pyramid Model of Digital literacy. The level of knowledge acquisition by teachers would correspond to the levels in the pyramid, and thereby, it would be easy to see them "climb up" the pyramid as they progress. A more thorough evaluation of the model using different cases and a careful revision of its components are considered as further steps in this research.

Keywords: teacher training, learning management systems, LMS, e-learning, process model, agile process

1. Introduction

Learning Management Systems (LMS), also known as virtual learning environments, have become a constituent part of the landscape in contemporary higher education (Berggren et al., 2005): technology now facilitates the essential components of education and promotes mass individualisation and flexibility of learning as well as increased student engagement and collaboration (Percy & Kelder, 2019). Furthermore, as technology evolves rapidly, institutions are urged to adopt new, upgrade or change the e-learning tools in use more frequently. LMS is an example of such tools, and the adoption of it is a challenging task for any academic institution since it involves a complex process of change in the teaching and learning process (Tømte, 2013; Sarkar, 2012; Howland & Wedman, 2004). Part of the challenge is the extensive planning that is required from the management and administration of an institution prior to the adoption of a new LMS, including a plan for training the faculty in using it in their teaching activities, especially in the educational environments where traditional teaching prevails. In such a context, not all teachers would essentially be comfortable in adapting to rapid technological changes (Howland & Wedman, 2004), and therefore, would need proper assistance via carefully designed LMS training programmes.

Viewed holistically, teacher training programmes in LMS need to account for both, professional development of teachers as individuals and the development of staff as a collective asset of academic institutions. As every institution differs from the rest on several attributes such as teaching and learning environments, internal policies and practices, and civic and cultural contexts (Howland & Wedman, 2004), among others, one would expect to apply tailored training solutions. However, given the variance, such solutions would be too numerous and of a one-time-use character, and thus, too costly to produce. In contrast, mass training solutions might seem like a reasonable choice. However, given that different teachers might possess different degrees of digital competence, not everybody would need the same training. Thus, without planning of who should be trained and when, how the training should be expedited and how the explicit and implicit costs of training can be moderated, mass training might result in financial and administrative challenges for institutions. It will also result in a lack of motivation in teachers to master their respective digital tools should they be misplaced for the training.

Academic development, faculty development, or teachers' professional development (Howland & Wedman, 2004, Fowler et al., 2016), including the preparation, delivery and evaluation of the training outcomes (Markauskaite & Reimann, 2008) and impacts (Ebert-May et al., 2011) discussed deeply in research. Studies such as (Lee, 2005) propose models and frameworks for in-service teacher training; models and designs concerning the content of the training programmes and how the teaching skills tied to e-learning can be developed efficiently and effectively are actively discussed in (Dabbagh, 2005; Unwin, 2005; Bannan-Ritland, 2008; Markauskaite & Reimann, 2008; Lim, Chai & Churchill, 2011; Nawaz, 2011; Gynther, 2016; Löfström & Nevgi, 2008; Ebert-May et al., 2011). Essential components for measuring the success of teacher training are discussed in (Gibbs & Coffey, 2000); they are teachers' pedagogical motivations, trainers' intentions, organisational context, and overall impacts of training programmes. The latest literature review by Ping, Schellings, & Beijaard (2018), complements this list with the following components: contents, sources of learning, and pedagogical aspects of training programmes. These are also discussed in the majority of related literature. Some journals on online learning (Kehrwald & Parker, 2019) focus solely on the pedagogical capabilities of LMS which are characteristic of the later stages of LMS adoption — such as media resources production, and thus, might not be suitable for consideration at earlier stages. More to that, current models of teacher training programmes emphasise design and pedagogical theories (Ping, Schellings, & Beijaard, 2018), but not much light is being shed on practical implementations and pragmatic return on investment.

We argue that teacher training tied to LMS adoption should be viewed as a *systematic training process* — as opposed to tailored approaches characteristic to teacher professional development programmes — that accounts for pedagogical motivations as part of a bigger whole which, in its turn, acknowledges institutions and teachers as two major stakeholders. The goal of this study is to design a process-centred solution for how teacher training programmes on newly implemented LMS can be designed in such a way that they are inclusive of different levels of digital competence, support the individual development of the teachers and are flexible enough to be applied in different institutional environments. Thereby, the study proposes a process model prescribing a sequential design of planning and delivery of a teacher training programme in starting up with LMS. The model aspires to be adaptable to the experiences of different academic institutions while advancing digital literacy and knowledge acquisition among teaching staff and raising the efficiency of academic process logistics. The model is tested for viability and improved upon by means of an empirical investigation carried out as part of this study.

2. Methodological considerations

This work is guided by the design science research methodology (DSRM) (Cloutier & Renard, 2018). We combine the *robust* principles of designing a systematic solution to a problem (Peffers et al., 2007), or an artefact, with the *soft* principles of extracting requirements for such a solution (Baskerville et al., 2009). Combining the two approaches ensures that the resulting artefact is created following a formal scientific procedure, is grounded in theoretical knowledge that is broad enough to provide diverse perspectives on the problem, and accounts for specific real-world considerations and practical demand. The artefact in question is a multi-level process model (Figure 5) for teacher training in the use of LMS in the context when a new LMS is introduced at a university where traditional, "off-line", teaching prevails. The model has both theoretical and empirical motivation. Methodological considerations of the soft DSRM are described below and presented sequentially in figure 1, where the brown portions stand for specific methodological steps.

2.1 Theoretical basis

Figure 1 depicts the methodological considerations behind this study. The principles of the co-creation and co-design methodology (Ramaswamy & Guillart, 2010) were employed to increase the practical relevance of the artefact since the methodology implied active collaboration between researchers and users of the research outcomes. Two co-creation sessions were held before and after the empirical study. The first, to explicate a poorly structured real-world problem — a possibly inefficient process of LMS training, to describe the concept of a solution using systems thinking — a process model, and to elicit the requirements for the model to be viable.

The second, to process the empirical data, relate the analysis to the preliminary model, and come up with an improved model design.

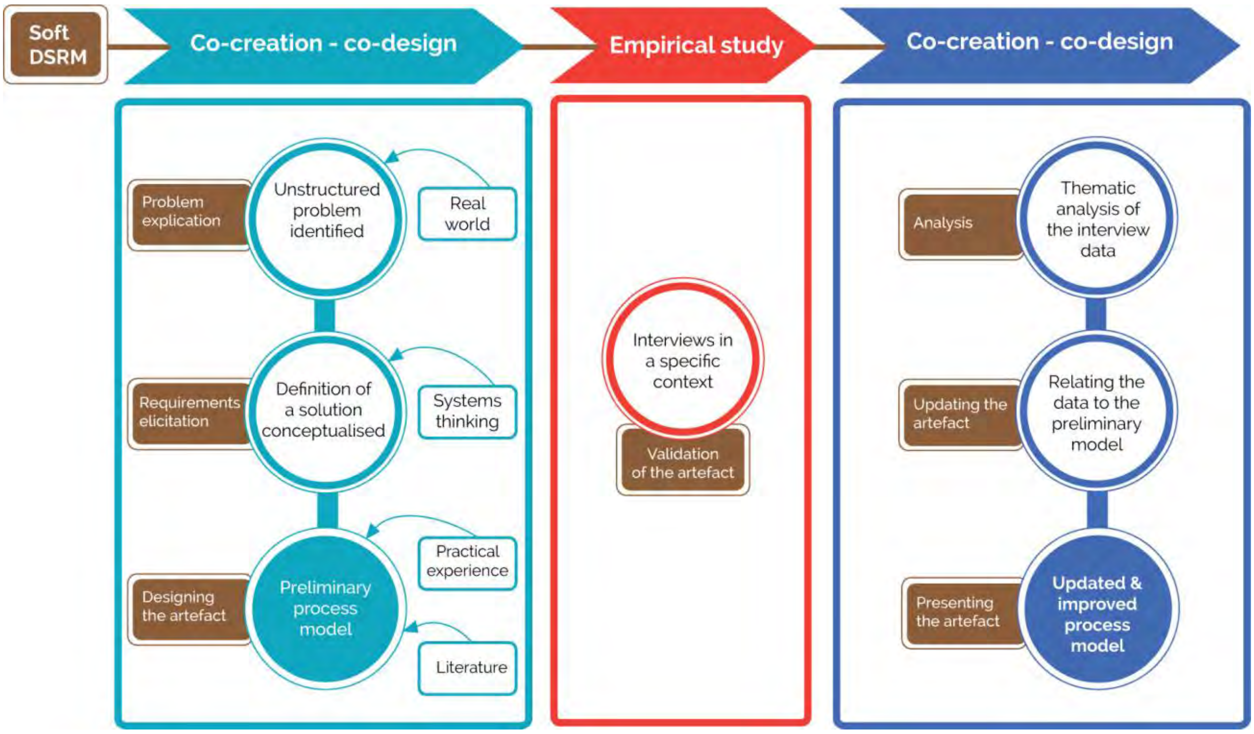


Figure 1: The methodological process of problem explication, requirement elicitation, and model development (to be read left to right, top to bottom)

The preliminary model was created using theoretical knowledge on information and data literacy and on process design, as well as using the practical experience of project management and using LMS in teaching. It was largely inspired by the following existing models: the Louisiana Information Literacy Model for Lifelong Learning (Picard, 2004), the PLUS (Herring, 2006), the BIG6 (Eisenberg et al., 2016) and the Sauce (Bond, 2004). These provided a comprehensive view of what aspects of training should have been stressed to deliver the training outcomes that were relevant to the end-users in the specified context of an LMS adoption by a university.

2.2 Empirical basis

The empirical part of the study served two purposes. First, to validate the preliminary model, and second, to update its design based on the data supplied by a real-life case of implementation of an LMS. The case of implementation of Moodle at the University of Rwanda (UR) between 2014 and 2019 was chosen for the longitudinal character of the teacher training data and for the suitable educational context — a higher educational institution where traditional teaching had been favoured historically allowed for an exploration that was not biased by the habitual use of technology. As part of this empirical investigation, eight deep semi-structured interviews were carried out at the UR in April 2019 with experienced and novice teachers, as well as with teacher trainers (referred to as "e-learning champions" in the interviews) who, under this case, were all trained in using an LMS — the "UR e-learning platform" based on Moodle. Eligibility for participation in the interviews was determined by having benefited from at least one training on the use of the LMS in question. The interview data were recorded digitally, transcribed using Transcribe Wreally (Wreally Studios, 2015) and then analysed qualitatively using MAXQDA (VERBI GmbH, 2019) to extract themes and categories from respondents' narratives that represented strengths and weaknesses in the current LMS teacher training process at the UR.

3. Results and analysis

Under the soft DSRM strategy, the process initiated with formulating a "specific problem" which, in our case, was the lack of a functional model for the process of teacher training on LMS. Explicating the problem has been carried out in three sessions of co-creation and co-design, with experts and regular LMS users. The resulting model is described subsequently. In the co-creation sessions, the following main aspects that are essential to be in the process have emerged.

Agility in the process: Agile methodology, in contrast to the highly standardised sequential waterfall method of development of artefacts, allows for iterations in the artefact development process (Beck et al., 2001). Although the Agile Manifesto (Beck et al., 2001) was composed with the software development perspective in mind, it brings to the front such aspects of the development process as the behaviour of individuals, continuous working models, user collaboration, and the possibility for the changes to be included at any subsequent stage of the artefact development (Beck et al., 2001). In the context of teacher training, agility brings in the possibility to refine the training programme based on the feedback and experiences from the previous iterations, which is an essential requirement in such a domain where teachers can have different levels of maturity with regard to digital competence.

Segmentation of training: For allowing the adaptation of an agile process, and the basic pedagogical principle of gradual increase in complexity of the training material, the training can be segmented into different stages from basic to advanced with several intermediate steps as needed. This will allow the teachers to be exposed to the simpler concepts and functions of an LMS in focus first, and then gradually progress to mastering more complex functionalities.

Cascading the training: The shortage of trainers for performing institution-wide training programmes in LMS is a logistically complicated process and choosing to cascade the training is cost- and time-effective (Suzuki, 2008). Following a systematic need-based selection of participants in each forthcoming iteration of training, institutions can easily cascade the training through making the teachers who underwent training at a certain level to be responsible for conducting the training at a lower level during the future iterations of the training programme. Such cascading is efficient since the number of trainers would increase gradually, as would the number of training sessions. Simultaneously, it is effective since the trainers can become “champions” in the subject.

Applied learning approach: The importance of applied learning (Ash and Clayton, 2009) was brought up as a suitable aspect in content design.

3.1 The preliminary model

The preliminary model evolved as a result of the first co-creation and co-design session (Figure 1) and is shown in figure 2.

3.2 The empirical investigation

As an essential step of the soft DSRM approach, the viability of an artefact should be tested in a suitable context. The context selected in this study is a higher education institution in Rwanda, as described in the methods section. The empirical investigation focused on the feasibility of the model with regard to the points of focus that emerged in the first co-creation session. The specific problem expressed during the session was expressed by most participants speaking of their own experience of the training process. For instance, they noted insufficient planning measures; long training sessions providing repetitive or irrelevant information; lack of opportunities to practice what is learnt before applying it to real-life courses; lack of follow-up and evaluation initiatives to assess the effect of the training that was received and lack of institutional incentives to support the trainees’ commitment to the use of LMS after training. They also reported occasions on which the same individual could have received identical training multiple times.

3.2.1 Agile methodology and its suitability for the process model

As pointed out by the respondents, it is important for the programme designers to have the flexibility to revise training plans in real time based on the outcomes of the previous iterations of the training and on the feedback from the trainees. Such feedback might concern, for instance, the content of the training, its pedagogy, or its practical limitations. The advantage of this approach is in the adaptability it promotes: the training programmes can be designed and redesigned on the spot to best suit particular institutional contexts.

3.2.2 Cascading the training

The respondents unanimously agreed on the need for cascading the training, especially in the Rwandan context, where digital expertise is scarce among teachers. It was noted in the interviews that early adopters of LMS can serve as “e-learning champions”, or “technology ambassadors”:

"...it was a training... like training of trainers. Ehm... Okay, we spent a whole week. And the training involved staff from different colleges."

"… But second, of course, is positioning e-learning champions in the institutional structure and this will allow them to be recognized by their colleagues."

Purpose	Identifying the purpose of the training programme allows framing the scope of each training based on the specific needs of the academic institution. Identifying which skills need to be improved and what new knowledge gained should be explicit right from the initial stage. A dedicated team can be appointed from the start to be responsible for managing the overall training process.
Defining the focus	The focus of the programme needs to be defined so that it meets the goal of training and provides the desired skills and knowledge in the use of LMS to teachers in support of their work.
Setting the scene	The grounds for the training should be prepared by carefully segmenting the training programme. Decision making is required to assign the training goals to corresponding levels of competence, from basic through to advanced. The number of iterations of the process until completion of the training is primarily decided here. However, the primary design of the programme can be revised later based on the new goals or training needs identified as a result of evaluation of previous iterations.
Pedagogy and didactics	This component is present in most teacher training programme designs as the most fundamental. Although this is a vital step of the process, it is intertwined with the previous step of segmentation of the programme and setting the training goals.
Participants	Participants should be selected according to specific institutional needs; it can be a group possessing the least number of digital competencies or a group of teachers who are motivated to use LMS the most. Trainers who are competent enough to support the teachers to learn the tools are also identified. Following the concept of cascading, in later iterations, the group of trainers can be expected to grow as well.
Curriculum material	Guidelines, training resources, related information, tools and technology should be prepared well before the start of each training session.
Disseminate resources	Participants should be contacted for dissemination of relevant information and content well in advance of the training.
Locations and access	Logistics and technological infrastructure required for conducting the training should be in place. It is common for technical failures and infrastructure limitations to occur unexpectedly, and therefore, alternative solutions should be considered and planned for beforehand.
Applied learning	The content of the training should be closely related to the courses the participants teach. This will allow them to combine training with performing their duties. For instance, teachers can create their course instances right in the LMS during training sessions.
Assessment	Feedback collected from participants during or after each training session is vital for refinement of the training programme on the whole and also beneficial for updating the training in the following iterations. The trainees can highlight good and bad practices by speaking about what went well and what did not.
Continuous support	What is often missing in training programmes is the support for continued use of LMS through follow up measures. Support can be provided through keeping the accounts active, timely troubleshooting and the possibility for teachers to continue using the tools after the training.
Collaborative learning	Allowing the participants to learn to use LMS in their own teaching work collaboratively and encouraging peer support is of high importance for effective learning.
Motivation	Teachers may not be inclined to take the training seriously if their efforts to learn new concepts and tools are not being properly recognized. Adequate incentives for acknowledging their efforts should be in place in order to retain their commitment and allow them to advance in the programme.
Evaluation of training	At the end of each iteration, it is important to evaluate the training with regard to each training session as well as to the progress made by each trainee or group of trainees. This step helps to bring up aspects of the training programme that worked well and those that did not produce expected results. Conclusions should be made and suggestions offered for improvement of the future training iterations.
Reporting	After each evaluation, a comprehensive report should be produced. It should include notes on the results and the impact of the training programme. Accordingly, recommendations for future training iterations should be documented.

Figure 2: The preliminary process model

3.2.3 Segmentation of training iterations

The need for a systematic segmentation was brought up by the respondents, for instance, in the following way:

"At the beginning, (...), we conduct a series of trainings in each department. In each department we had to train lecturers. But now, we are going... we target some newcomers, you know, to catch up, and other, you know, to refresh."

Another aspect that emerged in terms of segmentation concerned the training iterations. It called for sorting the training activities according to their position on the training timeline — before, during, and after. This way, for instance, the activities in the "before"-segment and from the perspective of the trainees would include reading the materials provided or completing a task requested *before* attending the training session. From the point of trainers, the "before"-segment would include preparing and disseminating the materials and tasks *well in advance* of the training session. An example of what should be considered in the "during"-segment, as emerged from the interviews, is embedding the training in the teachers' daily workload to enable them to absorb the new techniques through application in their teaching practice. This can help maintain motivation and retain the knowledge gained in the training. The majority of respondents justified the importance of applied learning. The "after"-segment would include collecting feedback from both the participants and the trainers at the end of each session. This activity is also recognized as good practice by related research (Fowler et.al., 2016). Figure 3 presents the themes that emerged during the qualitative analysis of the interviews.

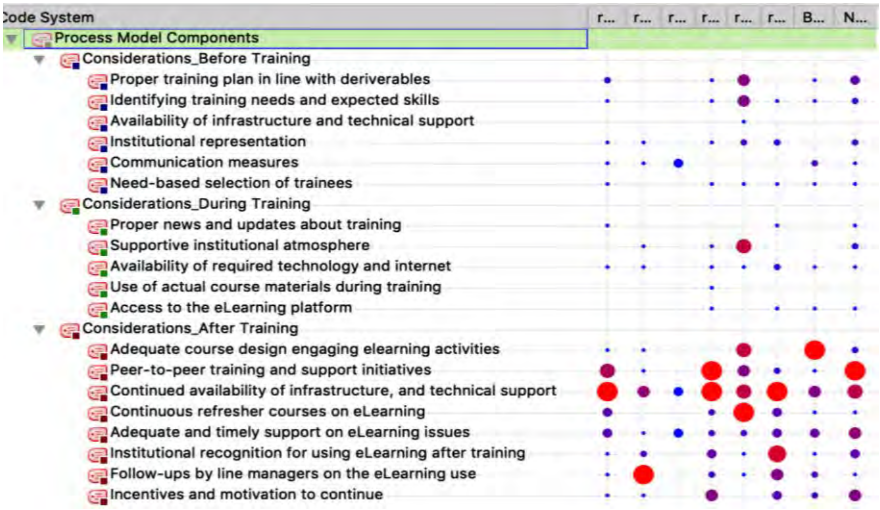


Figure 3: The outcome of the thematic analysis of the interview data

3.3 Feasibility check and the updated model

In the second co-creation and co-design session, the model was refined based on the outcome of the empirical study. The major update of the model corresponds to capturing two levels of segmentation: (1) inter-trainings; segmented according to the level of complexity of the training (from basic to advanced), and (2) intra-trainings; segmented according to before, during, and after in a single training iteration. This two-way perspective provides the possibility to improve the training process in relation to both the trainees' and the trainers' experiences in the future iterations of the training programme. The final process model for planning and delivering teacher training in using LMS as early adopters is presented in figure 4 below.

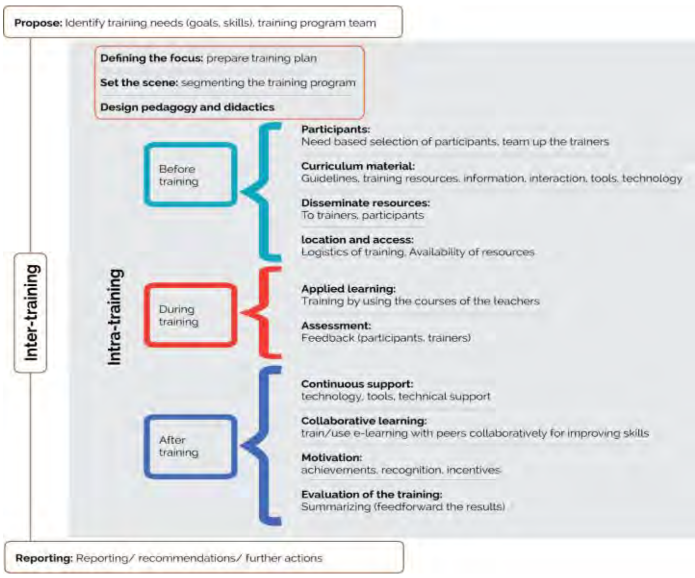


Figure 4: The process model for teacher training in using LMS as early adopters

4. Reflections

4.1 Theoretical underpinning

The process model in figure 4 is recursive with respect to within different training programmes (inter-training) and within a single training programme (intra-training). Introduction of agility to the recursive process of training allows strengthening consistent knowledge building in teachers. This can be illustrated in the form of a spiral model of knowledge construction, as illustrated in figure 5, with teachers beginning to learn the basics and incrementally progressing to acquire advanced skills.

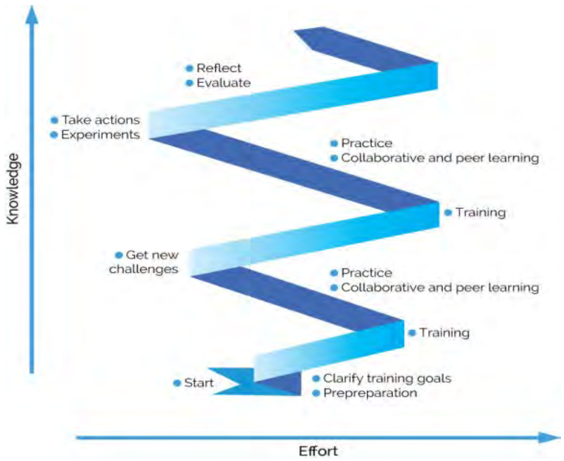


Figure 5: The spiral of knowledge construction in teachers

The spiral model resonates closely with the action learning model (Bhardwaj, 2013) and synergizes with a similar concept of action learning. In such a setup, one starts learning from the basics and progresses incrementally to familiarizing oneself with complex functionalities of an LMS in focus. Teachers also get the opportunity to learn at their own pace, prioritising the needs directed by their own preferences. Thereby, for a motivated teacher, it is possible to reach the level and the status of "e-learning champion" and start helping colleagues who find themselves at lower levels of the training in the capacity of an informal trainer.

Having a systematic process for teacher training which starts with a careful selection of participants, academic institutions can mobilize the teaching task force by equipping them with technological knowledge in a structured way. From the design thinking perspective, this process can closely follow the Pyramid Model of Digital literacy (Sharpe, Beetham, & de Freitas, 2010), such that the level of knowledge acquisition among teachers corresponds to different levels in the pyramid, and thereby, the individuals upon development of the skills will "climb" up the levels. In a snapshot, almost every member of staff in an academic institution should be aware of the digital tool or technology in focus ("I have…"), and among this group, the majority of those who need to use the tool or technology should have the skills (basics). Selected individuals from the latter group can level up with more advanced training ("I can..."). Motivated teachers from this group can receive even more training to advance at a quicker pace, that is, "I am..." in the Triangle of digital Literacy (Sharpe, Beetham, & de Freitas, 2010). Therefore, in such a training setting, as discussed in the preceding section, academic institutions would get a clear understanding of who has been trained and at which levels.

4.2 Practical scenarios

The model developed in this study was tested empirically in application to a specific case of the University of Rwanda, Rwanda, but it is worthwhile to reflect on how it would work in a different context, such as, for example, in Stockholm University (SU), Sweden. For instance, even a casual glance at the implementation of a new LMS at SU reveals several similarities with the outcome of the current study. In a decentralised organisation such as SU, teachers plan and carry out their duties in parallel with conducting research, teaching and taking on administrative tasks. Implementation of a new system leads to noticeable changes in work routines, all the more so because of an added duty — training — which also needs to be managed. Therefore, having a structured training process becomes vital to teachers' ability to manage the disruption to their work routines and plan accordingly. At SU, there are several entities responsible for technical integrations that influence the time and the pace at which the implementation of a new LMS in its full capacity can be rolled out. Central management would have little say in how this process should unfold in different departments and to different groups of members of staff because they can differ from each other greatly. That said, the implementation of a new LMS at SU can include the characteristics of cascaded training where colleagues rather than the management are the first-line informants.

4.3 The process model for teacher training

Simplified from figure 4, figure 5 illustrates the outcome of this study in the form of an abstraction of a process model for teacher training in using LMS as early adopters. This depiction of the process represents that its design can be flexible enough to be applied in different institutional environments and contexts.

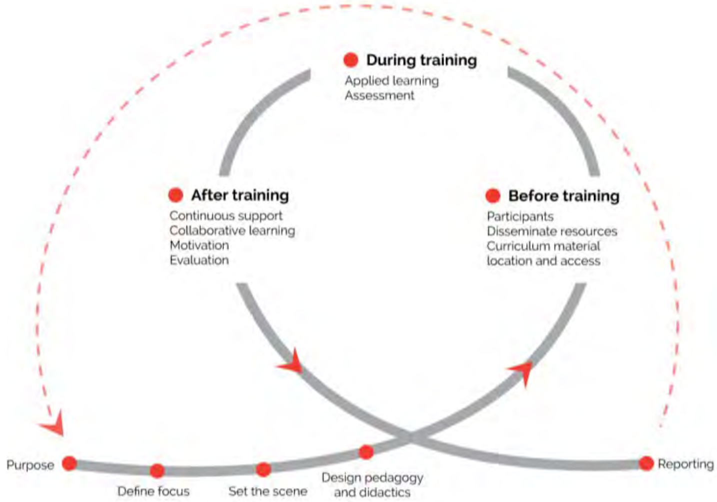


Figure 6: An abstraction of the process model for teacher training

The abstract process model for teacher training in using LMS as early adopters (Figure 6) presents the outcome of the second and final co-creation and co-design session. It is broad and generic enough to be independent of demographic peculiarities of a higher educational institution in focus, and therefore, can be applied in practice to various higher educational environments.

5. Concluding remarks

This study aimed to understand the practical scenario of the process of teacher training in using LMS as early adopters and propose a model for improving the training experiences that could maximize the individual development of teachers as well as institutional advancement. The model development was guided by the soft DSRM approach. The viability of the model was tested empirically using a case from the University of Rwanda. The model was created and then refined in two co-creation and co-design sessions. Accordingly, processual components to be considered before, during, and after training was proposed in the process model for the enhanced impact of teacher training. The model highlights that defining the purpose and the focus of the training as well as setting the scene for the training are essential to consider *before* the teacher training programme can be planned out in full. Reporting and suggestions for further design improvements are proposed as crucial for consideration *after* the training to support the sustainability of the training programmes. The proposed model can serve as a tool for effective planning and implementation of teacher training programmes on using LMS. The carefully structured and yet flexible process contributes to providing contemporary teachers with the skills and knowledge that are relevant in the current digital landscape of higher education worldwide. In terms of further research, an evaluation of the proposed process model for teacher training in using LMS could be undertaken using other cases of LMS implementation. A critical revision of the model's components in its application to a real case of planning out and conducting teacher training is also considered a possibility for further investigation.

References

Ash, S.L. & Clayton, P.H., 2009. Generating, deepening, and documenting learning: The power of critical reflection in applied learning.

Bannan-Ritland, B., 2008. Teacher design research: An emerging paradigm for teachers' professional development. In: A. E. Kelly, R. A. Lesh, & J. Y. Bak, eds. Handbook of Design Research Methods in Education. New York: Routledge. pp.246–262.

Baskerville, R., Pries-Heje, J., & Venable, J., 2009. Soft design science methodology. In: Proceedings of the 4th International Conference on Design Science Research in Information Systems and Technology - DESRIST '09. ACM Press, Philadelphia, Pennsylvania, pp.1–11. https://doi.org/10.1145/1555619.1555631

Beck, K., Beedle, M., van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., Grenning, J., Highsmith, J., Hunt, A., Jeffries, R., Kern, J., Marick, B., Martin, R.C., Mellor, S., Schwaber, K., Sutherland, J., & Thomas, D., 2001. Manifesto for Agile Software Development.

Berggren, A., Burgos, D., Fontana, J.M., Hinkelman, D., Hung, V., Hursh, A., & Tielemans, G., 2005. Practical and pedagogical issues for teacher adoption of IMS learning design standards in Moodle LMS.

Bhardwaj, M., 2013. Action Learning and Action Research. Manas Bhardwaj's Stream. Available at: https://manasbhardwaj.net/action-learning-vs-action/ [Accessed 5 June 2019].

Bond, T., 2004. Sauce: A Teacher's Handbook. Kanuka Grove Press.

Cloutier, M., & Renard, L., 2018. Design Science Research: Issues, Debates and Contributions. Projectics / Proyéctica / Projectique, 20(2). p.11.

Dabbagh, N., 2005. Pedagogical models for E-Learning: A theory-based design framework. International Journal of Technology in Teaching and Learning, 1(1). pp.25–44.

Ebert-May, D. et al., 2011. What We Say is Not What We Do: Effective Evaluation of Faculty Professional Development Programs. BioScience, 61(7). pp.550–558.

Eisenberg, M.B., Murray, J., & Bartow, C., 2016. The Big6 Curriculum: Comprehensive Information and Communication Technology (ICT) Literacy for All Students. ABC-CLIO, Libraries Unlimited, Santa Barbara.

Fowler, D., Macik, M.L., Sandoval, C.L., Bakenhus, C., & MacWillie, S., 2016. Program (re) design model: A sustainable, system-level approach to faculty development. The Journal of Faculty Development, 30(2). pp.17–25.

Gibbs, G., & Coffey, M., 2000. Training to teach in higher education: a research agenda. Teacher Development, 4(1), 31-44. https://doi.org/10.1080/13664530000200103

Gynther, K., 2016. Design Framework for Adaptive MOOC Enhanced by Blended Learning: Supplementary Training and Personalized Learning for Teacher Professional Development. Electronic Journal of e-Learning, 14(1). pp.15–30.

Herring, J.E., 2006. A Critical Investigation of Students' and Teachers' Views of the Use of Information Literacy Skills in School Assignments. Research Journal of the American Association of School Librarians, School Library Media Research (SLMR), 9(2006). pp.1–29.

Howland, J., & Wedman, J., 2004. A Process Model for Faculty Development: Individualizing Technology Learning. Journal of Technology and Teacher Education, 12(2). pp.239–262.

Kehrwald, B.A., & Parker, B., 2019. Editorial - Implementing online learning: Stories from the field. Journal of University Teaching & Learning Practice, 16(1), Art. 1. Available at: https://ro.uow.edu.au/jutlp/vol16/iss1/1 [Accessed 2 July 2019].

Lee, H., 2005. Developing a Professional Development Program Model Based on Teachers' Needs. Professional educator, 27. pp.39–49.

Lim, C. P., Chai, C. S., & Churchill, D., 2011. A framework for developing pre-service teachers' competencies in using technologies to enhance teaching and learning. Educational Media International, 48(2). pp.69–83.

Löfström, E., & Nevgi, A., 2008. University teaching staffs' pedagogical awareness displayed through ICT-facilitated teaching. Interactive Learning Environments, 16(2). pp.101–116.

Markauskaite, L., & Reimann, P., 2008. Enabling teacher-led innovation and research: A conceptual design of an inquiry framework for ICT-enhanced teacher innovation. In: Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications. AACE: Chesapeake, USA, pp.3484–3493.

Nawaz, A., 2011. Users' training: The predictor of successful eLearning in HEIs. Global Journal of Computer Science and Technology, 11(4). pp.1–9.

Peffers, K., Tuunanen, T., Rothenberger, M.A., & Chatterjee, S., 2007. A Design Science Research Methodology for Information Systems Research. Journal of Management Information Systems, 24. pp.45–77. https://doi.org/10.2753/MIS0742-1222240302

Percy, A., & Kelder, J.–A., 2019. Editorial - Implementing online learning: Stories. Journal of University Teaching & Learning Practice, 16(2). Art. 1.

Picard, C.J., 2004. Guidelines for Library Media Programs In Louisiana Schools.

Ping, C., Schellings, G., & Beijaard, D., 2018. Teacher educators' professional learning: A literature review. Teaching and Teacher Education, 75. pp.93–104.

Ramaswamy, V., & Guillart, F., 2010. The Power of Co-Creation. Harvard business review. pp.100 – 109. New York: Free Press.

Sarkar, S., 2012. The role of information and communication technology (ICT) in higher education for the 21st century. The Science Probe, 1(1). pp. 30–41.

Sharpe, R., Beetham, H., & de Freitas, S. (2010). Rethinking learning for a digital age: How learners are shaping their own experiences. London: Routledge.

Suzuki, T., 2008. The effectiveness of the cascade model for in-service teacher training in Nepal. In: Proceedings of the 2nd International Multi-Conference on Society, Cybernetics and Informatics, vol.1. pp. 272–277.

Tømte, C. E., 2013. Educating Teachers for the New Millennium?-Teacher Training, ICT and digital competence. Nordic Journal of Digital Literacy, 10. pp.138–154.

Unwin, T., 2005. Towards a framework for the use of ICT in teacher training in Africa. Open Learning: The Journal of Open, Distance and e-Learning, 20(2). pp.113–129. https://doi.org/10.1080/02680510500094124
VERBI GmbH, 2019. MAXQDA: The art of data analysis. [computer software]. Available at: https://www.maxqda.com/ [Accessed 25 April 2019].
Wreally Studios, 2015. Transcribe. [online browser app]. Available at: https://transcribe.wreally.com/ [Accessed 25 April 2019].

Assessing Programming Concepts in the Visual Block-Based Programming Course for Primary School Students

Siu-Cheung Kong and Yi-Qing Wang
Centre for Learning, Teaching and Technology, The Education University of Hong Kong, Hong Kong SAR
sckong@eduhk.hk
yiqing@eduhk.hk
DOI: 10.34190/EEL.19.035

Abstract: The present study aimed to investigate primary school students' achievement in programming concepts after 6-month learning of Scratch programming and 6-month learning of App Inventor programming. A test of programming concepts was developed based on the evidence-centered approach to assess students' progression. Online tests were administered to 1678 grade-5 students in class with the help of teachers. Students were given 30 minutes for each test before and after the programming course. Based on partial matrix sampling method, three test forms were created with 5 common anchoring items to reduce students' burden of completing the full test form developed for this study. The unidimensional dichotomous Rasch model was therefore employed for calculating students' ability scores. Results suggested that the test is valid for measuring programming concepts according to the mean-square fit statistics and other fit indices. Paired sample t-test was conducted to evaluate students' progression based on the ability scores. Results of the study showed that the programming course is effective as students made significant improvement upon course completion. In addition, group differences in gender and perceived competence (low vs medium vs high) were further explored with independent sample t-test. Results showed no significant gender differences regarding students' progression. In other words, boys and girls had similar initial levels of programming ability scores and rates of improvement regarding programming concepts. Results further revealed some interesting group patterns that boys with medium levels of perceived competence and girls with low levels of perceived competence show the most rapid improvement, indicating the course influenced different groups of students to different extents. Findings of this study shed light on the importance of visual block-based programming as a means for fostering programming concepts among primary school students. Educational policymakers should refer to the findings and propose policies to support programming education so that students can establish a solid foundation of programming concepts for the development of computational thinking.

Keywords: app inventor programming, primary school students, programming concepts, programming education, Scratch programming, visual block-based programming

1. Introduction

Computational thinking (CT) is an analytical thinking process facilitated by the use of computer science concepts, which helps to foster ability of problem identification and problem solving (Wing, 2006). In the digital era, CT is no longer a skill limited to computer scientists, but is fundamental to everyone (Wing, 2006) and is a valuable competence in today's workforce (Sanford and Naidu, 2016). Recognizing the immense need of equipping our next generation with CT ability, educators have been implementing CT courses for K-12 students since the last decade (Grover and Pea, 2013; Bocconi et al, 2016). Researchers advocated the use of the visual block-based programming environment as the means to develop CT because it offers "low floor" (ease of use), "high ceiling" (increased complexity), and "wide walls" (supporting a variety of projects) for young programming learners (Resnick et al, 2009). With most courses targeting secondary school students, recent effort has been made to integrate CT education into the primary school curriculum in some countries (Bocconi et al, 2016). Grover and Pea (2013) argued that early exposure to CT is crucial for building computational literacy because it helps generate interest and competence among the young generation. They added that learning CT not only helps students to understand the technological world, but also helps develop the problem-solving skills which are useful for their early education. It is possible for primary school students to learn basic CT practices, such as 'abstraction' and 'decomposition' (Rijke et al, 2018); and even kindergarten students can develop interest in CT and programming (Bers et al, 2014). These researchers suggested that it is never too early to learn CT.

Recently, scholars called for the need of evaluating teaching effectiveness and learning progression in CT education (Bocconi et al, 2016). Programming concepts serve as the fundamental elements of student's CT learning and participation (Brennan and Resnick, 2012). Young students are encouraged to learn programming concepts as the prerequisite before they can move on with advanced CT learning and form positive attitudes towards CT education. Recognizing the significance of learning programming concepts, previous researchers started to focus on exploring potential outcomes in middle schools and universities (e.g., Giordano and Maiorana, 2014; Grover, Pea and Cooper, 2015). To date, there are only a few studies evaluating students' progression of programming in a rigorous manner (e.g., Sáez-López, Román-González and Vázquez-Cano, 2016). And assessments of programming concepts in primary grades using intervention designs remain scarce in the existing education literature (Bocconi et al, 2016). Adopting the CT framework proposed by Brennan and Resnick (2012), the current study specifically assessed primary school students' programming concepts, including repetition, conditionals, parallelism and sequences, and data structure and algorithms. This study aimed to address this research need by delivering programming intervention courses to primary school students in Hong Kong, such that students' progression during the course can be evaluated. Thus, this paper attempted to answer the question of whether visual block-based programming, such as Scratch and App Inventor, is effective to foster programming concepts among primary school students. In order to facilitate the assessment of progression, we developed an in-class evaluation test to gauge students' test abilities regarding programming concepts before and after intervention. In our study, we also explored the influences of gender and initial levels of perceived competence on the learning progression of programming concepts among primary school students.

2. Literature review

2.1 CT education in primary school settings

Wing (2006) advocated that everyone should possess CT ability. Since then, the number of CT publications in education have been increasing rapidly. A total of 1112 articles were published between year 2006 to 2017 (Hsu, Chang and Hung, 2018). Majority of the activities in CT education were conducted in programming and mathematics classes, the learning strategies employed were mostly problem-based and project-based learning (Hsu, Chang and Hung, 2018). For example, in Meerbaum-Salant, Armoni and Ben-Ari's study (2013), a project-based computer science course was delivered to middle school students. They worked on a series of tasks throughout the course, which enabled them to build up a workable program artifact gradually. Sáez-López, Román-González and Vázquez-Cano (2016) integrated programming in sciences and arts in an intervention study among primary school students. Through tackling real-life issues with their programming projects, students were able to think critically and creatively. These CT studies were mostly conducted using visual block-based programming which allows young children to construct programs by dragging and snapping compatible command blocks, and enables them to focus on the design and logic of programming by avoiding complex programming syntax (Resnick et al, 2009). Thus, students' cognitive load and anxiety are greatly reduced, and they are consequently motivated to program and make progress in programming learning (Meerbaum-Salant, Armoni and Ben-Ari, 2013).

The CT framework proposed by Brennan and Resnick (2012) suggested three components of CT, namely CT concepts, CT practices, and CT perspectives. They further pointed out that repetition, conditionals, parallelism and sequences, and data structure and algorithms as key dimensions of CT concepts that are highly useful in visual block-based programming. "Repetition" means running a series of actions multiple times; "Conditionals" means making decision based on circumstances; "Parallelism and Sequences" means sorting a series of task commands and making different events happen simultaneously; "Data Structure and Algorithms" means storing, retrieving, and manipulating data with mathematical and string operations (Brennan and Resnick, 2012). Like previous studies, we endorsed these four frequently used dimensions of CT concepts and employed them as the basis for evaluation of programming concepts in our study (Ericson and McKlin, 2012; Grover, Pea and Cooper, 2015). Some studies proposed that events and procedures should also be included (Giordano and Maiorana, 2014). Nevertheless, the aforementioned four dimensions of CT concepts are most acknowledged in the current CT literature and can be explicitly taught, demonstrated and assessed through visual block-based programming, such as Scratch and App Inventor.

2.2 Programming concepts

The young generations are considered as "digital natives" due to their frequent exposure to digital technology (Prensky, 2001). However, being able to "read" but not "write" may not qualify them as digitally literate (Resnick et al, 2009). Learning and innovation skills, digital literacy skills, career and life skills are three essential skills for the 21st century. Programming is posited to be the crucial means to cultivate these skills according to various researchers (Resnick et al, 2009; Sanford and Naidu, 2016). It allows young children to express themselves by creating new artifacts, to build upon existing products through collaborations, and more importantly to develop problem-solving and reasoning skills for the daily life (Resnick et al, 2009). Indeed, learning programming facilitates cognitive development in students. For instances, past research evidenced an increase in students' programming understanding and self-efficacy after they receive programming courses at school (Kong, Chiu and Lai, 2018). Therefore, we argued that students who receive programming education would show strengthened abilities in learning programming concepts. Meanwhile they learn to perform better in other non-programming academic disciplines (Kafai and Burke, 2013). In short, early experience with programming can cultivate critical problem-solving skills, enhance overall academic achievements, and further allow young students to be better positioned in this fast-paced technological world.

2.3 Evaluation on learning effectiveness of programming concepts

Most CT initiatives for K-12 students yielded resounding results. For example, Ericson and McKlin (2012) attempted to help students learn computing and develop positive attitudes towards computer science through an 8-week summer camp. Students were taught to use different visual block-based programming tools, ranging from Scratch to Alice and from PicoCrickets to App Inventor. Their intervention findings indicated positive changes in attitudes and programming concepts among the students, especially for underrepresented groups, i.e. female and black students. In addition, other researchers (Grover, Pea and Cooper, 2015) found that middle school students who participate in a Scratch programming course make improvement in their algorithmic thinking, mathematics skills and overall understanding of CT. They also found that the students are able to transfer their learning from Scratch programming to a more sophisticated text-based programming. In the similar vein, we developed the programming course and the corresponding evaluation tests for the purpose of assessing students' progression in programming concepts before and after the course.

3. Method

3.1 Course design and implementation

We developed a 3-year programming curriculum on Scratch and App Inventor for primary school students. The targeted school teachers were recruited in the teacher development training where they were trained according to the programming curriculum we designed. After the training, they delivered the programming course to their students. Students were required to learn several programming concepts each class and programming activities related to each new concept would be tested for deepening students' comprehension. In addition, students were required to complete a final project to demonstrate their learning abilities during the programming course. They were encouraged to explore and work collaboratively. In this programming course, teachers played a supportive role and provided timely guidance when students encountered learning barriers.

3.2 Sample and procedure

The study sample consists of 1678 primary school students in the fifth grade from 20 different schools in Hong Kong. Majority of the schools are aided schools (85%), the remaining 15% are direct subsidy scheme schools and government schools. Among the participants, 53% are boys. Students were given 30 minutes for each online test before and after the programming course. On average, a majority of the students completed the test within the time requested.

3.3 Test development

The programming concepts test was developed using the Evidence-Centered Design approach (ECD). ECD is a systematic test development framework designed according to the principles of evidentiary reasoning (Mislevy, Steinberg and Almond, 2003). The framework aims to make specific linkage between observable behaviors with theoretical constructs, and improves the validity of inferences to be made. In our study, statements regarding what students can do to demonstrate their possession of each programming concepts were first proposed. These statements were reviewed by the development team in order to confirm their alignments with the learning goals. Assessment items in the context of Scratch and App Inventor were then developed to elicit the behavior specified by the statements. More than 30 questions were developed in the final pool. Our study analyzed 12 questions in both pre- and posttests (repetition: 2 items; conditionals: 3 items; parallelism and sequences: 4 items; data structure and algorithms: 3 items). In order to reduce students' burden when taking the programming concepts test, partial matrix sampling method was adopted. More specifically, we created three different online test forms with 5 common anchoring items across each form. These forms were randomly distributed to students. Two sample questions of the programming concepts test are provided as follows:

The conditionals item (see Figure 1) is a task for identifying the incorrect statement with respect to an "if…then…else" programming block from the App Inventor script.

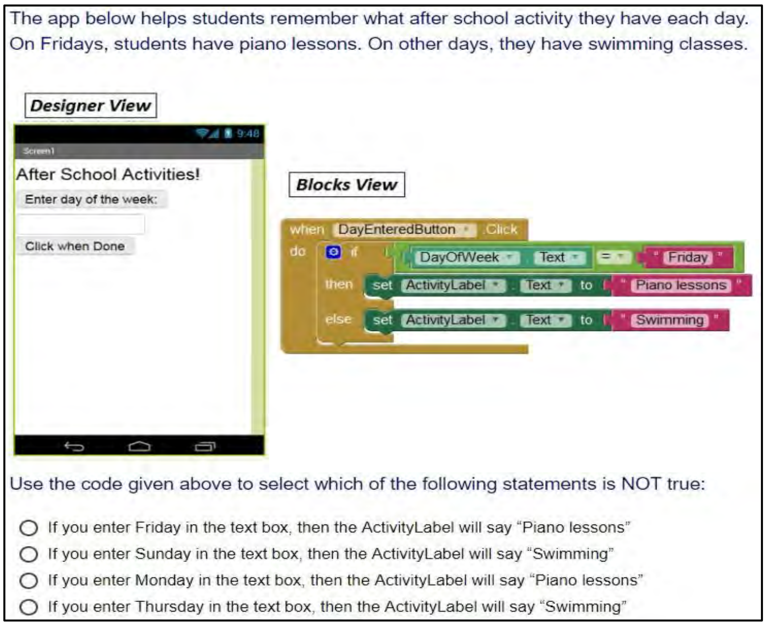


Figure 1: Example of an item testing students' understanding of conditionals

The parallelism and sequences item (see Figure 2) is a task for identifying the anticipated outcomes corresponding to the two Scratch scripts that differ in their orders of programming blocks.

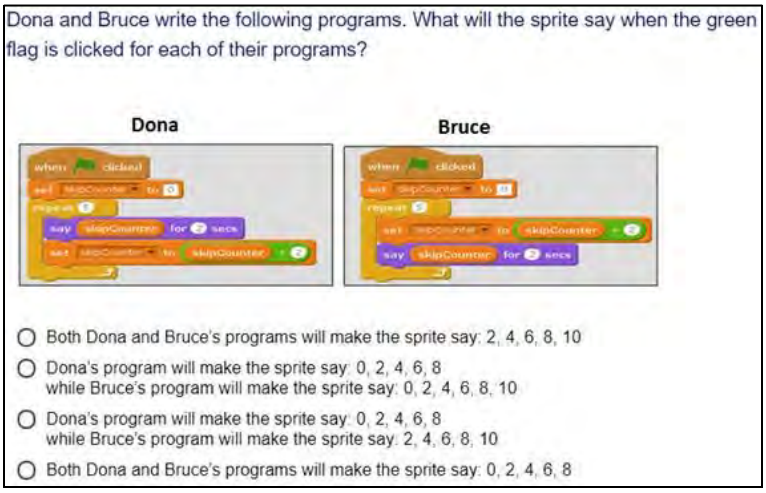


Figure 2: Example of an item testing students' understanding of parallelism and sequences

3.4 Analytical procedures

Each response was coded dichotomously, 1 for correct answers and 0 for incorrect answers. Item Response Theory (IRT) was adopted to create an overall measure of programming concepts. IRT is a latent variable paradigm, which is used for the development and evaluation of psychological assessments. It estimates and places item difficulty parameters and person ability scores on the same continuum, therefore allowing us to compare traits across tests. In the current study, a unidimensional 1-parameter logistic model (Rasch model) was adopted for analysis. Using Mplus 7.4, we calculated the pre- and posttests personal ability scores for each participant. In addition, R 3.5.1 was used for graph visualization. Paired sample t-test was conducted to test students' progression based on the programming course. The effect size of students' progression, measured in Cohen's d, was also calculated to demonstrate the magnitude of the findings. Moreover, we conducted independent sample t-test across different subgroups. Specifically, we conducted group analyses for gender and initial levels of perceived competence (low vs. medium vs. high). Finally, paired sample t-test was employed to further assess the significance of each subgroup's progression.

4. Result

4.1 Model fit and parameter statistics

To examine the validity of the test, unidimensional dichotomous Rasch analysis was conducted for both pretest and posttest data. The analysis showed that both infit and outfit mean square values of the pretest items were within 0.72 to 1.40; and that of the posttest items were within 0.67 to 1.30. They were within the range of 0.6 to 1.4, which indicated the appropriateness for measurement (Bond and Fox, 2007). Also, our model showed adequate fit with respect to both pretest (CFI = .966; TLI = .965; RMSEA = .046) and posttest data (CFI = .912; TLI = .909; RMSEA = .069), supporting a single programming concepts dimension.

We also checked the item and person distribution by looking into the Wright maps (see Figure 3 & 4). In general, the question items spread evenly across the scale and were able to discriminate a majority of students' abilities. Overall, the results supported the valid use of our newly developed test in measuring programming concepts.

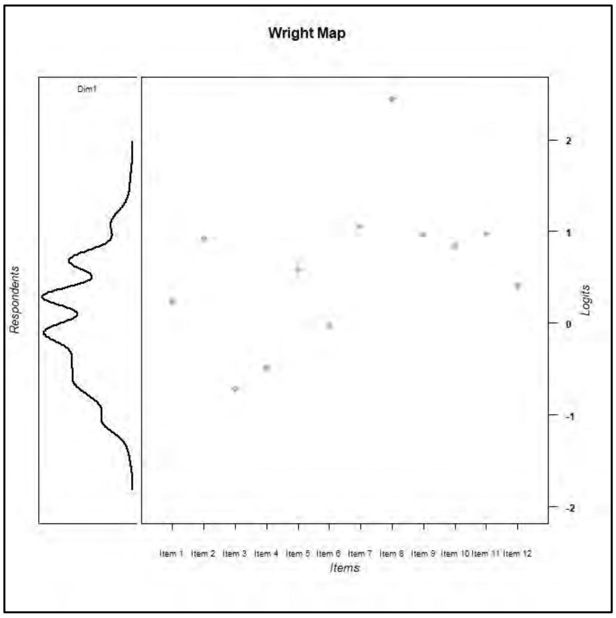


Figure 3: Wright map for the programming concepts assessment in the pretest

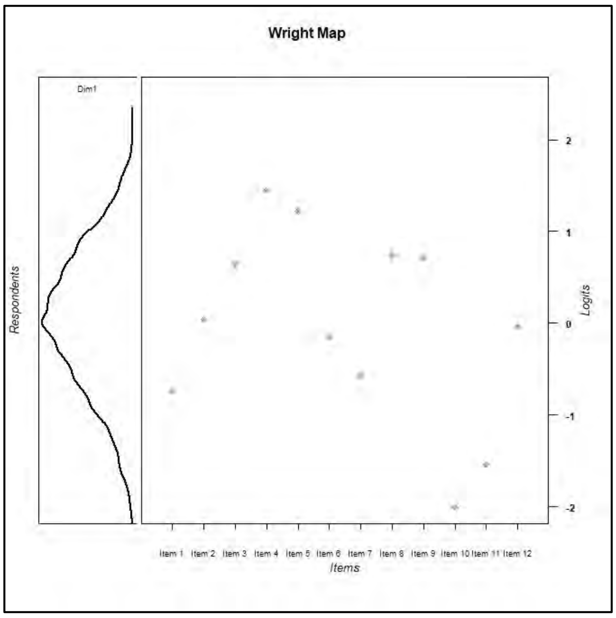


Figure 4: Wright map for the programming concepts assessment in the posttest

4.2 Course effectiveness

Descriptive statistics were calculated for both programming concepts ability scores in pre- and posttests (Table 1). The paired sample t-test result showed that students exhibited a significant increase in ability scores, t(1677) = -3.213, $p < .01$; and the effect size (d = .11) was considered moderate in most educational research (Kraft, 2018).

Table1: Summary of descriptive statistics for programming concepts pre- and posttests

Descriptive Statistics	Pretest	Posttest
Maximum Score	1.655	1.935
Minimum Score	-1.503	-1.950
Mean Score	-0.029	0.035
Standard Deviation	0.626	0.741
Skewness	0.045	-0.156
Kurtosis	-0.605	-0.378

To evaluate the gender effect on students' progression in programming concepts, independent sample t-tests were conducted. Results showed that boys (n = 863) and girls (n = 755) did not differ significantly from each other in their pretest ($\Delta\bar{x}$ = -.010, t (1616) = -.319, *n.s.*) and posttest ability scores ($\Delta\bar{x}$ = -.007, t (1616) = -.191, *n.s.*). However, as shown in Table 2, both genders exhibited significant improvement in programming concepts after the intervention course.

Table 2: Evaluation results by gender and initial level of perceived competence

Subsample	N	Pre/Post Mean	Paired t-test	Effect size
Boys	863	-.024/.037	.030*	0.105
Girls	755	-.014/.045	.045*	0.103
Low Perceived Competence	206	-.177/-.034	.017*	0.236
Medium Perceived Competence	719	-.024/.038	.047*	0.105
High Perceived Competence	603	.052/.077	.448	0.003

* $p < .05$

When we further analyzed students according to their initial levels of perceived competence (low, medium, high), students with high perceived competence tended to have significantly higher programming concepts ability scores than students with medium ($\Delta\bar{x}$ = .076, t (1320) = -2.22, $p < .05$) and low perceived competence ($\Delta\bar{x}$ = .229, t (807) = -4.51, $p < .001$). In addition, Students with different initial levels of perceived competence showed different progression in their ability scores. More specifically, students with low and medium perceived competence showed significant increase in their ability scores of programming concepts upon the completion of the programming course (Table 2).

Moreover, we explored the potential interaction effect of gender and perceived competence levels. The paired sample t-test indicated that boys with medium perceived competence ($\Delta\bar{x}$ = .105, t (328) = -2.25, $p < .05$) and girls with low perceived competence ($\Delta\bar{x}$ = .231, t (117) = -3.16, $p < .01$) showed the greatest improvement in their programming concepts ability scores when compared with other groups. Figure 5 and 6 show the progression plots for boys and girls respectively.

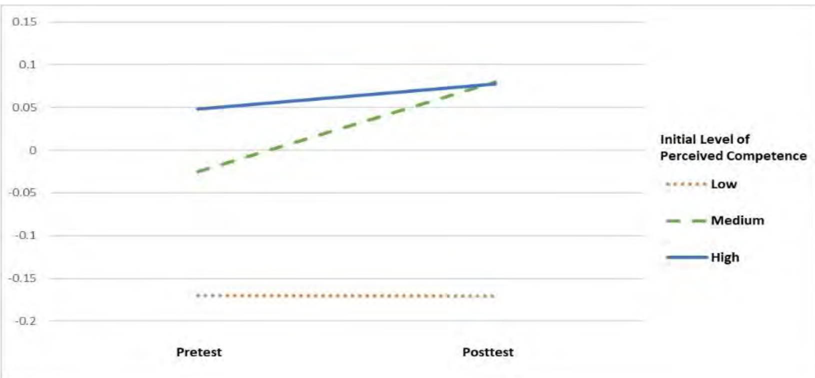


Figure 5: Boys' progression of programming concepts

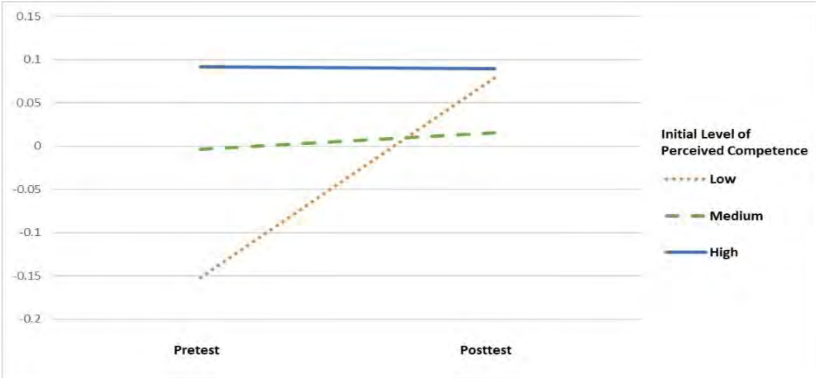


Figure 6: Girls' progression of programming concepts

5. Discussion

In the current study, we attempted to evaluate primary school students' progression of programming concepts based on the visual block-based programming course. Our findings suggested that visual block-based programming education evidently fosters students' programming concepts. Specifically, the significant increase in ability scores from pre- to posttests indicated that students can better understand and demonstrate these concepts in the programming context. Moreover, our study showed no significant gender differences in ability scores between boys and girls. This finding might be counterintuitive, as many studies pointed out gender issues in learning programming. In fact, past computing literatures showed no consistent trends for gender differences. For example, Rijke et al (2018) found that girls has a faster increase in abstraction ability after the age of 9.5 years old compared with boys of the same age. While, Atmatzidou and Demetriadis (2016) suggested that girls require more training time to be as competent as boys in computational thinking. Therefore, this might suggest that gender differences can be sample-specific and topic-specific. However, when we further analyzed boys and girls based on the initial level of perceived competence, some interesting interaction patterns emerged, i.e., boys with medium perceived competence and girls with low perceived competence experienced the greatest improvement. Especially, our results showed that girls with low initial perceived competence are the main beneficiaries from the programming intervention. One possible explanation could be due to the stereotype of girls. Historically, research showed that boys and girls differ in their level of perceived competence in gender stereotypical ways (Eccles et al, 1993). It is unsurprising that female, as an underrepresented group in programming, has lower confidence in computational thinking (Ericson and McKlin, 2012). In our study, girls had significantly lower initial perceived competence scores than boys ($\Delta\bar{x}$ = -.376, $t(1469) = 7.70$, $p < .001$). 10.1% of boys and 17.4% of girls were classified into low perceived competence groups respectively. This low perceived competence group of girls could possibly hold strong gender stereotype and perceived themselves less competent in programming before the intervention. They performed poorly in the pretest, which could be a manifestation of either low programming concepts ability, low perceived competence or stereotype threat. Throughout the intervention course, these girls developed a better understanding of programming concepts, and consequently they showed positive attitude and stereotype change (Ericson and McKlin, 2012), which invoke motivation to learn and catalyze the improvement among this low perceived competence group of girls. Finally, both boys and girls with high perceived competence demonstrated higher initial programming concepts ability but showed no significant improvement after the course. These findings are insightful in several ways. In our study, students with high perceived competence significantly outperformed their counterparts in the pretest. However, they showed no improvement during the programming intervention. This could be explained by the ceiling effect (Salkind, 2010), which suggested that the assessment may not be able to capture the actual improvement in the ability scores of these students or this course may be a bit too simple to stimulate their potential growth.

Although integration of CT in the K-12 curriculum has received heated discussions among researchers, most literatures evaluating CT education were conducted in middle school settings. The primary school students are nearly neglected. Even scarcer is the research on programming intervention for primary grades to improve their programming concepts. Our study contributed to the current literature by examining the effectiveness of visual block-based programming intervention in primary school settings. Specifically, we developed the programming concepts test using the ECD approach. The test showed satisfactory validity, which supports the use of the ECD approach in the programming context. With this new valid test, we further deepened our understanding of the relationships between students' dispositional factors and their learning progression of programming concepts. This allowed us to tap into diverse learning abilities and needs of students, and encouraged us for future improvement of programming education in primary schools.

6. Practical implication

The above findings could provide several practical insights to our current pedagogical design of programming education. First, Scratch and App Inventor are proved to be effective for fostering programming concepts among primary school students. We encourage the integration of visual block-based programming tools for future attempts of teaching programming in primary school settings. The idea of creating these visual block-based programming tools is to offer 'low floor', 'high ceiling', and 'wide walls' programming languages for beginners. Particularly, unremitting efforts have been made to further lower the floor for young-aged users since traditional programming languages are difficult to learn and comprehend (Resnick et al, 2009). Visual block-based programming also allows teachers to teach and assess different aspects of programming concepts by easily focusing on the usage of different programming blocks. Educational policy-makers should put more effort and resources into the implementation of visual block-based programming as it can positively contribute to programming education in primary schools (Kong and Wang, 2019).

Second, the findings of our study suggested that the intervention is particularly crucial for some marginalized students, i.e., girls with low initial perceived competence. The visual block-based programming intervention helps induce positive attitude change (Ericson and McKlin, 2012) and further sparks learning motivation among them. We recommend the screening test for identifying the marginalized students before the implementation of programming courses. Teachers should pay extra attention to their learning needs in order to assist them in attaining their potentials. We also advocate that future programming courses provide tailored learning experience for students from different backgrounds, such that all of them will be engaged in learning and flourish in their own pace.

7. Limitation and future research directions

It is also important to recognize the potential limitations in this study. Firstly, we only focused on assessing students' programming concepts. However, in order to attain a comprehensive understanding about students' CT development, we might need to assess more indicating factors, such as students' attitudes and practical skills of programming. Researchers in future are encouraged to examine a wide scope of factors in students who learn visual block-based programming.

Secondly, the results of our study showed that some of the student subgroups show no significant improvements in programming concepts. Either it was due to the ceiling effect or the lack of learning motivation. Nevertheless, it is suggested that the programming course may not benefit all students to the same extent. We advocate that future studies further explore the conditional effects on the learning progression of programming concepts to extend the findings of the current study. This allows programming educators to tailor courses for students with different backgrounds and needs, and therefore improve the efficiency of the programming intervention.

8. Conclusion

In this study, we investigated the effectiveness of the visual block-based programming course in fostering primary school students' programming concepts. Students' ability scores of programming concepts were measured before and after the intervention. Paired sample t-test indicated significant improvement in programming concepts upon course completion. In addition, boys and girls showed quite similar ability scores of programming concepts. We also found that the programming course is particularly beneficial to boys with medium initial perceived competence and girls with low initial perceived competence. These findings could contribute to a deepened understanding of learning progression of programming concepts among young school learners. We hope that our study could stimulate more future research to explore the potential of visual block-based programming education in primary school settings.

Acknowledgements

The authors would like to acknowledge the funding support of this Coolthink@JC project from the Hong Kong Jockey Club Charities Trust.

References

Atmatzidou, S. and Demetriadis, S. (2016) "Advancing students' computational thinking skills through educational robotics: A study on age and gender relevant differences", *Robotics and Autonomous Systems*, Vol 75, pp 661-670.

Bers, M. U., Flannery, L., Kazakoff, E. R. and Sullivan, A. (2014) "Computational thinking and tinkering: Exploration of an early childhood robotics curriculum", *Computers & Education*, Vol 72, pp 145-157.

Bocconi, S., Chioccariello, A., Dettori, G., Ferrari, A., Engelhardt, K., Kampylis, P. and Punie, Y. (2016, June) "Developing computational thinking: Approaches and orientations in K-12 education", *EdMedia 2016: World Conference on Educational Media and Technology, Association for the Advancement of Computing in Education (AACE),* Vancouver, Canada, pp 13-18.

Bond, T. G., & Fox, C. M. (2007) *Applying the Rasch model: Fundamental measurement in the human sciences (2nd ed.),* Lawrence Erlbaum Associates Publishers, Mahwah, NJ.

Brennan, K. and Resnick, M. (2012, April) "New frameworks for studying and assessing the development of computational thinking", *Proceedings of the 2012 annual meeting of the American Educational Research Association,* Vancouver, Canada, Vol 1, 25 pages.

Eccles, J., Wigfield, A., Harold, R. D. and Blumenfeld, P. (1993) "Age and gender differences in children's self-and task perceptions during elementary school", *Child development*, Vol 64, No. 3, pp 830-847.

Ericson, B. and McKlin, T. (2012, February) "Effective and sustainable computing summer camps", *Proceedings of the 43rd ACM technical symposium on Computer Science Education,* ACM, Raleigh, NC, USA, pp 289-294.

Giordano, D. and Maiorana, F. (2014, April) "Use of cutting edge educational tools for an initial programming course", *2014 IEEE Global Engineering Education Conference (EDUCON)*, IEEE, Istanbul, Turkey, pp 556-563.

Grover, S. and Pea, R. (2013) "Computational thinking in K–12: A review of the state of the field", *Educational researcher*, Vol 42, No. 1, pp 38-43.

Grover, S., Pea, R. and Cooper, S. (2015) "Designing for deeper learning in a blended computer science course for middle school students", *Computer Science Education*, Vol 25, No. 2, pp 199-237.

Hsu, T. C., Chang, S. C. and Hung, Y. T. (2018) "How to learn and how to teach computational thinking: Suggestions based on a review of the literature", *Computers & Education*, Vol 126, pp 296-310.

Kafai, Y. B. and Burke, Q. (2013) "Computer programming goes back to school", *Phi Delta Kappan*, Vol 95, No. 1, pp 61-65.

Kong, S. C., Chiu, M. M. and Lai, M. (2018) "A study of primary school students' interest, collaboration attitude, and programming empowerment in computational thinking education", *Computers & Education*, Vol 127, pp 178-189.

Kong, S. C., and Wang, Y. Q. (2019) "Positive youth development from a "3Cs" programming perspective: a multi-study investigation in the university", *Computer Science Education,* pp 1-22.

Kraft, M. A. (2018) Interpreting Effect Sizes of Education Interventions, Brown University Working Papers, Providence, https://scholar.harvard.edu/files/mkraft/files/kraft_2018_interpreting_effect_sizes.pdf.

Meerbaum-Salant, O., Armoni, M. and Ben-Ari, M. (2013) "Learning computer science concepts with scratch", *Computer Science Education,* Vol 23, No. 3, pp 239-264.

Mislevy, R. J., Almond, R. G. and Lukas, J. F. (2003) "A brief introduction to evidence-centered design", *ETS Research Report Series*, Vol 2003, No. 1, pp i-29.

Prensky, M. (2001) "Digital natives, digital immigrants. From on the Horizon", *MCB University Press*, Vol 9, No. 5, pp 1-6.

Resnick, M., Maloney, J., Monroy-Hernández, A., Rusk, N., Eastmond, E., Brennan, K. and Kafai, Y. B. (2009) "Scratch: Programming for all", *Communications of the ACM,* Vol 52, No. 11, pp 60-67.

Rijke, W. J., Bollen, L., Eysink, T. H. and Tolboom, J. L. (2018) "Computational Thinking in Primary School: An Examination of Abstraction and Decom-position in Different Age Groups", *Informatics in education*, Vol 17, No. 1, pp 77-92.

Sáez-López, J. M., Román-González, M. and Vázquez-Cano, E. (2016) "Visual programming languages integrated across the curriculum in elementary school: A two year case study using "Scratch" in five schools", *Computers & Education*, Vol 97, pp 129-141.

Salkind, N J. (2010) *Encyclopedia of research design,* SAGE Publications, Inc., Thousand Oaks, CA, viewed 8 May 2019, doi: 10.4135/9781412961288.

Sanford, J. F. and Naidu, J. T. (2016) "Computational thinking concepts for grade school", *Contemporary Issues in Education Research*, Vol 9, No. 1, pp 23-32.

Wing, J. M. (2006) "Computational thinking", *Communications of the ACM*, Vol 49, No. 3, pp 33-35.

Investigating Participants' Collaborative Patterns in a MOOC for Teacher Professional Development

Nikolaos Koukis and Athanassios Jimoyiannis
Department of Social and Educational Policy, University of Peloponnese, Greece
nkoukis@uop.gr
ajimoyia@uop.gr
DOI: 10.34190/EEL.19.095

Abstract: This paper reports on a teacher professional development MOOC, designed to prepare Greek language teachers in secondary education schools towards designing and implementing collaborative writing activities in their classroom. Using a hybrid mode, a new design framework for MOOCs is proposed, organised along three dimensions of teachers' learning activities: a) individual engagement, b) peer interaction and mutual support, and c) collaborative creation of educational artefacts. The pedagogical principles that determine the particular framework were authentic learning, case-study approach, peer-supported, collaborative and self-regulated learning. A mixed method of research data analysis was used regarding teachers' engagement and their learning presence in the collaborative learning activities. The analysis showed that the present MOOC achieved high completion rate (57.6%). In addition, the results provided supportive evidence that the design framework was effective towards promoting teachers' active engagement, peer interaction and support, as well as development of learning design abilities to integrate collaborative writing with Google Docs in their classroom.

Keywords: MOOCs, e-learning, teacher professional development, collaborative writing, Google Docs

1. Introduction

During the last decade, e-learning is moving from conventional on-line programs to more open, personalised, flexible and distributed learning environments that support active, collaborative, self-directed and lifelong learning, thus overcoming time and distance barriers. Among new forms of e-learning, Massive Open Online Courses (MOOCs) are widely recognized as a new paradigm in on-line learning, continually gaining intense educational and pedagogical interest. They constitute an alternative to the conventional e-learning courses offering enhanced opportunities to large numbers of learners to participate in quality educational programs for free and without any prior knowledge or official requirements.

On the other hand, higher education institutions, around the world, face great challenges for educational reforms in order to respond to the growing demands of flexible and inclusive education for great numbers of students coming from diverse backgrounds. Many universities realised the potential of MOOCs and adopted them as an important aspect of their educational policy, starting to offer MOOCs to their students as well as to the public (Conole, 2015; Milligan & Littlejohn 2017; Perez-Sanagustin et al. 2017; Stich & Reeves, 2017). In addition, the main features of MOOCs, i.e. openness, massiveness, the variety of learners' background and previous experiences, the new forms of engagement and learning etc., have influenced an intense research interest about MOOCs (Bonk et al., 2015; Eriksson, Adawi & Stohr, 2017; Gašević et al., 2014; Hew, 2016; Littlejohn et al., 2016; Tseng et al., 2016; Veletsianos & Shepherdson, 2016):

Traditionally, teacher professional development (TPD) can be provided in formal courses and training programs, as well as in short term workshops lasting for few days. MOOCs were also suggested as an alternative for teacher professional development offering flexibility and enhanced opportunities to the teachers to attend on-line courses without time and distance barriers (Koutsodimou & Jimoyiannis 2015; Laurillard, 2016 Vivian, Falkner & Falkner, 2014). Given that MOOCs are becoming more and more popular among teachers and higher education institutions, a wide range of issues regarding MOOC pedagogy and learning design are open for further investigation (Castaño-Muñoz et al., 2018; Karlsson et al., 2014; Koukis & Jimoyiannis, 2019; Laurillard, 2016; Wang et al., 2018).

This paper reports upon a new design framework regarding MOOCs for teacher professional development based on peer support and teachers' collaborative creations of educational artefacts. The starting point was the idea that formal MOOCs, focusing on delivering the appropriate educational material to the teachers, are not responding effectively to their enhanced professional development needs. The particular design framework used a mixed mode directed along three dimensions that determine teachers' learning in MOOCs: a) individual engagement, b) peer interaction and mutual support, and c) collaborative creation of educational artefacts.

This framework was also expected to provide a new context for understanding teachers' knowledge construction and collaborative patterns during MOOC's worktime. It was applied in the design and the implementation of a MOOC aiming to support Greek language teachers towards developing the knowledge and the skills needed to integrate collaborative writing with Google Docs in their classroom practices. The analysis of teachers' discussions in their group forums showed that dialogue, ideas sharing and reflection were directed toward pedagogical and learning design issues, as well as the collaborative creation of new artefacts; i.e., educational scenarios and learning activities aiming to engage their students in collaborative writing with Google Docs. The findings revealed an evolving culture of group working, collaborative thinking and creation and a sense of community among peers. In addition, they provided supportive evidence that the MOOC design framework was effective towards promoting teachers' active engagement, self-regulation, interaction, collaboration, as well as knowledge sharing and co-creation.

2. Literature review

Literature review indicated a wide range of research studies regarding MOOCs (Bonk et al., 2015; Eriksson et al., 2017; Gašević et al., 2014; Hew, 2016; Littlejohn et al., 2016; Veletsianos & Shepherdson, 2016). The majority of them were descriptive and directed to four main dimensions (Koutsodimou & Jimoyiannis 2015): (a) the different perspectives of the large and diverse body of the participants involved in MOOCs (i.e. students, tutors, designers, institutions etc.), (b) factors related to the learners (i.e. motivation to participate, values and expectations, personal, cognitive or psychological barriers, and the high learner dropout rates), (c) learning design issues, related to MOOC pedagogy, content and discipline, course resources and learning material, technologies used, learning activities, learner guidance and support, tutor and facilitator roles etc., and (d) factors related to the need for new methods and schemata for analysing learners' participation and engagement patterns (learning analytics).

Despite the growing rates of applying MOOCs in teacher professional development (TPD-MOOCs), this topic appeared to be a rather under-researched field. Only few studies were identified, and the published results have been mainly descriptive in nature. The findings regarding TPD-MOOCs are directed towards three research dimensions (Koukis & Jimoyiannis 2019): a) MOOC pedagogy and design factors, b) teachers' motivation, interests and personal achievements, and c) MOOC effectiveness with regards to teacher professional development.

Recent research in TPD-MOOCs is beginning to show promising results with regards to participants' personal interests and motivation, their learning outcomes and the completion rates achieved (Castaño-Muñoz et al., 2018; Karlsson et al., 2014; Koukis & Jimoyiannis, 2017; Koutsodimou & Jimoyiannis 2015; Laurillard, 2016; Wang et al., 2018). Other researchers analysed the interaction between participants, their patterns of engagement and the forms of self-regulated learning (Castaño et al., 2015; Conole, 2015; López-Meneses et al., 2015; Littlejohn et al., 2016). For example, Karlsson et al. (2014), using empirical data from surveys and interviews, identified as positive factors the connection and collaboration among peers in a cMOOC designed to prepare Swedish teachers about using digital tools in their instruction. However, some teachers highlighted as weak factors, that did not helped them to be more active, the lack of course structure, their needs for support and guidance during MOOC implementation, and the lack of homogenous teacher groups.

Laurillard (2016) reported that the participant teachers in TPD-MOOC considered that the course achieved the intended learning outcomes and covered their own expectations. In addition, teachers' engagement in MOOC forums was maintained throughout the course and supported effective co-learning among professionals. Similarly, Koukis & Jimoyiannis (2017) have shown that teachers' motivation to participate in a TPD-MOOC about using ICT in Greek language instruction was mainly related to the course openness and flexibility, their personal development needs, and the connection of MOOC content to the classroom reality. Additionally, Wang et al. (2018) showed that the majority of the teachers who were positive about a TPD-MOOC related to Flipped Classroom pedagogy, had a relatively rich teaching experience and were in a stage of experimentation and reassessment in their teaching career; in addition, they demonstrated strong skills of goal-setting and self-regulated learning.

Given the increased interest about TPD-MOOCs, the present study was designed with the ambition to provide new knowledge, in terms of critical pedagogical issues and design factors that determine successful MOOCs for teacher professional development. The first assumption that addressed this study was landed on the existing literature and the idea of promoting collaborative learning within groups of peers (Conole, 2015; McLoughlin & Lee, 2010; Shea & Bidjerano, 2010). The second assumption was that the participants, as experienced educators themselves, have developed a coherent base of pedagogical knowledge that could help to reveal valuable information regarding MOOC design and pedagogy factors. Therefore, the following research questions were addressed:

- Can we reveal the main aspects of teacher' collaborative patterns in a TPD-MOOC through the lens of learning presence conceptual framework?
- What were teachers' perceptions about their collaboration in a TPD-MOOC?

3. A new design framework for TPD-MOOCs

In relation to the pedagogical principles of MOOC design and implementation, current literature adopted the general distinction proposed by Siemens (2013), who identified two main formats of MOOCs:

- *Connectivist* or *cMOOCs,* which put emphasis on connected, collaborative and reflective learning. These type of MOOCs are based on the theory of connectivism, which considers knowledge as a social construct, distributed over networks and shaped by participants' engagement, self-direction, creativity, collaboration and connectivity.
- *xMOOCs*, which are considered as an extension of the traditional on-line courses and they are based on the knowledge transfer model. xMOOCs are predominant among institutions and learners are much more familiar with this format. Typically, they use similar platforms with the traditional online courses to provide learning content and appropriate educational material to the learners. For example, they use video micro-lessons and automatically marked quizzes for student feedback and evaluation.

xMOOCs have been criticized as not providing sufficient learner support and engagement. However, they have shown capacity of scale and, over their evolution, they have added a variety of novel learning and assessment activities, e.g., educational games and simulations (Hew, 2016). On the other hand, cMOOCs have been much less popular despite that proponents advocated that they provide enhanced opportunities for learners' collective thinking and collaborative learning (Cochrane et al., 2015). Criticism about cMOOCs noted that participants encounter many difficulties, i.e. unfamiliarity with the learning model that characterize cMOOCs, lack of necessary knowledge and skills, difficulties in goal setting, interaction and collaboration with others, information overload due to many content sources used and information flow etc. (Li, Tang, & Zhang, 2016).

In the last decade, e-learning was moving to learner-centered approaches that offer enhanced opportunities for self-directed and collaborative learning within social and connected spaces (McLoughlin & Lee, 2010; Shea & Bidjerano, 2010). In this perspective, some researchers started to create *hybrid types* of MOOC by incorporating in course design features from both modes, with the aim to promote participants' engagement and knowledge sharing (Koutsodimou & Jimoyiannis 2015; Ostashewski, Howell, & Dron, 2016; Crosslin & Dellinger, 2015). The aim of the present study was to contribute to the debate regarding MOOCs for teacher professional development by providing a design framework for TPD-MOOCs blending various pedagogical features. This approach started from the idea that formal xMOOCs, since they are directed by the knowledge transfer philosophy, are not effective to respond to teacher professional development needs. Therefore, the proposed MOOC design framework put emphasis on encouraging teachers' dialogue, reflection and collaboration within a community of peers/active learners, in order to diffuse technical knowledge and skills, to enable their creativity and, finally, to connect new pedagogical and technological knowledge with classroom practice.

3.1 Pedagogical dimensions of TPD-MOOCs

Having a great experience in teacher professional development, in both conventional and on-line courses, the main hypothesis addressing the design of the present MOOC was that teachers are preferring to enrol to structured courses. As suggested by existing research findings, the majority of the participant teachers were familiar with and preferred this type of MOOC structure (Karlsson et al., 2014; Koukis & Jimoyiannis, 2017). Firstly, the present TPD-MOOC was *structured* in terms of how the particular units were organized and presented. Secondly, we adopted n current ideas and trends egarding online learning that put emphasis on active, self-directed and collaborative learning within a community of peers (McLoughlin & Lee, 2010; Tsiotakis & Jimoyiannis, 2016; Shea and Bidjerano, 2010). Therefore, the design framework of the present teacher professional development MOOC was based on the idea of blending pedagogical features and approaches of both types of MOOCs.

The fundamental pedagogical principles determining the design of this particular TPD-MOOC were:

- **Authentic learning:** MOOC units were placed in an authentic context, directly reflecting the way that teachers are expected to use new knowledge in the classroom reality (Herrington & Kervin, 2007).
- **Case-study approach:** The course topics were built across the main idea of collaborative writing. Teachers' were engaged in appropriate activities, designed to familiarise them with the four modes of collaborative writing, i.e. *sequential writing, horizontal-division writing, stratified-division writing* and *reactive writing* (Storch, 2011).
- **Collaborative learning:** Participants were assigned in groups of 4-5 teachers. They were encouraged to work in a collaborative manner to create Google Docs artefacts as well new lesson plans applicable in their own classrooms.
- **Peer-supported learning:** Teachers were encouraged to mutually provide technical help and support, and learn from each other through their engagement in online discussions, sharing ideas and resources about course topics, and reflecting on new knowledge and skills in relation to classroom reality.
- **Self-regulated learning:** Teachers' collective thinking and self-regulation actions within their groups, were expected to be addressed along four mutually related dimensions that determine their own professional learning: *forethought and planning*, *monitoring*, *strategy use*, and *reflection* (Shea & Bidjerano, 2010; Zimmerman, 2008).

In response to the issues above, the participant teachers were expected to take responsibility for their learning, to be involved in inquiry procedures, to ask for and offer assistance and support, to adopt self-regulated practices and collaborate with others in order to achieve their learning outcomes (Koukis & Jimoyiannis, 2019; Littlejohn et al., 2016). Therefore, the particular MOOC design framework put emphasis on encouraging teachers' dialogue, reflection and collaboration within a community of peers/active learners, in order to diffuse technical knowledge and skills, to enable their creativity and, finally, to connect new pedagogical and technological knowledge with classroom practice.

3.2 Course units and timeline

From the perspective of teacher professional development, this TPD-MOOC was designed with the aim to support Greek language teachers towards developing and enhancing a) their technical skills and pedagogical abilities to use Google Docs as a collaborative writing tool in Greek language instruction; b) their pedagogical knowledge and learning design skills. The course units were structured on a weekly basis. Table 1 shows the organisation, teachers' workflow, assignments and learning activities for each unit.

Teachers' learning is considered as both, an individual and a collaborative process, addressed along two, mutually related, dimensions of their participation: a) *individual work* and continuous contribution to the course forum; b) *collaborative work* and mutual support in groups of 4-5 individuals, who were relatively free from course constraints. Individual and collaborative coursework were properly interwoven towards achieving the objectives of teachers' professional development in relation to the four modes of collaborative writing (Storch, 2011). Finally, teachers' engagement in the design of an authentic educational scenario about collaborative writing and their reflection on its application in classroom practice (6th group assignment) offered enhanced opportunities for comprehensive discussions on pedagogical ideas, peer feedback and conclusions regarding the effectiveness of Google Docs as collaborative writing environment.

Teacher assessment was based on individual engagement and contribution to the collaborative tasks as well as on his/her interaction with peers in the group and with participants in different groups. MOOC completion requirements for each participant were: a) to interact with others in the MOOC community and contribute to the main discussion topics of the course; b) to be an active member in his/her group and contribute in an open and self-directed way to both, the process and the content of collaborative creations using Google Docs. Thus, learning was expected to result not from information transmission but from teachers' active engagement and self-regulation in specific collaborative writing situations, offered by five group assignments-tasks (Table 1).

Table 1: MOOC units and teacher assignments

Week	Course topics and learning activities
1	Familiarisation with the MOOC platform Introduction to collaborative writing

Week	Course topics and learning activities
	1st assignment: Discussion forum about ICT in education, pedagogy and language learning
2	First collaborative writing mode: Sequential writing *2nd Group assignment-task: Sequential writing using Google Docs*
3	Second collaborative writing mode: Horizontal-division writing *3rd Group assignment-task: Horizontal-division writing using Google Docs*
4	Third collaborative writing mode: Stratified-division writing *4th Group assignment-task: Stratified-division writing using Google Docs*
5	Fourth collaborative writing mode: Reactive writing *5th Group assignment-task: Reactive writing using Google Docs*
6-7	*Designing educational scenarios of collaborative writing* *6th Group assignment-task: Teachers collaborative design of the educational scenario* *Application of the scenario in their own classroom practice* *Discussion, peer feedback and conclusions*
8	Critical reflection *7th assignment: Discussion forum about MOOCs and teacher professional development*

3.3 Context and participants

The specific MOOC offered on March 2018 by the eLearning Research Group, Department of Social and Educational Policy, University of Peloponnese, in Greece. After an open call, a total of 566 Greek language in-service teachers were enrolled. They were teaching in upper and lower secondary schools while they were coming from different geographical districts of the country. The course was hosted and delivered through the Open eClass learning management system. Short tutorials in the form of video-lessons, produced by the authors, were available in the on-line platform.

One tutor and his assistant were acting as course moderators and facilitators of teachers' e-tivities (Salmon, 2003). Their intervention, along the course timeline, was necessary in only few cases. Teachers' technical barriers, pedagogical difficulties and concerns about collaborative writing were effectively responded by peer assistance and support through relevant forum threads in the MOOC platform. The teachers were encouraged to use the educational material available in the course units, to be active participants in group learning tasks and discussions, to offer support to their peers and reflect on their personal and group achievements.

4. Research method

4.1 Data collection and procedure

In line with the MOOC design framework, our analysis was directed along three main axes: a) teachers' engagement, b) peer interaction and collaboration analysed using the model of *learning presence* (Shea and Bidjerano, 2010), and c) teacher' perceptions of their collaboration in group activities. Two main data sources were used in the present study: a) log data gathered from the MOOC platform which reflect teachers' individual participation and engagement (i.e., forum postings to the main course topics and in-group postings related to teachers' collaborative activities), b) quantitative data received through a survey administered one week after the completion of the course using an on-line anonymous questionnaire.

4.2 The sample

All participants in the sample completed the course successfully. Completely responded questionnaires for analysis received from 326 Greek language teachers, 40 males and 286 females. They were teaching in lower secondary schools (41%) and upper secondary schools (42.2%) while 16.8% were serving in various educational or administration positions. Among the participants, 53.2% were certified by the Greek Ministry of Education after attending the official teachers' training program about ICT in education (basic or advanced level). In addition, 80.1% of the teachers reported that they had a previous e-learning experience from distance, before attending the particular MOOC.

4.3 Analysis framework

Focusing on the connectivist and collaborative aspects of this teacher professional development MOOC, primary research data were extracted from teachers' discussion posts in the MOOC platform, related to the five collaborative activities within groups along the eight weeks of the course. Established content analysis procedures, well-known and applied in the analysis of asynchronous on-line interactions, were used to analyse teachers' patterns of peer interaction, support and collaborative design activities within their groups. Every post was considered as the unit of analysis; typically, posts included questions, replies, suggestions, alternative or new ideas, argumentation or criticism regarding a particular activity, as well as responses to previous peer comments in the group discussions.

In order to codify teachers' collective thinking and self-regulation actions within their groups we used the learning presence framework (Shea & Bidjerano, 2010), which effectively addresses the regulatory processes displayed by the teachers. Content analysis of their contributions to the group discussion forum included four mutually related dimensions (i.e., forethought and planning, monitoring, strategy use, reflection) and the related categories proposed by Shea et al. (2013).

Once the coding scheme was established two independent researchers analysed all contributions in the group forum. Initial and negotiated inter-rater agreement was established to refine and finalise the coding scheme. Data reduction, thematic interpretation as well as the relevant categories and indicators of the learning presence framework were emerged from a detailed sententious analysis.

5. Results

5.1 Teachers' engagement

Compared to existing findings in the literature (Tseng et al, 2016; Vivian, Falkner & Falkner, 2014), this TPD-MOOC achieved a high completion rate (57.6%). Finally, 326 teachers completed the course successfully, since they contributed to the five collaborative (group) assignments and they were active participants in the MOOC discussion forums along the 8 weeks of the coursework.

The teachers were encouraged to regularly participate in short and/or comprehensive discussions in the platform forum. They had the opportunity to discuss about course objectives and organisational issues, learning content and assignments, technical problems or other difficulties they were facing at. They also were able to interchange ideas and provide mutual guidance and support to their peers. The main discussion topics were related to both, general and specific themes concerning collaborative writing and ICT in language learning. Overall, 153 discussion topics were raised and 3224 posts were uploaded by the participants (mean value 9.9 posts per teacher).

At the same time, a separate group forum was running in the MOOC platform with the aim to support teachers' collaborative activities within their groups. Peer interaction, collaborative work and mutual support were spontaneously emerging within 91 teacher groups of 4-5 individuals. Overall, 671 discussion topics and 11647 posts were recorded (mean value 35.7 posts per teacher). It is quite reasonable that the majority of the participants devoted more time and effort to interact with peers in their own group compared to their contribution to the general discussions at the course level.

5.2 Teachers' collaboration patterns

In the context of self-regulated learning, Shea & Bidjerano (2012) identified learning presence as an important moderator between teaching, social and cognitive presence. They also advocated that, in the absence of satisfactory teaching presence, and this is the case of MOOCs, measures of significant learning are contingent upon student ability to self-regulate their learning. In this sense, the notion of learning presence was addressing our analysis further by assuming that it could potentially shed light into the critical aspects of teachers' self-directed collaborative learning actions within their groups. Table 2 provides indicative transcripts from teacher posts explaining the main categories of their learning presence within group activities related to stratified-division writing mode (4th course week).

Table 2: Learning presence analysis of participants' posts in the Group Forum during the 4th week

Category	Example
Forethought and planning	*Until the end of this week, working as a team, we have to co-create a text applying the stratified-division writing mode. To achieve better and immediate results, I believe that all group members must work as writers and only one as the editor.*

Category	Example
	I agree that we must undertake specific roles according to the collaborative writing mode of this week! I would like, also, to remind that setting a specific time schedule will help us to complete our assignment in time.
Monitoring	*First of all, I hope that all group members have studied the material about the new collaborative writing mode and we all have understood the assignment of the 4th week. The next step is to decide about the role that everyone will take on.*
	It was my turn to contribute after receiving the invitation. So, I added a couple of new paragraphs to our text. Please, feel free to correct and modify anything that needs to be changed…
Strategy use	*I would like to ask about something critical. As an editor, can I say/write my opinion and make changes in the text during the creation process or do I need to leave the content changes for the end?*
	I think that this assignment offers the opportunity to exploit the Google Docs platform and do creative things. There is no need to create a theoretical text to show our knowledge. But we can really create new knowledge, through our collaboration.
Reflection	*I was really inspired by collaborative writing. Yesterday, I asked my pupils (first high school grade) to write, using a notebook one after the other, their views and concerns in order to create a 'thoughts repository'…*
	It the beginning of every week, I am stressful and afraid that we will not succeed to complete the new assignment. Thanks to our collaboration and the mutual support, we completed every assignment in time; I feel very happy to be a member of this hard-working group.

Our findings confirmed Laurillard's (2016) reporting that teachers' engagement in the course forum was a success factor for a TPD-MOOC which supported co-learning among professionals. Despite differences that were expected among the various groups, teachers were active participants and harness the features of the group forum to organise their collaboration, to discuss about strategies and the evolution of the common text, to make corrections, modifications or extensions and to reflect upon their creations and the collaborative mode they used. Many groups exhibited high rates of self-regulation actions, through the group forum, with the aim to improve their collaboration in the weekly assignments and their achievements as well. In some groups, on the other, teachers' learning presence activity was not high or continuous. They rather preferred to work in the middle or in the end of the week.

As an example, Figure 1 outlines the frequencies of the learning presence categories regarding teachers' collaborative and self-regulation posts in the discussion forum of group 29 related to the assignment of the 4th week. Overall, 145 comments appeared in the group forum and supported their collaborative activities regarding the *stratified-division writing* mode. The majority of teachers' postings were assigned to the categories of *monitoring* (44.8%) and *forethought and planning* (26.9%), following by the *strategy use* (16.6%) and teachers' *reflection* (11.7%).

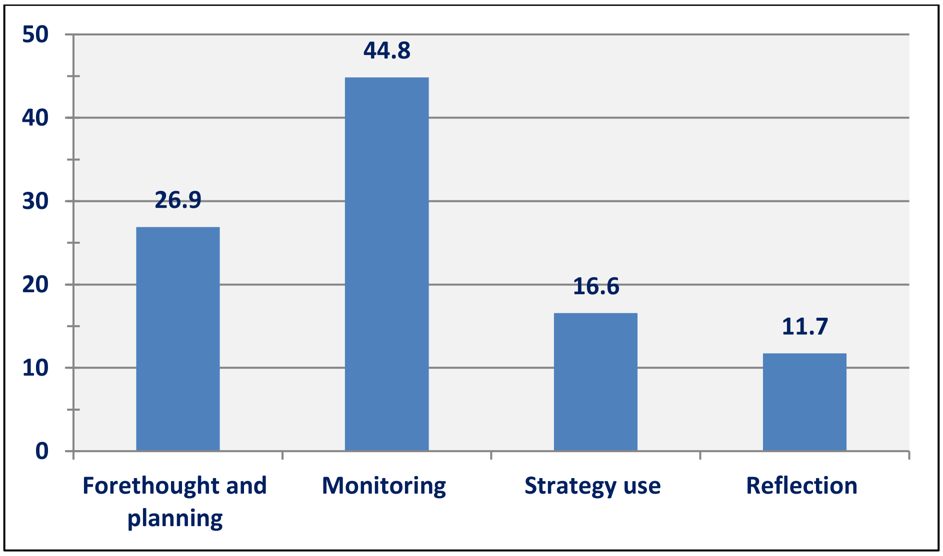


Figure 1: Learning presence categories of teachers' discussion posts (group 29)

5.3 Teachers' perceptions of collaboration within groups

Figure 2 shows a graphic representation of teachers' perceptions about the collaborative aspects of the TPD-MOOC as well as their activities towards responding to the course assignments. The vast majority, i.e. 9 out of 10 participants attending this MOOC, were satisfied of their contribution to the group assignments and thought that collaborative text creation was effective in their own group. In addition, they perceived this particular MOOC as a community of teachers with common interests, they were supported by other peers through the course discussion forums and they rated as an important outcome their ability to work with other people that were unknown to them, before their participation in this MOOC. On the other hand, 12% of the participant teachers reported difficulties in the collaborative assignments of this MOOC.

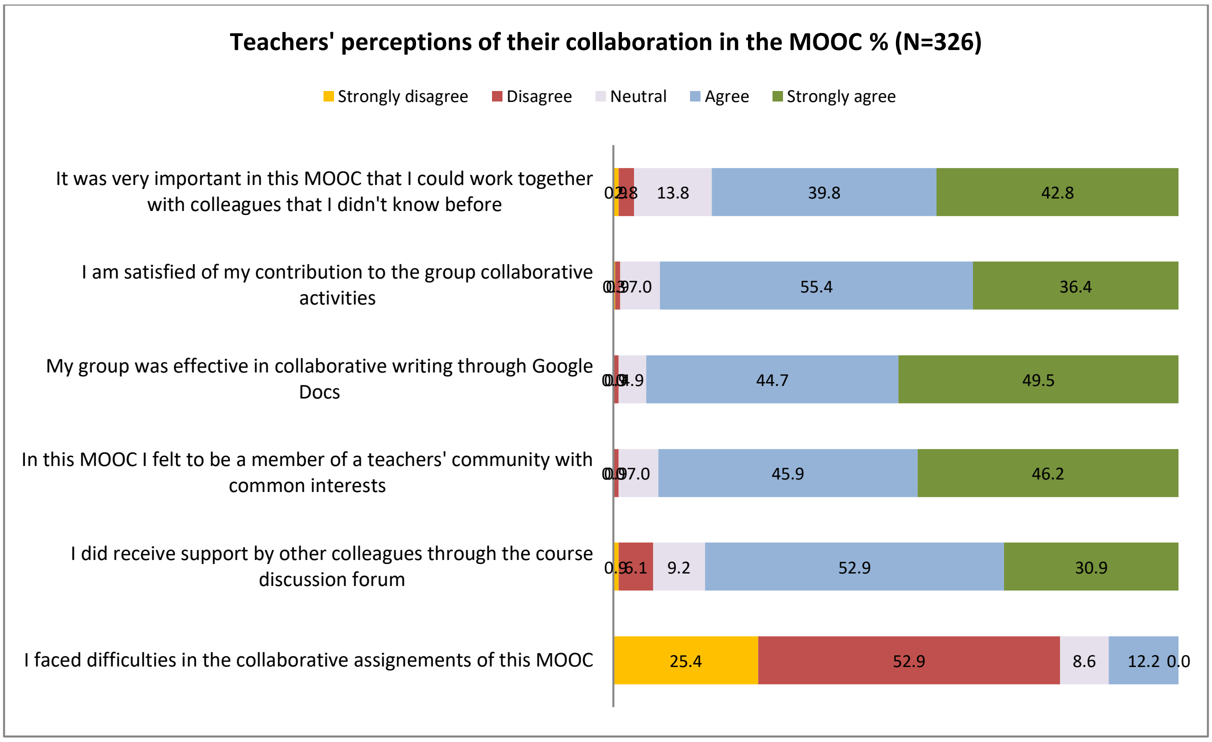


Figure 2: Teachers' perceptions about MOOC design factors

6. Conclusions

The main goal of this study was to provide a hybrid design framework of MOOCs for teacher professional development, organised along three dimensions of learning activities, i.e. individual engagement, peer interaction and support, and collaborative creation of educational artefacts. The proposed framework was applied in a TPD-MOOC supporting Greek language teachers to develop and enhance their technological and pedagogical abilities to use Google Docs in their instruction as a collaborative writing tool.

In addition, this study provided a new form of analysing teachers' collaborative actions in MOOCs by using the categories of the learning presence construct. Our results confirm existing findings in the literature concerning the creation of an authentic framework for teacher professional development (Cochrane et al., 2015; Karlsson et al., 2014; Koukis & Jimoyiannis, 2017; Koutsodimou & Jimoyiannis 2015; Laurillard, 2016). Confirming research findings by Littlejohn et al. (2016), both quantitative and qualitative analysis showed the potential of MOOCs as an effective environment offering enhanced opportunities for teacher professional development through active engagement, self-regulation, collaboration, knowledge sharing and co-creation. It appears that the features of the TPD-MOOC design framework promoted teachers' motivation and retention, since this MOOC achieved a high completion rate compared to the existing literature (Vivian, Falkner & Falkner, 2014). The participants were positive about the collaborative features of this MOOC and stressed their perceptions of belonging in a teacher community of learning.

In conclusion, the findings indicate that hybrid TPD-MOOCs are, in many senses, self-organised, and dynamically evolving systems. Therefore, a more critical understanding of their complexity, with regards to teacher connections and knowledge flow, is very important for both, research and implementation in practice. Our future research will be directed to combining Social Network Analysis with qualitative content analysis representing teachers' learning presence to shed light into the information flow in MOOCs, participants' connections and group structure, as well as the power and the influence each teacher can have within the community of a TPD-MOOC.

References

Bonk, CJ, Lee, MM, Kou, X, Xu, S & Sheu, FR 2015, 'Understanding the self-directed online learning preferences, goals, achievements, and challenges of MIT OpenCourseWare subscribers', *Educational Technology & Society*, vol. 18, no. 2, pp. 349-368.

Castaño-Muñoz, J, Kalz, M, Kreijns, K & Punie, Y 2018, 'Who is taking MOOCs for teachers' professional development on the use of ICT? A cross sectional study from Spain', *Technology, Pedagogy and Education*, vol.27, no. 5, pp. 607-624.

Chiu, T & Hew, T 2018, 'Factors influencing peer learning and performance in MOOC asynchronous online discussion forum', *Australasian Journal of Educational Technology*, vol. 34, no. 4, pp. 16-28, https://doi.org/10.14742/ajet.3240.

Cochrane, T, Narayan, V, Burcio-Martin, V, Lees, A, & Diesfeld, K 2015, 'Designing an authentic professional development cMOOC', In T. Reiners, B.R. von Konsky, D. Gibson, V. Chang, L. Irving, & K. Clarke (Eds.), *Proceedings of Ascilite 2015: Globally connected, digitally enabled* (pp. FP:41-FP:52). Perth: Ascilite.

Conole G 2015, 'Designing effective MOOCs', *Educational Media International*, vol.52, no. 4, pp. 239-252.

Crosslin, M & Dellinger, J 2015, 'Lessons learned while designing and implementing a multiple pathways xMOOC + cMOOC', In D. Rutledge & D. Slykhuis (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2015* (pp. 250-255). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE).

Eriksson, T, Adawi, T, & Stohr, C 2017, 'Time is the bottleneck: a qualitative study exploring why learners drop out of MOOCs', *Journal of Computing in Higher Education*, vol. 29, no. 1, pp.133-146.

Gašević, D, Kovanović, V, Joksimović, S, & Siemens, G 2014, 'Where is research on massive open online courses headed? A data analysis of the MOOC Research Initiative', *The International Review of Research in Open and Distance Learning*, vol. 15, no.5, pp. 134-176.

Herrington, J & Kervin, L 2007, 'Authentic learning supported by technology: Ten suggestions and cases of integration in classrooms', Educational Media International, vol.44, no.3, pp. 219-236.

Hew, K.F 2016, 'Promoting engagement in online courses: What strategies can we learn from three highly rated MOOCS', *British Journal of Educational Technology*, vol.47, no.2, pp. 320-341.

Karlsson, N, Godhe, A, Bradley, L & Lindström, B 2014, 'Professional Development of Teachers in a MOOC, in *Proceedings of the 22nd International Conference on Computers in Education*, pp. 868-877, Asia-Pacific Society for Computers in Education, Japan.

Koukis, N & Jimoyiannis, A 2017, 'Designing MOOCs for teacher professional development: analysis of participants' engagement', in *Proceedings of the 16th European Conference on eLearning, ECEL 2017, ACPI, Porto*, pp. 271-280.

Koukis, N & Jimoyiannis, A 2019, 'MOOCS for teacher professional development: exploring teachers' perceptions and achievements', *Interactive Technology and Smart Education*, vol.16, no.1, pp. 74-91.

Koutsodimou, K, & Jimoyiannis, A 2015, 'MOOCs for teacher professional development: investigating views and perceptions of the participants', in *Proceedings of the 8th International Conference of Education, Research and Innovation – ICERI 2015*, pp. 6968-6977, Seville, Spain: IATED.

Laurillard, D 2016, 'The educational problem that MOOCs could solve: professional development for teachers of disadvantaged students' *Research in Learning Technology*, vol. 24, art. 29369, DOI: 10.3402/rlt.v24.29369.

Li, S, Tang, Q & Zhang, Y 2016, 'A case study on learning difficulties and corresponding supports for learning in cMOOCs', *Canadian Journal of Learning and Technology*, vol.42, no.2, pp. 44-67.

Littlejohn, A, Hood, N, Milligan, C, & Mustain, P 2016, 'Learning in MOOCs: Motivations and self-regulated learning in MOOCs', *Internet and Higher Education*, vol. 29, pp. 40-48.

López-Meneses, E, Vázquez-Cano, E, & Román, P 2015, 'Analysis and implications of the impact of MOOC movement in the scientific community: JCR and Scopus (2010-13)', *Comunicar*, vol. 22, no. 44, pp. 73-80.

McLoughlin, C, & Lee, MJW 2010, 'Personalised and self-regulated learning in the Web 2.0 era: International exemplars of innovative pedagogy using social software' *Australasian Journal of Educational Technology*, vol. 26, no. 1, pp. 28-43.

Milligan, C, & Littlejohn, A 2017, 'Why study on a MOOC? The motives of students and professionals', *International Review of Research in Open and Distributed Learning*, vol. 18, no. 2, pp. 91-102.

Ostashewski, N, Howell, J & Dron, J 2016, '*Crowdsourcing MOOC interactions: Using a social media site cMOOC to engage students in university course activities',* Retrieved 12 June 2019, from http://oasis.col.org/bitstream/handle/11599/2528/PDF?sequence=4&isAllowed=y

Perez-Sanagustin, M, Hilliger, I, Alario-Hoyos, C, Delgado Kloos, C, & Rayyan, S 2017, 'H-MOOC framework: reusing MOOCs for hybrid education', *Journal of Computing in Higher Education*, vol. 29, no. 1, pp. 47-64.

Salmon, G 2003, *E-Moderating: The key to teaching and learning online*, London, Routledge.

Shea, P & Bidjerano, T 2010, 'Learning presence: Towards a theory of self-efficacy, self- regulation, and the development of a communities of inquiry in online and blended learning environments', *Computers & Education*, vol.55, pp. 1721–1731.

Shea, P & Bidjerano, T 2012, 'Learning presence as a moderator in the community of inquiry model', *Computers & Education*, vol.59, pp. 316–326.

Shea, P, Hayes, S, Uzuner-Smith, S, Vickers, J, Bidjerano, T, Gozza-Cohen, M, Jian, S-B, Pickett, AM, Wilde, J & Tseng, C-H 2013, 'Online learner self-regulation: Learning presence viewed through quantitative content and social network analysis', *International Review of Research in Open and Distance Learning*, vol.14, no.3, pp. 427-461.

Siemens, G 2013, 'Massive Open Online Courses: Innovation in education?' in R. McGreal, W. Kinuthia & S. Marshall (Eds.), *Open Educational Resources: Innovation, Research and Practice,* pp. 5-15, Commonwealth of Learning and Athabasca University, Vancouver.

Stich, A, & Reeves, T 2017, 'Massive open online courses and underserved students in the United States', *Internet and Higher Education* vol. 32, pp. 58–71.

Storch, N 2011, 'Collaborative writing in L2 contexts: Processes, outcomes, and future directions', *Annual Review of Applied Linguistics*, vol.31, pp. 275-288.

Tseng, SF, Tsao, YW, Yu, LC, Chan, CL, & Lai, KR 2016, 'Who will pass? Analyzing learner behaviors in MOOCs', *Research and Practice in Technology Enhanced Learning*, vol. 11, art. 8, DOI 10.1186/s41039-016-0033-5.

Tsiotakis, P, & Jimoyiannis, A 2016, 'Critical factors towards analysing teachers' presence in on-line learning communities', *The Internet and Higher Education*, no. 28, pp. 45-58.

Veletsianos, G, & Shepherdson, P 2016, 'A systematic analysis and synthesis of the empirical MOOC literature published in 2013–2015', *International Review of Research in Open and Distributed Learning*, vol. 17, no. 2, pp. 198-221.

Vivian, R, Falkner, K, & Falkner, N 2014, 'Addressing the challenges of a new digital technologies curriculum: MOOCs as a scalable solution for teacher professional development', *Research in Learning Technology*, vol. 22, art. 24691, DOI: 10.3402/ rlt.v22.24691

Wang, Q, Chen, B, Fan, Y & Zhang, G 2018, '*MOOCs as an Alternative for Teacher Professional Development: Examining Learner Persistence in One Chinese MOOC'*, Peking University, Beijing.

Wang, Z, Anderson, T & Chen, L 2018, 'How learners participate in connectivist learning: An analysis of the interaction traces from a cMOOC, *International Review of Research in Open and Distributed Learning*, vol.19, no.1, pp. 44-67.

Zimmerman, B 2008, 'Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects', *American Educational Research Journal*, vol.45, no.1, pp. 166-183.

Students Behavioural Patterns on the National Open Education Platform

Viola Larionova[1], Andrey Sheka[2] and Stanislaus Vasilyev[3]
[1]Ural Federal University, Ekaterinburg, Russia
[2]Krasovskii Institute of Mathematics and Mechanics, Ural Branch of the Russian Academy of Science, Ekaterinburg, Russia
[3]Yandex LLC, Moscow, Russia
viola-larionova@yandex.ru
andrey.sheka@gmail.com
snv1111111@gmail.com
DOI: 10.34190/EEL.19.126

Abstract: Over the past decade, online learning technologies have become widespread in the non-formal education, higher education and additional vocational training sectors. The best Russian and foreign universities produce digital content and create online courses that are used not only by students of these universities, but also by other educational organizations for the implementation of their educational programs. Digital platforms that host online courses allow monitoring and logging of every step of learners and their achievements, while mastering a course and passing current tests and final exams. This creates the prerequisites for developing adaptive learning systems that adapt to each learner, determine their level of knowledge, track behavioral patterns, learning styles, and automatically organize content that enables achieving the best learning outcome. The study is aimed at analyzing the behavioural patterns of students while mastering massive open online courses. For this purpose, six online courses created by two universities were studied: Ural Federal University and National University of Science and Technology (MISiS). All the courses are hosted on the National Open Education Platform (Russia), which is based on edX open-source platform. To analyze the behaviour patterns, logs of students' activity on the platform were examined. Using the IP addresses the data was normalized by time zones. Different types of student interaction were explored with the content throughout the courses and the peculiarities of student's work with different components of the courses were described. During the study some typical temporal patterns of students' behaviour were revealed and analyzed in conjunction with their success rate. The findings of the research may be useful to the authors of the courses for improving the content, as well as to the tutors for supporting learners during training or education programmes.

Keywords: e-learning, massive open on-line courses, national platform, open education, big data, behavioural patterns, open edX

1. Introduction

The development of the information society and change of the technological structure created new challenges for national educational systems related to digitalization of educational content (Tække et al, 2017), the widespread introduction of online technologies (The 2018 OpenupEd Trend Report on MOOCs, 2018), the introduction of new adaptive approaches (Holon IQ, Report "Education in 2030", 2018) to the organization of educational process and support for students (Ho, 2017). Over the past decade online learning technologies have become widespread not only in the non-formal education sector, but also in the field of higher and secondary professional education. At the same time, in the context of the rapid growth of online courses in the world, there remains a requirement for the active visible acquisition of knowledge. This is due both to the imperfection of the online courses themselves and to the low motivation of students, who mostly belong to the so-called "generation Z" and have a number of specific abilities to mastering information - technological dependence, impatience, desire for engagement, the habit of getting information by web surfing and a number of others (Gen Z in the Workplace, 2018). How are representatives of this generation studying? What are their behavioral features in mastering new information? How can these issues be considered when creating online courses? Answers to these questions will allow to form new approaches to the pedagogical design of courses and improve the efficiency of online learning.

Today in higher education, students and teachers produce a huge amount of data related to the educational process, including information on entrance examinations, data on the students' progress, their social activities, and scientific achievements. Increasingly, teachers and administrators use these data to improve the academic performance of students in individual disciplines (modules) and in educational programs (Esichaikul et al, 2011). New educational technologies expand opportunities to support students' learning activities, individualize learning paths, provide early warning of failures and targeted actions to keep their attention throughout the learning period (Dorça et al, 2012; Guo, 2014). Digital systems allow logging of every student step in mastering the course and their achievements during the passage of control measures, as well as analysis of feedback from students' interaction with the system at the current time (Martins et al, 2008). This creates the prerequisites for the development of adaptive learning systems that adapt to each learner, determine levels of knowledge, track behavioral patterns, learning styles and automatically organize content to achieve the best learning outcome (Gein, 2006).

Currently, universities around the world are actively implementing online learning. To date, almost 100 million students have been trained in 11 400 online courses created by teachers from more than 900 universities in the world (Shah, 2019). Universities produce digital content and create online courses that are used not only by students of these universities, but also by other educational organizations for the implementation of educational programs. In addition, the massive open online courses, providing unlimited free access to the content of the best professors of famous universities, are highly popular among the general population in non-formal life settings. In this regard, large amounts of data have been collected on open education platforms, which allow analysis of the features of the learning processes for various groups of students based on a statistical approach and obtain objective and reliable information about the efficacy of online learning (Kadoić et al, 2018; Maretić et al, 2017; O'Farrell, 2017; Larionova et al, 2018).

2. Research methodology

The study is aimed at analyzing the behavioural patterns of students while mastering massive open online courses. For this purpose, six popular online courses created by two universities were studied: Ural Federal University (UrFU) and National University of Science and Technology (MISiS). The courses studied are "Russian business language culture", "Self-management", "Mechanical Engineering", "Life safety", "Personal Efficiency: Time Management", "Strength of materials". The sample is based on data from the 2017 fall semester.

The edX open-source platform tracking logs were used for the analysis, which contain information about any learner actions on the platform and the time-stamp of these actions. In order to exclude outliers, we analyzed the records of students who completed at least 4 course tasks. The study analyzed the records related to the interaction of students with textual and video content, as well as data related to the passage of control tests. The main tool for data analysis and visualization was the Anaconda 5.2 software package.

3. The results of the behavioral activity analysis of online courses students

General information about the online courses used to analyze students' behavioral patterns is given in Table 1. The total enrollment on the courses was 31,382, of whom 7,290 people successfully completed the training, which corresponds to 23% of the total number of students. The volume of data processed in the course of the study in the form of logs of students' activities on online courses exceeded 18 million records, which indicates statistically significant results of the analysis.

Table 1: General information about online courses

Course code on the platform	The name of the online course	University	Number of log entries	Number of users	Number passed course	Course completion rate
SAFETY	Life safety	MISiS	9441229	7077	1794	0,25
TMNG	Personal Efficiency: Time Management	MISiS	2409333	11799	1336	0,11
MATSTR	Strength of materials	MISiS	1292955	1492	394	0,26
RUBSCULT	Russian business language culture	UrFU	2426497	5372	2186	0,41
SMNGM	Self-management	UrFU	1035464	3816	716	0,19
ENGM	Mechanical Engineering	UrFU	2100838	1826	864	0,47

Because the logs of courses on the platform do not contain information about the user's time zone, and the time of user activities is indicated by the internal server time, ip-addresses were analyzed to obtain information about the local time of user actions. It is worth noting that a small number of users used proxy servers, for example, some users came from ip-addresses belonging to seventeen different time zones, which made it difficult to determine the local time taken by the listener of the action. However, the vast majority of users used ip-addresses only from one time zone.

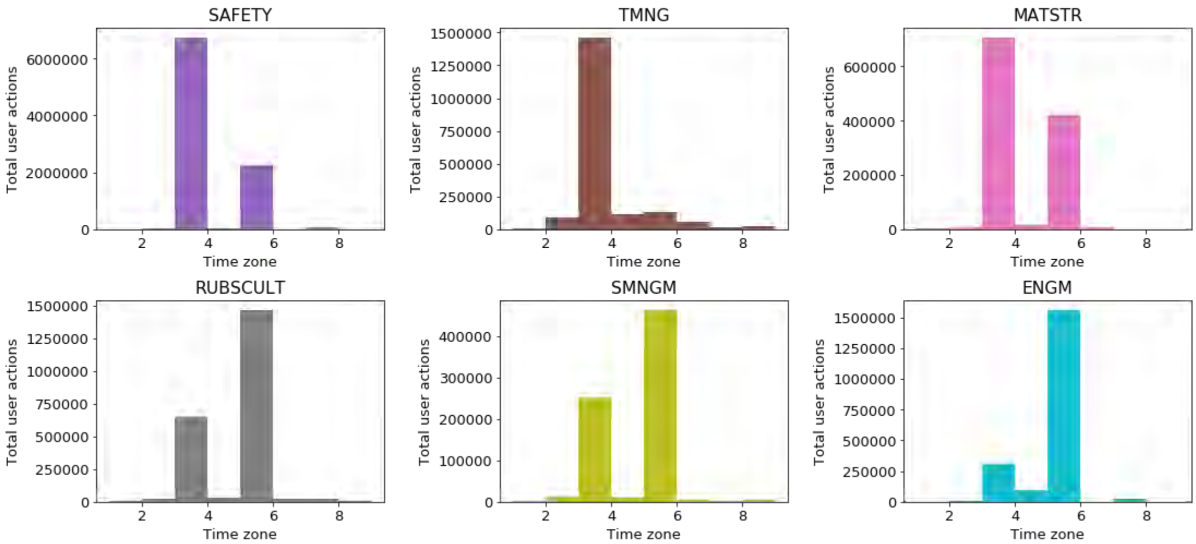


Figure 1: The distribution of online course user activity by time zone

Since the online courses selected for the study were mandatory for students of UrFU and MISiS, the majority of students were concentrated in two time zones: GMT +3 (Moscow, St. Petersburg) and GMT +5 (Yekaterinburg). As can be seen from Figure 1, for the MISiS courses, the largest number of activities were performed by users from the Moscow time zone, and for UrFU courses, the majority of users were from the Yekaterinburg time zone.

Figure 2 shows the distribution of the activity of users of online courses by time of day, taking into account the correction for the time zone in which the student was at the time of activity. The analysis showed that the most convenient time for students to work with the materials of online courses is the second half of the day. For all the courses under consideration, there is a large pronounced peak of activity in the area of 20-22 hours of local time. On some courses it is possible to notice the small and wider peak at about 15 hours. At the same time, the minimum activity occurs for five o'clock in the morning local time. Further, in order to visualize the listeners' activity, by weeks and days of the week, we will shift the beginning of the day to 5 am local time.

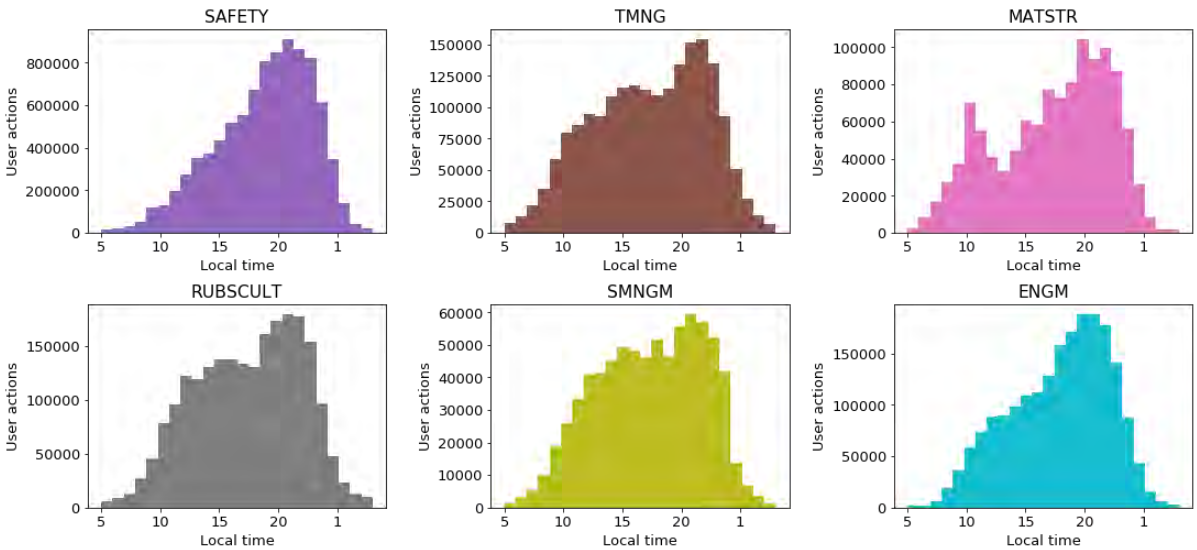


Figure 2: The distribution of user activities online courses by time of day

The graph of user activity by day of the week (see Figure 3) shows that the open education platform is used most actively on weekends. In the middle of the week, the activity of students is minimal, although the behavior patterns of users from different courses differ markedly. For example, for the course "Life safety" most of the activity takes place on the weekend. While on the course "Personal Efficiency: Time Management", students learn evenly throughout the week, which may be due to the specifics of this course, aimed at developing the skill of self-organization. However, the weekend activity even on this course is still above average.

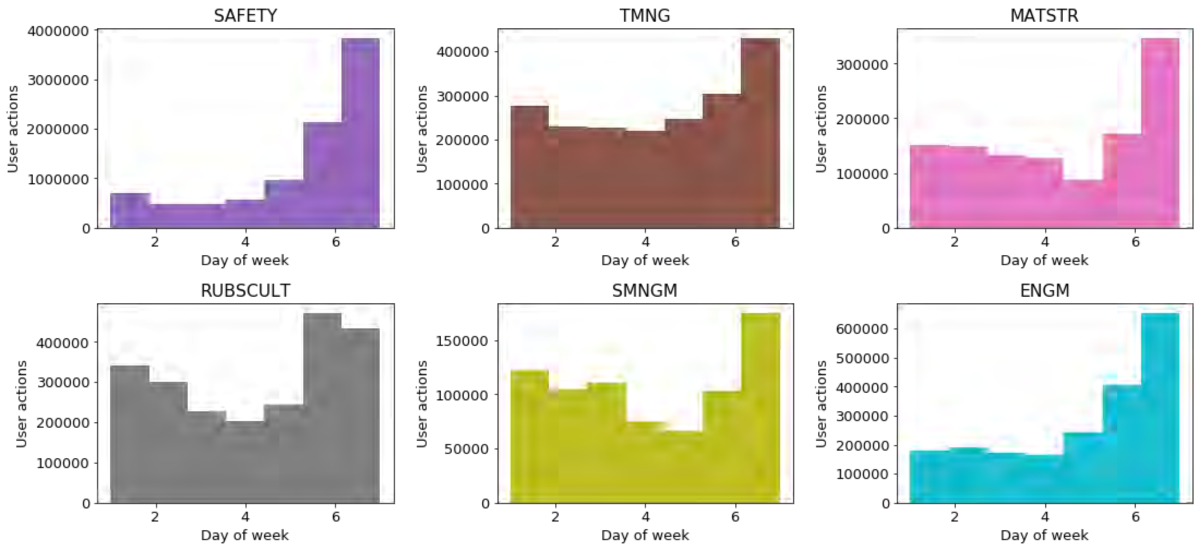


Figure 3: The distribution of user activities online courses by day

The heat map of the distribution of listeners' activity by days of the week and time of day (see Fig. 4) shows that the majority of events for all courses occur on Sunday evening and Saturday evening. Also, all courses show increased activity in the evenings on weekdays and a small surge of activity in the afternoon at the beginning of the week, which gradually decreases from Monday to Thursday.

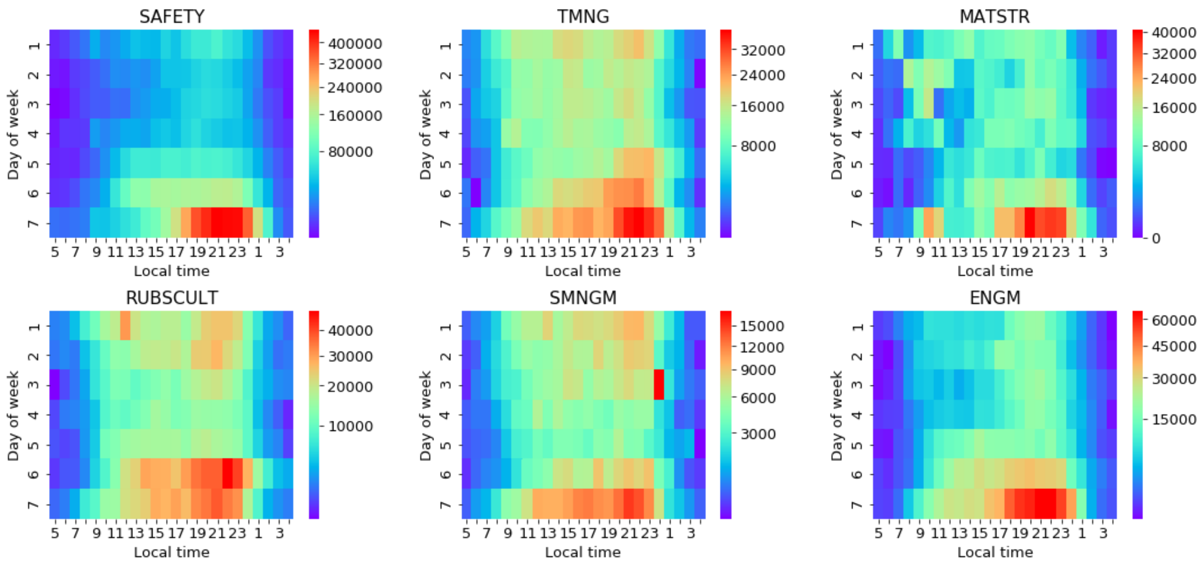


Figure 4: The distribution of listeners' activity by day of the week and time of day

During the semester (the fall semester lasts from week 37 to week 52), user activity is very uneven and no general pattern has been found (see Fig. 5). Apparently, this is due to the current and final control schedules, which may differ significantly in different courses. For each course, activity peaks are observed at the time of preparation and passing tests. As can be seen from the figure, a very large number of students tried to pass the “Self-management” course on Wednesday at week 41, and the course “Strength of materials” had increased attention at week 45, and this week there is a peak of activity at around 10 am.

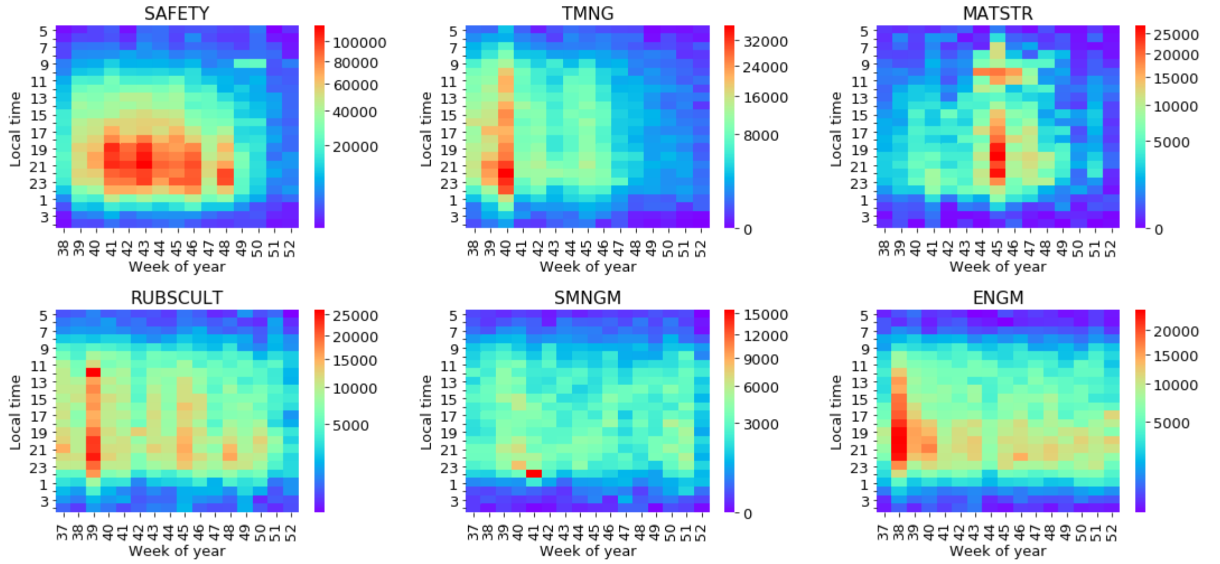


Figure 5: The distribution of student activity per week in the semester and time of day.

If we consider the average start time of the beginning of the user's activity in the system, then for all courses, except for the course “Strength of materials”, an interesting pattern is visible: the earlier the listener begins to engage in the day, the worse his average performance in the course. This can be explained by the fact that students who study harder, spend more time preparing and work in later hours. The course "Strength of Materials" has its own feature, which can be seen on the heatmap in Figure 5. Users enter this course during the day on certain days of the week, which is most likely due to the passing of tests during full-time classes or seminars on the course. In this case, it is logical to assume that students, who do not skip classes, pass the course more successfully than others.

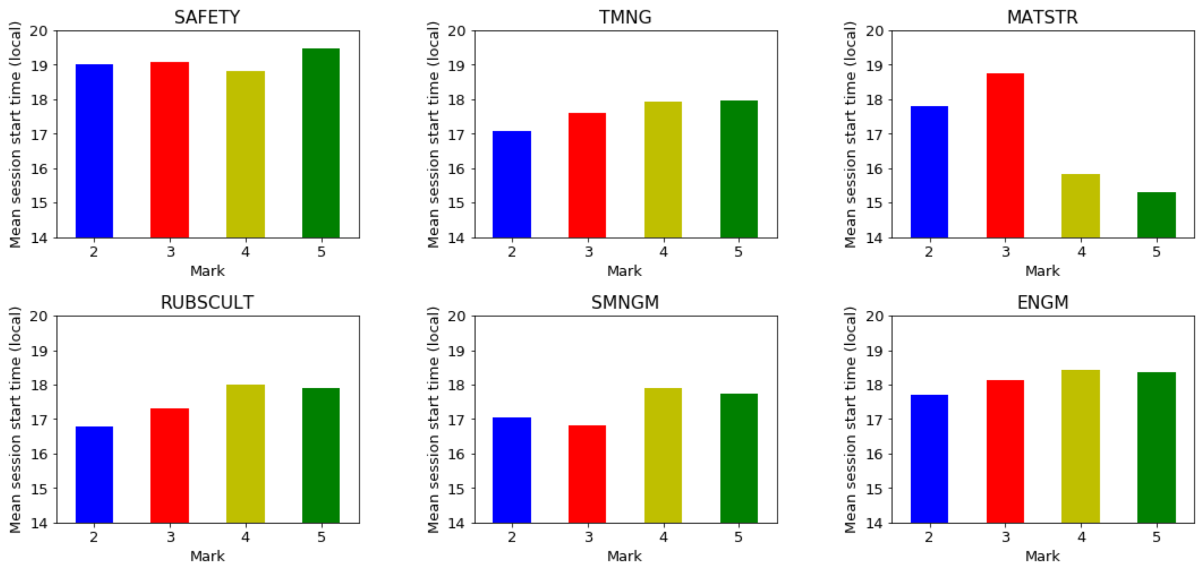


Figure 6: The dependence of student performance on the average time to start working in the course

In our opinion, statistics on the number of system user actions and the dependence of the students’ progress on their activity are interesting. As can be seen from figure 7, for engineering courses (right column) the dependence of the assessment on the number of actions is clearly visible: the more a student does, the higher his grade. In humanities courses such dependence is not expressed. In addition, for the courses “Culture of Russian Business Speech” and “Self-Management”, there is an extremely low activity of the entire group of users, which is typical both for excellent students and for underachieving students.

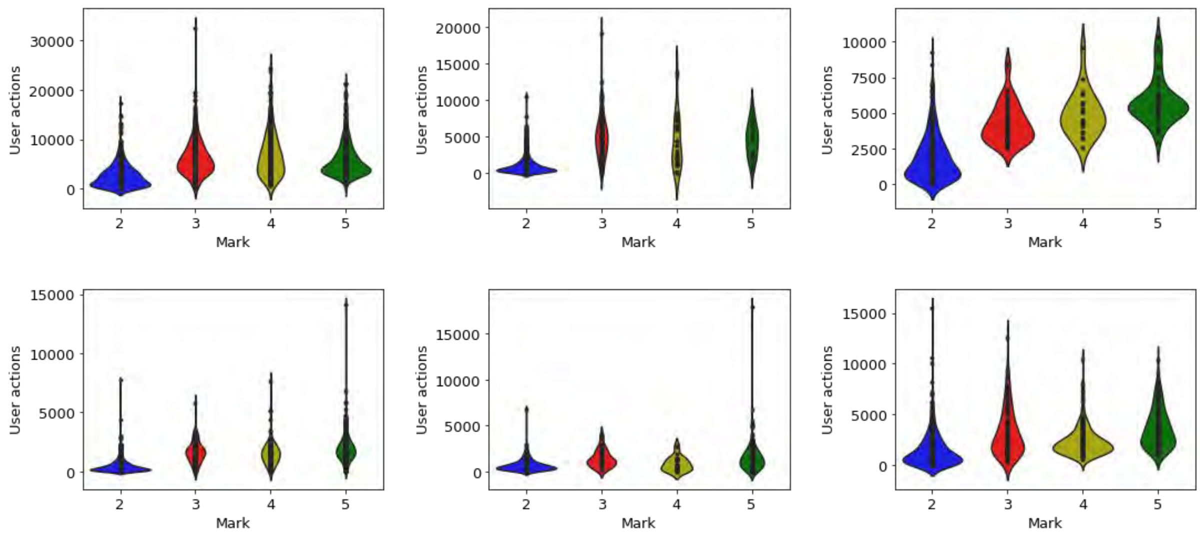


Figure 7: The dependence of student performance on the total number of user actions in the system

Figure 8 shows the share of video views in the online course of the total number of events, and the effect of this parameter on the students' progress on the course. So for the courses "Mechanical Engineering" and "Life Safety" the success of students on the course is directly related to watching video lectures: the more often a student watches video lectures, the more likely he is to receive a positive assessment of the course. And it is quite logical because the teacher usually explains the most important topics and complex questions during the video lectures.

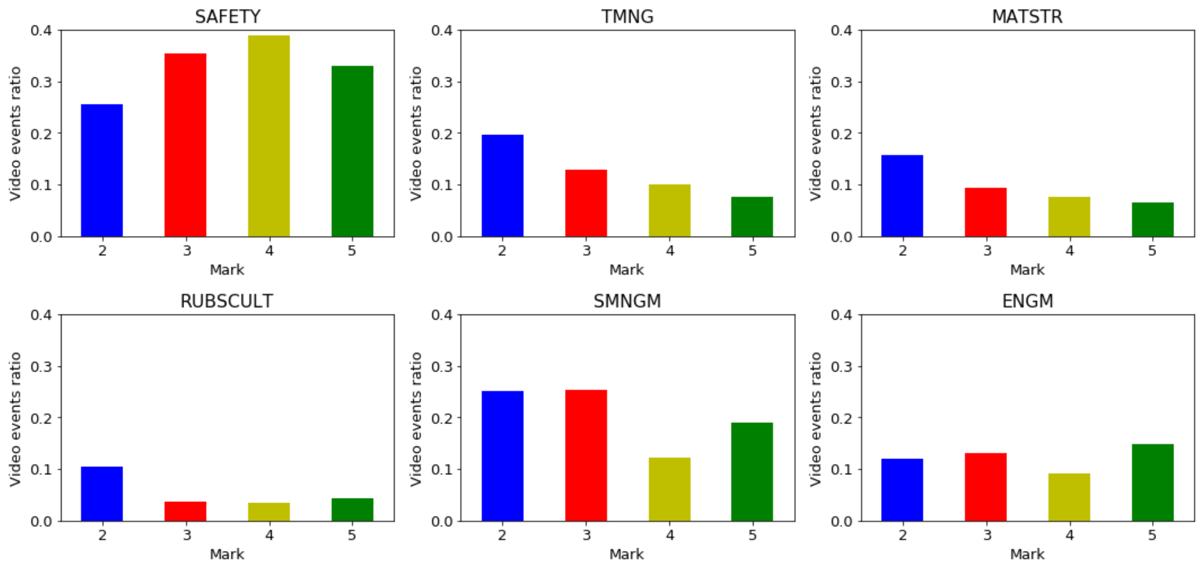


Figure 8: The share of events related to viewing the video of the total number of events

However, for the MISiS courses "Personal Efficiency: Time Management" and "Strength of materials", as well as for the UrFU courses "Russian business language culture" and "Self-management" the reverse pattern is visible: the more students pay attention to watching videos, the lower their grades. It makes the authors think about the usefulness / uselessness of video materials presented in the course. It can be assumed that students use alternative sources of information to prepare and pass the final test.

4. Conclusion

The analysis of user behavior in the study of courses on the National Open Education Platform allowed the following patterns to be established:

- The educational activities of students in massive open online courses are highly uneven both in time of day and in days of the week;
- The most comfortable time for students to study is evening time on weekends;

- During the training period, there are bursts of student activity associated with the time of the current and final testing.
- Activities associated with watching video lectures have little effect on student performance;
- For engineering courses, students' academic progress is determined by their activity in working with an online course, whereas for humanitarian courses such dependence is not observed.

The results can be used to develop an adaptive learning system and automated support tools for students in online courses, as well as to improve the methods of online learning and pedagogical design of online courses.

Acknowledgements

The work was supported by Act 211 Government of the Russian Federation, contract № 02.A03.21.0006.

References

Divjak, B. and Maretić, M. (2017) *Learning Analytics for Peerassessment: (Dis) advantages, Reliability and Implementation Learning Analytics for Assessment* : State of the Art, Journal of Information and Organizational Sciences, Vol 41, No. 1, pp 21–34.

Dorça, F.A., Lima, L.V., Fernandes, M.A., Lopes, C.R. (2012) *A stochastic approach for automatic and dynamic modeling of students learning styles in adaptive educational systems*, Informatics in Education, Vol 11, No. 2, pp 191–212.

Esichaikul, V., Lamnoi, S., Bechter, C. (2011) *Student modelling in adaptive e-learning systems*. Knowledge Management & E-Learning: An International Journal (KM&EL), Vol 3, No. 3, pp 342–355.

Gen Z in the Workplace (2018) 2018 Report by Ripplematch, 11 p. Retrieved from: https://ripplematch.com/generation-z-workplace-report.pdf Дата обращения 23.10.20182 (accessed 2 June 2018).

Gein, A., Istomin, D., Sheka, A (2016) Smart technologies in psycho-oriented strategies of adaptive education, Smart Education and e-Learning 2016 (Smart Innovations. Systems and Technologies), Vol 59, pp 397-404. (Smart Innovation, Systems and Technologies). Retrieved from: DOI: 10.1007/978-3-319-39690-3_35.

Guo, P.J., Kim, J., Rubin. R. (2014) *How Video Production Affects Student Engagement: An Empirical Study of MOOC Videos*, Proceedings of the First ACM Conference on Learning and Scale (Atlanta, GA, 4–5 March 2014), New York: ACM, pp 41–50.

Ho, A. (2017) *Advancing Educational Research and Student Privacy in the"Big Data" Era*, Washington, DC: National Academy of Education. Retrieved from: https://naeducation.org/wp-content/uploads/2017/05/Ho-FINAL.pdf (accessed 2 June 2018).

Holon IQ, *Report "Education in 2030"* (2018) Electronic Resource. Retrieved from: https://www.holoniq.com/2030 (accessed 2 June 2018).

Kadoić, N., Oresk, D. (2018) *Analysis of Student Behavior and Success Based on Logs in Moodle*, Conference: 41st International Convention on Information and Communication Technology, Electronics and Microelectronics MIPRO 2018 at: Opatija, Croatia, pp 730-735. DOI: 10.23919/MIPRO.2018.8400123.

Larionova, V., Brown K., Bystrova T., Sinitsyn E. (2018) *Russian Perspectives of Online Learning Technologies in Higher Education: An Empirical Study of a MOOC*, Research in Comparative and International Education, Vol. 13, No. 1, pp 70–91.

Martins, A.C., Faria, L., De Carvalho, C.V., Carrapatoso, E. (2008) *User modeling in adaptive hypermedia educational systems*, Educational Technology & Society, Vol 11, No. 1, pp 194–207.

O'Farrell L. (2017) *Using Learning Analytics to Support the Enhancement of Teaching and Learning in Higher Education*. Paper presented at National Forum for the Enhancement of Teaching and Learning in Higher Education. Retrieved from: https://www.teachingandlearning.ie/wp-content/uploads/2018/01/Final_LA-Briefing-Paper_Web-with-doi.pdf (accessed 2 June 2018).

Shah, D. (2019) *Year of MOOC-based Degrees: A Review of MOOC Stats and Trends in 2018*, Electronic Resource. Retrieved from: https://www.classcentral.com/report/moocs-stats-and-trends-2018 (accessed 2 June 2018).

Tække J.& Paulsen, M. (2017) *Digitalisation of education — the theory of the three waves*, Fællestrykkeri for Sundhedsvidenskab og Humaniora, Aarhus University, 30 p. Retrieved from: https://www.academia.edu/33425898/Digitalisation_of_education_the_theory_of_the_three_waves (accessed 2 June 2018).

The 2018 OpenupEd Trend Report on MOOCs (2018) D. Jansen; L. Konin`gs (Eds.). Maastricht, NL: EADTU. https://www.openuped.eu/images/Publications/The_2018_OpenupEd_trend_report_on_MOOCs.pdf (accessed 2 June 2018).

A Critique of Blended Learning: Examples From an Undergraduate Psychology Program

Maria Limniou and Caroline Hands
School of Psychology, University of Liverpool, UK
Maria.Limniou@liverpool.ac.uk
cahands@liverpool.ac.uk
DOI: 10.34190/EEL.19.136

Abstract: The adoption of technology to a University curriculum is challenging and requires a complex blend with pedagogical components. The aim of this study is to examine how digital learning tools could enhance first year modules supporting blended learning approaches. Two psychology modules are used as examples to discuss two different blended approaches and study student engagement with learning process by exploring their performance on online activities under the perspective of module design, students' engagement with formative and summative assessments, and digital literacy. The digital learning tools that supported the two blended learning approaches were wikis, blogs, online tests. This investigation was conducted for two subsequent years in a UK Psychology School in which a large number of students were enrolled. The total number of students who participated in this investigation for the 2016-2017 academic year was 407 and for the 2017-2018 academic year was 405. In the first example, an academic performance comparison was conducted between the students who have been engaged with online formative activities and those students who have attended the face-to-face classes only in a transferable skills module. In the second example, a compulsory online continuous assessment process was followed to support a first-year psychology module aiming to enhance student learning on biology topics. This article discusses how students might engage with online formative and summative activities in association with their performance and how different assessment types alongside with the use of different digital learning tools might enhance blended learning environments. Findings of this study suggest that teachers should connect formative with summative assessments in order to increase student performance and they should consider blended learning approaches under the perspective of pedagogical principles and continuous assessment in order to increase student engagement with their learning process.

Keywords: blended learning, formative assessment, module design, student engagement, summative assessment, academic performance

1. Introduction

In a Higher Education learning environment, contact hours between teachers and students support face-to-face teaching modes with learning resources available to students through University Library and/or the School repository. Technology-Enhanced Learning (TEL) is defined as "the effective use of digital technologies to support learning and teaching" in order to provide students with an opportunity to "enjoy a more flexible learning experience" (Joint Information Systems Committee, 2014). The increasing availability of both hardware and software allows students and teachers to support a flexible learning approach (Gordon, 2014) increasing the teaching design opportunities for blended learning (Lai, Lam and Lim, 2016). Based on Boelens et al (2015), blended learning is an instructional approach that combines online and face-to-face instructional activities. Essential components of the blended learning approach are either any portion of student learning experience could deliver with online media or any teaching effort which aims to find students' individual needs so that instruction can be personalized. The Christensen Institute (https://www.christenseninstitute.org/blended-learning-definitions-and-models/) has described four models which support the 'blended learning' concept. The main characteristic of all these four models is that learning can be flexible in terms of time, place, learning path and pace. However, there is no specific framework for teachers to follow in order to implement their blended learning approaches (Boelens, De Wever & Voet, 2017). As a result, there is a difference between the way blended learning has been adopted by teachers in a local, national, and international context (Kirkwood & Price, 2014; Liu & Chen, 2018; Mykhnenko, 2016). Jones and Bennett (2016) offers a definition of module design following blended learning paradigm, "the creation of context-sensitive learning habitats that cater to the differing needs of blended and online -only students, within a single pedagogical ecosystem" (p.1). Therefore, because of the lack of a standard framework, University programs integrate technology into their curriculum in different ways based on their own needs, resources, and staff beliefs (Galvis, 2018).

When teachers design their own modules, they tend to follow the model that the School curriculum has designed (Butcher, Davies & Highton, 2006). Biggs (1996a) introduced the outcomes-based approach (constructive alignment), as a course/module design process based on which learning outcomes are the indicators for the teaching approaches and assessment methods used. Through Biggs's (1996b) Presage-Process-Product (3P) model of teaching (Figure 1), a dynamic system is formed between student factors, teaching context, on-task approaches to learning, learning outcomes, which mutually interact (Biggs & Tang, 2007).

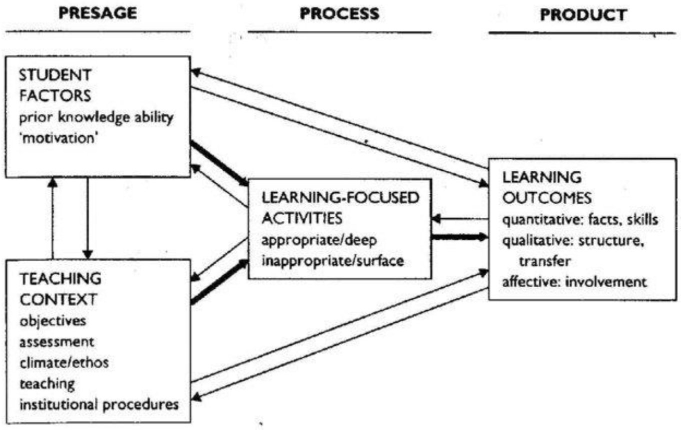


Figure 1: The Presage-Process-Product (3P) model of teaching and learning (Biggs 1996b, p.62)

Additionally, the module design process is influenced by national and/or international bodies/organizations which provide general guidelines based on the national education system and/or universal trends. For example, the UK psychology undergraduate programs are following the requirements of the QAA Benchmark Statement for Psychology (https://www.qaa.ac.uk/quality-code/subject-benchmark-statements) in order to satisfy the requirements for British Psychological Society (BPS) (appropriate professional body which confers Graduate Basis for Chartership- http://www.bps.org.uk/). The QAA subject benchmark statement for Psychology identifies the key skills that students need to develop over their studies in relation to the assessment methods: 1. Generic and 2. Subject-specific. The assessment methods that are recommended for Schools to support student generic skills are related to communication skills (written and verbal) and information technology skills, whilst in the case of subject-specific skills are related to biology and brain cognition. Academic literacies cover the way in which students engage with a discipline (e.g., psychology) or area of study, and how teachers assist them to facilitate this (Lea and Street, 2006). Many researchers have studied how to embed academic literacies within the curriculum supporting the writing cycle (Bastalich, Behrend and Bloomfiled, 2014; Benzie, Pryce and Smith, 2017; Murray and Nallaya, 2016). However, many other researchers have advocated the need for an educational change from the traditional teaching and learning approaches to be more interactive, active, and collaborative through the use of the digital environment in order to enhance digital literacy skills of students and to support the needs of the 21st century (Simpson & Obdalova, 2014; Leahy & Dolan, 2010). UNESCO (2004) has moved from the initial definition of *literacy* "as the set of technical skills of reading, writing and calculating" (p.6) to "the ability to identify, understand, interpret, create, communicate and compute, using printed and written materials associated with varying contexts" (p.13). This change is in alignment with the changes that are required to move from the needs of the industrial society (20th century) to the use of the Internet and digital technology into our everyday lives in the 21st century. UNESCO's six basic competencies of digital literacy are accessing, managing, evaluating, integrating, creating, and communicating information. Secker and Coonan (2013) introduced a new practical curriculum framework to support University with the embedment of digital literacies into their curriculum which is related to managing, presenting, communicating, and social dimension of information. Another framework has been introduced by Ng (2012) in which digital literacy results from three dimensions: 1. Technical (e.g., connection and use of devices and their peripherals), 2. Cognitive (e.g., ability to think critically in the search, evaluate and produce digital information) and 3. Social-emotional (e.g., ability to use the Internet for communication, collaboration and learning purposes). The UK Joint Information Systems Committee (JISC, 2014) has integrated all the above described models and has produced a digital literacy skills framework. It has defined digital literacies as "those capabilities which fit an individual for living, learning and working in a digital society" (http://bit.ly/2cc2ScL) The proposed framework identifies the overlap between six elements: 1. ICT proficiency, 2. Information, data and media literacies, 3. Digital learning and development, 4. Digital communication, collaboration and participation, 5. Digital creation, problem solving and innovation and 6. Digital identity and wellbeing. Figure 2 illustrates the aforementioned six elements.

The way that any of the above framework could be integrated into the teaching and learning process is related to blended learning approach, as it has been described above. Although some researchers have proposed structures to support the transition of learning from a face-to-face environment to a blended learning one, such as the Five Step Model (Salmon, 2000) and the Conversational Framework (Laurillard, 2002; 2012), all have advocated the importance of online interaction between students, teachers, and resources in order to support the construction of knowledge and skills. However, each discipline/each module combines the recommendations from national and international organizations, follow the teaching design frameworks, and adopt technology in their courses/modules in order to assist students to develop their own digital literacy skills (Watling, 2009).

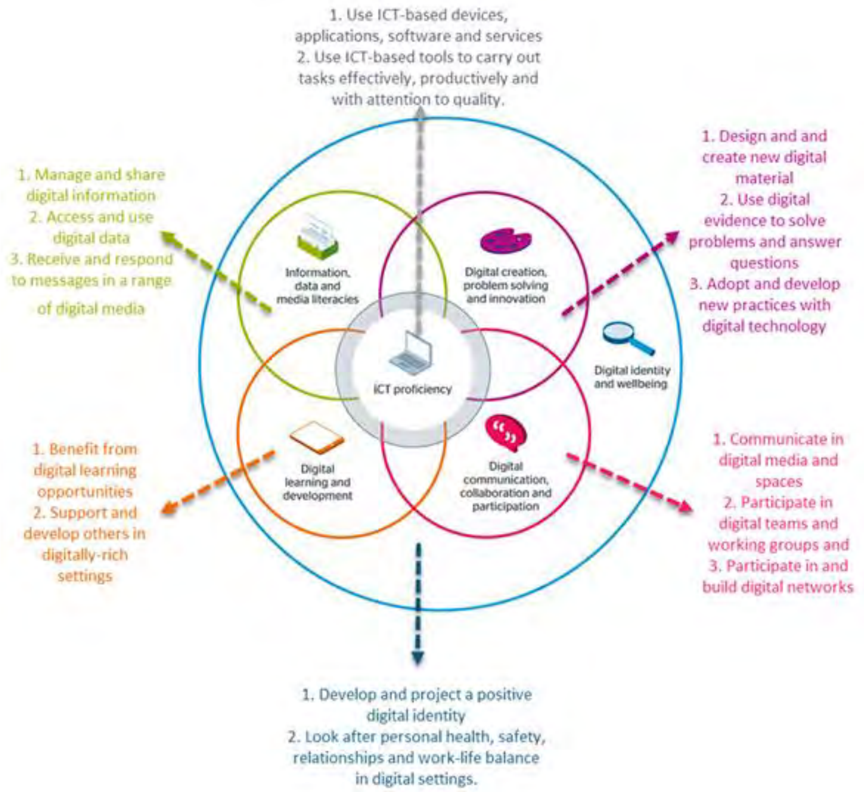


Figure 2: JISC developing students' digital literacy framework

The aim of this study is to examine how digital learning tools could enhance first year modules supporting blended learning approaches. Two practice examples from a UK School of Psychology are discussing two different blended learning approaches exploring student performance on online activities under the perspectives of module design, students' engagement with assessments, and academic and digital literacy. The first example examines a first-year module on transferable skills which combines online formative activities through wikis, blogs and online tests in order to support students to develop writing skills (generic skills). The second example examines the association between online tests with the paper-based exams. The online continuous assessment was followed in order to support a first-year psychology module on the cognitive area of biology (subject-specific skills).

2. Methodology

2.1 Experimental conditions and participants

This investigation was conducted over the period of two academic years (2016-2017 and 2017-2018). The total of psychology students per academic year who was enrolled to the two modules (Transferable Skills and Biological Psychology) is illustrated in Table 1. Both modules were compulsory for the first-year undergraduate level of studies.

Table 1: The total number of students per academic year

Academic Year	First-year psychology students	Males	Females	Home students
2016-2017	407	51	356	398
2017-2018	405	53	352	395

2.1.1 Example 1: Transferable skills-module design, technology integration and participants

This module involved fortnightly tutorial meetings between small groups of students and their Academic Advisor (AA) throughout the first semester (approx. 8 students/AA). The purpose of each meeting was for the AA to introduce students to some of the skills that were important in their degree and beyond, following the QAA recommendations. These included skills in research writing and referencing. Throughout their academic life, students need to discuss other researchers' work in order to support arguments by citing the appropriate references (academic literacies). The learning outcomes were to enable students to develop necessary referencing skills and to present research findings and arguments in an essay format. Students and AAs faced learning issues mainly because it was difficult to discuss and develop all the relevant skills in two tutorial sessions (1hour/session). Part of the summative assessment of this module was a referencing test, where students presented their ability to cite different sources by following the APA (American Psychological Association) Style and their ability to discuss a psychology topic in an essay format. By following the constructive alignment principles, AAs assisted students to develop these skills by covering different activities over each tutorial session. For example, AAs initially provided a title from their own research area and demonstrated to students how researchers could find journals, books, and other resources, and how these resources could be stored. After this initial activity, AAs discussed with their students how to reference in APA style and provided examples of how APA references should be presented within the context of a scientific document. In the second tutorial session, students discussed two introduction sections and two essay conclusion sections from two different essays in class. Students discussed the strengths and weaknesses of them as a group, the essay structure, and the argument development.

After each in-class session, students had the opportunity to participate in online formative activities by following a blended learning approach. The online activities covered similar topics to those that students discussed with their AAs in class. For example, in the first online activity the students should find at least three journal article, book, and/or conference references based on an essay title that were provided by their AAs. The reference list should be written in the APA style and they could collaborate with their peers through a group *wiki* activity by sharing references and creating a collaborative reference list (Figure 3). After the second tutorial session, an essay introduction and an essay conclusion example were provided as group *blog* activities. Students provided their comments underneath the blog posts. Finally, an *online practice test* was available for them in order to familiarize themselves with the type of questions that they should answer on their summative *online referencing test*.

Instructions for the first activity

Search for sources (e.g., articles and books) and create a referencing list for the topic below

What is the role of psychology in multimedia design for educational purposes?

The referencing list will be written following the **APA style**.

Each student should find at least **3 references** (journal, book or book chapter, internet source).

Generic feedback will provided by your academic advisor.

Please firstly type your name and then the references that you have found. See an example below.

Reference List

Maria Limniou

Mayer, R., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. *Educational psychologist, 38*(1), 43-52.

[redacted]

Shneider, S., Nebel, S. & Rey, G.D. (2016). Decorative pictures and emotional design in multimedia learning. *Learning and education, 44*, 65-73. DOI: 10.1016/j.learninstruc.2016.03.002

Fenesi, B., Kramer, E. & Kim, J.A. (2016). Split-attention and coherence principles in multimedia instruction can rescue performance for learners with lower working memory capacity. *Applied Cognitive Psychology, 30*(5), 691-699. DOI: 10.1002/acp.3244

Schweppe, J. & Rummer, R. (2016). Integrating written text and graphics as a desirable difficulty in long-term multimedia learning. *Computers in human behaviour, 60,* 137-137. DOI: 10.1016/j.chb.2016.02.035

[redacted]

Konigschtulte, A. (2015) Sound as Affective Design Feature in Multimedia Learning – Benefits and Drawbacks from a Cognitive Load Theory Perspective. *Proceedings of the IADIS International Conference on Cognition & Exploratory Learning in Digital Age*, 75-83.

Park, B., Münzer, S., Seufert, T., Brünken, R. (2016) The role of spatial ability when fostering mental animation in multimedia learning: An ATI-study. *Computers in Human Behavior 64*, 497-506.

Huang, X., Mayer, R.E. (2016) Benefits of adding anxiety-reducing features to a computer-based multimedia lesson on statistics. *Computers in Human Behavior 63*, 293-303.

[redacted]

Zhang, K. (2012). An analysis of the relation between multimedia assisted instruction and physical education. *IERI Procedia, 2,* 759-764.

Figure 3: Example on students' contribution in a wiki page

Although the first-year students received a grade for their participation in each online activity, these were formative; therefore, their formative grade did not count towards their final module mark. However, students were informed that these activities would help them to assess their knowledge, practice skills, and to receive feedback in order to improve their academic performance. The aim of the types of online activities was to allow students to think metacognitively about the nature of writing an essay and the cognitive processes of the discipline (Cope et al, 2013), and to allow them to develop their digital literacy skills as they used a variety of digital tools. Table 2 illustrates the number of participants for each activity along with the number of students who were not engaged with the online process.

Table 2: The student rate (%) who participate in each online activity per academic year.

Academic Year	Wiki participation	Blog participation	Online practice test participation	No participation in any activity
2016-2017	42%	31.2%	39.3%	27.5%
2017-2018	50.1%	34.6%	45.7%	22.2%

2.1.2 *Example 2: Biological psychology – module design, technology integration and participants*

The main aim of the "Biological Psychology" module was to introduce to first-year students the basic concepts and principles associated with Biological Psychology; in particular, the brain and its functions. In order to engage students with their learning process, the teacher followed a blended learning approach, where online voting platforms was used to support in-class discussions, and the lectures were recorded and uploaded on the module Virtual Learning Environment (VLE) space after the lecture. In addition to the streamed lectures, PowerPoint presentations were available on the VLE in two formats: a). complete, and b). with missing spaces to aid engaged note taking. Thus, students could fill the gaps on PowerPoint presentations and check their responses at their own time. Videos, a discussion board, and other supplementary material supported the student learning process both before and after the lecture time.

The summative assessment was a 2-hour Multiple Choice Test (MCT) under exam conditions (paper-based exam, weight 75%) and 1-hour of online tests (split into 4 smaller online tests, 15 minutes/per 12 question online test, weight 25%) spread over the 12-week semester. This module has been designed by following the constructive alignment principles and the continuous assessment process which can be defined as 'the use of tests over a learning unit and the accumulation of results in a final grade' (Miller, Inrie & Cox, 1998, p. 34). Specifically, the online tests were available to the first-year students after lectures in weeks 3, 5, 7, and 9. Students had one-week time to revise the appropriate lectures and to complete the online tests, when they felt ready. There were five different types of questions included in each online test: multiple choice, matching, jumbled sentence, fill in multiple blanks and hot spot (Figure 4).

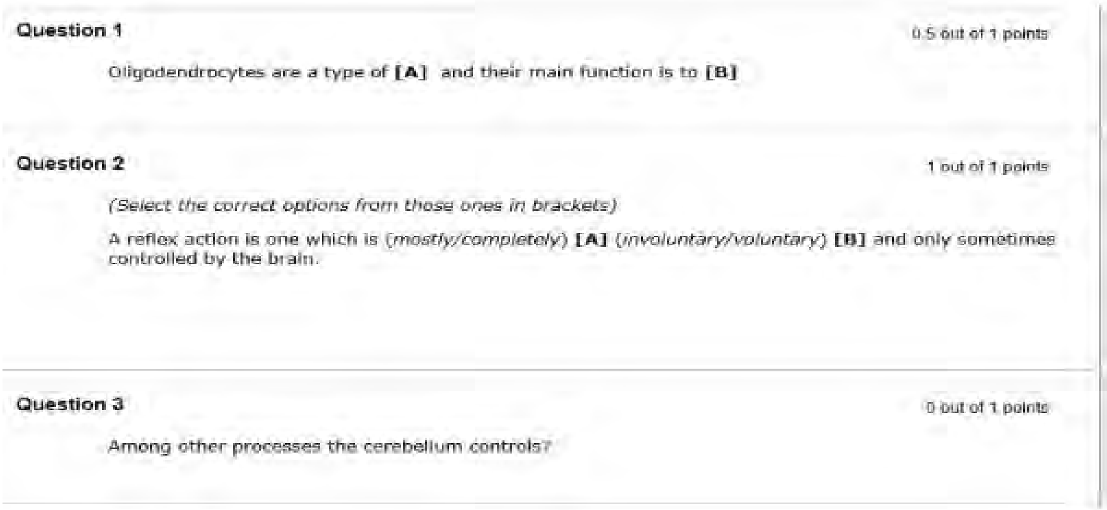


Figure 4A: A sample of the question statement and the score per question became available to students after the due date

"Please study the first three lectures."

How to access your online test and how to check your score per question:

Click on **My Marks** and online **MCT: Week 3** to see your attempt and the overall % mark. If you then click on your % mark, you will be able to see the questions (but not the answer options) along with your score for each question.

We do not provide specific feedback for each question, rather an overall mark, and the question with the score so you can check if you have gotten this correct, partially correct or incorrect and use this to decide which topics you need to revise further.

Part of your learning process is to review these questions and revise anything you are unsure of at your own time and space.

Please check the score you got in each question and revise the topics accordingly.

These questions covered material from

Lecture 1: question 1-4

Lecture 2: questions 5-8

Lecture 3: questions 9-12

Revision: We suggest you revise the topics from the questions you answered incorrectly and those for which you were unsure of the correct answer.

There are several ways you can review this information:

1. The lectures have been recorded and can be found by clicking on the stream link in the menu bar of the module and then on the lecture which contains the information you need.
2. The PowerPoints and other content such as videos can be found by clicking on the Content link and Teaching Week 1, 2 or 3
3. You can also review the information in the text books for this module, here is a list of topics covered and page ranges for each of the course text books:

Topic	Carlson	Pinel
Evolution	Pages: 14-21	Pages: 45-58
Directional Terms	Pages: 67-76	Pages: 85-88
Axonal Transport	Pages: 27-40	Pages: 76-84
Types of Cells and their structure in nervous system	Pages: 28-40	Pages: 76-85
Communication within neurones and Signal Integration	Pages: 40-51	Pages: 101-115
Communication between neurones	Pages: 51-63	Pages: 109-116
Neurotransmitters and Synaptic events	Pages: 108-128	Pages: 117-122

If after reviewing these areas you are still unsure about any aspect of these topics, please post any questions or comments to the discussion board (you have the option of posting anonymously).

Figure 4B: An example of the overall feedback where the students should work out which topics they need to revise further based on their question grades

There was a pool of questions for each lecture and the system delivered to students a random selection of questions so that each student to have a slightly different test. Students received feedback and grades after the due date of each online test allowing them to think more deeply about the meta-understanding of the cognitive topic and their own learning process (Bereiter, 2002). Table 3 illustrates the number of students who completed the four online tests over the semester and participated in the final MCT paper-based exam.

Table 2: The student rate (%) who completed the online tests (OT) over the semester for the two academic years

Academic Year	OT 1 (Week 3)	OT 2 (Week 5)	OT 3 (Week 7)	OT 4 (Week 9)
2016-2017	98.5%	95.1%	89.9%	74.7%
2017-2018	97.8%	93.3%	86.9%	92.1%

2.2 Results

2.2.1 Example 1: Transferable skills

Grades (academic performance) on the essay were not significantly different between the two years so these data were analysed together. However, Table 3 illustrates the student essay grades per their participation in online formative activities for each academic year.

Table 3: The mean (±SD) values for the student essay grades after (non)participating in different online activities.

Academic Year	Wiki participation	Blog participation	Online practice test participation	No participation in any activity
2016-2017	62(±9.8)	67(±7.8)	59(±9.6)	56(±7.0)
2017-2018	63(±10.2)	65(±9.7)	61(±8.7)	57(±6.8)

A correlation analysis on student academic performance reveals if there is any association between the students who have been engaged with the online formative activities (e.g., wiki, blog and online practice test) and those students who have attended the face-to-face tutorial classes only. A Spearman's correlation showed a positive significant relationship with all three types of online activities.

Wiki: rs (.812) =0.330, p < .001 (low medium correlation)
Blog: rs (812) = 0.394, p <.001 (low medium correlation); and
Online practice test: rs (812) = 0.161, p <.001 (a very weak correlation).

A simple regression was run to examine the effects of the activities cumulatively. In the case of the essay, the number of activities undertaken significantly predict 12% of the variance in essay grade, R^2 =0.124(810), β=0.353, p <.001. Logistic regression was run to examine the effects of participating or not in each of the three tasks (referencing test, blog, and wiki) on the student performance on essay.

Wiki: The model explained 19.0% (Nagelkerke R^2) of the variance in essay grades and correctly classified 54.0% of cases.
Blog: The model explained 19.0% (Nagelkerke R^2) of the variance in essay grades and correctly classified 67.0% of cases.
Online practice test: The model explained 20.0% (Nagelkerke R^2) of the variance in essay grades and correctly classified 57.0% of cases.

Thus, each of the three activities predicted higher grades in the essay, with broad participation showing the strongest association.

Grades on the summative referencing test were found to be significantly different between the two years so are addressed separately in the analysis. A Spearman's correlation showed a positive association between taking the online practice reference test and the grades on the summative reference test (Table 4).

Table 4: The mean and standard deviation (±SD) values for the referencing grades along with the correlation results per year

Academic Year	Mean(±SD)	Correlation values	Category
2016-2017	68(±18.1)	r_s (407) = 0.329, p <.001	weak correlation
2017-2018	72(±17.6)	r_s (405) = 0.500, p <.001	medium correlation

2.2.2 Example 2: Biological psychology

In both academic years, each of the online test (OT 1, 2, 3, and 4) showed a medium correlation with the final MCT exam. Table 5 illustrates the correlations between each online test with the final MCT exam per each year. Overall, there was no significant difference between test performances for the two years.

Table 5: The mean and standard deviation (±SD) values for each online test (OT 1, 2, 3, and 4) along with the final exam grades (Pearson's correlation coefficient-(r))

Academic Year	OT1		OT2		OT3		OT4	
	Mean (±SD)	r	Mean (±SD)	r	Mean (±SD)	r	Mean (±SD)	r
2016-2017	59(±17)	0.287	65(±19)	0.324	61(±20)	0.382	57(±19)	0.483
2017-2018	57(±18)	0.429	71(±16)	0.378	64(±18)	0.423	63(±19)	0.440

3. Discussion

In this article, two examples in which blended learning approaches are used in 2 different ways, including different digital learning tools in order to assist students to develop generic and subject-specific skills have been discussed. The two modules on transferable skills and psychological biology followed the 3P framework in order to associate the learning outcomes and activities with assessments. In both examples, the online student participation and their performance (two student cohorts for two subsequent academic years) were examined as indicators of the student learning progress in a blended learning environment.

The first-year psychology students had the opportunity to participate in online formative activities, such as wiki, blog and practice, in order to enhance their (academic and digital) skills and practice themselves in areas related to their summative assessment. The online activities replicated the activities that they followed in class but in an online format. Based on the results, student participation in online formative activities offered a higher grade on their summative assessment. The benefit was cumulative and the more online activities students participated in, the more likely they were to get a higher grade. This suggests that engaged students who had taken part in digital activities were significant more likely to perform better than those who did not participate. However, as these online activities were formative (without being compulsory and gaining grades), the student rate which would act as an engagement indicator with the learning process outside the tutorial classes was no more than 50.0% per activity. On the contrary, the rate of students who participated in each online test on the biology module was high (at least 75% per activity), as their grades contributed to the final grade for this module (summative assessment). This last point led to the argument that online activity which might not contribute to the final module grade might not achieve the optimum student rate participation. Additionally, the relationship between the students' performance on the module summative assessment with their engagement with the online activities was examined. Similar with the case of the transferable skills, the relationship of each online activity with the final grade was medium. Although this point is in alignment with other researchers' work related to formative assessment (Furtak et al., 2016), it also provides evidence that teachers should provide grades for student participation in online activities (combining formative with summative assessment) in order to enhance their learning process "forcing" to participate in the online activities through the gaining grades process. Although the contribution of online activities in both blended learning approaches was similar to the student final summative assessment, it seems that students preferred their participation in any type of online activity to have a direct impact on their grades (as evidenced by the second example) and not to spend time on activities without gaining a grade for their learning effort (as evidenced by the first example) just reflecting on the feedback which received from their teachers and/or their peers.

The described examples represent how blended learning environment might influence on student learning regarding their performance by following design recommendations from the Higher Education institutions, organizations, and professional bodies. Although these examples were related to psychology, the general design and pedagogical principles are the same to other disciplines as well. For example, studying digital literacy as described by JISC (2014), it is obvious that apart from the interactions between the learning material and teachers, students should develop digital skills through their interaction with their peers, devices and the outside world (out the class walls). In the first example, teachers used blogs, wikis and online test as part of the formative assessment process in order to allow students to communicate with each other through the use of different software and devices enhancing their collaboration skills. Theoretically, by following this approach students could enhance their digital literacy skills along with their learning, as they could learn "anywhere, anytime and anyhow". However, in reality as these online activities were part of the formative assessment process, there were a substantial number of students (approx. 22%) who did not participate in any of them. In the second example, teachers allowed students to complete the online tests anytime (within the period of one week) and anywhere they wished (in and outside campus). They received the feedback along with the grade for their participation in each online test after the due date. By studying the teacher perspective, student participation in online wiki and blog activities is more demanding than online test, as they need to read student comments/posts and provide more personalised feedback. Although this is potentially a more effective process in supporting student learning by not making use of formative opportunities, students preferred to focus on online activities which have a grade attached to the academic performance. This is an issue that teachers need to take into their account before designing any module.

References

Bastalich, W., Behrend, M., and Bloomfield, R. (2014). "Is Non-subject Based Research Training a 'Waste of Time', Good Only for the Development of Professional Skills?, *Teaching in Higher Education,* Vol 19, No. 4, pp 373–384.

Benzie, H., Pryce, A., and Smith, K. (2017). "The Wicked Problem of Embedding Academic Literacies", *Higher Education Research and Development,* Vol 36, No. 2, pp 227-240.

Bereiter, C. (2002) *Education and Mind in the Knowledge Age*, Lawrence Erlbaum, Mahwah NJ.

Biggs, J. (1996a) "What the Students Does: Teaching for Enhanced Learning", *Higher Education Research & Development*, Vol 18, No. 1, pp 57–75.

Biggs, J. (1996b) Western Misconceptions of the Confucian-Heritage Learning Culture. In Watkins, D. and Biggs, J. *The Chinese Learner: Cultural, Psychological and Contextual Influences*, Comparative Education Research Centre and The Australian Council for Educational Research Ltd., Camberwell.

Biggs, J. and Tang, C. (2007) *Teaching for Quality Learning at University*, Open University Press/McGraw Hill, Maidenhead.

Boelens, R., Van Laer, S., De Wever, B. and Elen, J. (2015) "Blended Learning in Adult Education: Towards a Definition of Blended Learning" [online], Adult Learners Online!, http://www.iwt-alo.be/wp-content/uploads/2015/08/01-Project-report-Blended-learning-in-adult-education-towards-a-definition-of-blended-learning.pdf

Boelens, R., De Wever, B. and Voet, M. (2017) "Four Key Challenges to the Design of Blended Learning: A Systematic Literature Review", *Educational Review Research*, Vol 22, pp 1-18.

Butcher, C., Davies, C. and Highton, M. (2006) *Designing Learning: From Module Outline to Effective Teaching*, Routledge, London.

Cope, B., Kalantzis, M., Abd-El-Khalick, F. and Bagley, E. (2013) "Science in Writing: Learning Scientific Argument in Principle and Practice", *e-Learning and Digital Media*, Vol 10, pp 420–41.

Galvis, A. H. (2018) "Supporting Decision-Making Processes on Blended Learning in Higher Education: Literature and Good Practices Review" *International Journal of Educational Technology in Higher Education*, Vol 15, No. 25, pp 1-38.

Gordon, N. (2014) "Flexible Pedagogies: Technology-Enhanced Learning", [online], The Higher Education Academy, https://www.heacademy.ac.uk/flexible-pedagogies-technology-enhanced-learning

Furtak, E. M., Kiemer, K., Circi, R .K., Swanson, R., de León, V., Morrison, D. and Heredia, S. C. (2016) "Teachers' Formative Assessment Abilities and their Relationship to Student Learning: Findings From a Four-Year Intervention Study", *Instructional Science*, Vol 44, No. 3, pp 267–291.

Joint Information Systems Committee (JISC) (2014) "Jics: e-Learning Programme", [online], http://www.webarchive.org.uk/wayback/archive/20140614020907/http://www.jisc.ac.uk/whatwedo/programmes/elearning.aspx

Jones, A., and Bennett, R. (2016). "Reaching beyond and Online/Offline Divide: Invoking the Rhizome in Higher Education Course Design", *Technology, Pedagogy and Education,* Vol 26, No. 2, pp 193–210.

Kirkwood, A. and Price, L. (2014) "Technology-Enhanced Learning and Teaching in Higher Education: What is "Enhanced" and How do we Know? A Critical Literature Review", *Learning, Media and Technology*, Vol 39, No. 1, pp 6–36.

Lai, M., Lam, K. and Lim, C. (2016) Design Principles for the Blend in Blended Learning, Teaching in Higher Education, Vol 21, No. 6, pp 716–729.

Laurillard, D. (2002) *Rethinking University Teaching: A Framework for the Effective Use of Learning* Technologies, (2nd Edition). Routledge, London.

Laurillard, D. (2012) "Building Pedagogical Patterns for Learning Technology", Routledge, New York.

Lea, M. and Street, B. (2006) The 'Academic Literacies' Model, Theory and Psychology, Vol 45, No. 4, pp 368–377.

Leahy, D. and Dolan, D. (2010) Digital Literacy: A Vital Competence for 2010. In N. Reynolds, & Turcsanyi-Szabo (Eds)., *Key Competencies in the Knowledge* Society (pp. 210-221), Springer, New York.

Liu, X. and Chen, X. (2018) "Disruptive Technology Enhanced Learning: The Use and Misuse of Digital Technologies in Higher Education", *Innovations in Education and Teaching International*, Vol 55, No. 1, pp 119-120.

Miller, A., Imrie, B. and Cox, K. (1998) *Student Assessment in Higher Education: A Handbook for Assessing Performance*. Kogan Page, London.

Murray, N., and Nallaya, S. (2016). "Embedding Academic Literacies in University Programme Curricula", *Studies in Higher Education,* Vol 41, No. 7, 1296–1312.

Mykhnenko, V. (2016) "Cui bono? On the Relative Merits of Technology-Enhanced Learning and Teaching in Higher Education", *Journal of Geography in Higher Education*, Vol 40, No. 4, pp 585–607.

Ng, W. (2012) *Empowering Scientific Literacy Through Digital Literacy and Multiliteracies*, Nova Science Publishers, New York.

Salmon, G. (2000). *E-Moderating: The Key to Teaching and Learning Online*, Kogan Page, London.

Simpson, R. and Obdalova, O. (2014) New Technologies in Higher Education-ICT skills of Digital Literacy. *Procedia-Social and Behavioural Sciences*, Vol 154, pp 104-111.

Secker, J. and Coonan, E. (2013) *Rethinking Information Literacy: A Practical Framework for Supporting Learning*, Facet Publishing, London.

UNESCO (2004) "The Plurality of Literacy and Its Implications for Policies and Programs", [online], http://unesdoc.unesco.org/images/0013/001362/136246e.pdf

Watling, S. (2009). Technology-Enhanced Learning: A New Digital Divide? In: Bell, L., Stevenson, H. and Neary, M. (eds.) *The Future of Higher Education: Policy, Pedagogy and the Student Experience*, Continuum, London.